Uttar Pradesh Power Transmission Corporation Ltd.

220/132/33kV Substation Babina (Jhansi)

Tender Specification NO. SD-819

Tender Document for EPC Turnkey Bid

Office of the Superintending Engineer, Electricity Substation Design Circle-I Uttar Pradesh Power Transmission Corporation Limited, 13^{TH,} FLOOR, SHAKTI BHAWAN EXTENSION, 14-ASHOK MARG, LUCKNOW-226001 E-mail: <u>seesdc1@upptcl.org</u>

U.P. POWER TRANSMISSION CORPORATION LIMITED

Tender Notice against Specification No. SD-819 Through E-Tendering

E-Tenders in two parts, **Part-I** (Earnest Money, Technical and Commercial details etc.), **Part-II** (A) - (Prices for Electrical/ Mechanical works covering all works other than Civil works) & **Part-II** (B) - (Prices for Civil works) valid for six months are invited for the work mentioned here under.

Construction of 220/132/33kV Substation Babina (Jhansi), with SAS on turn-key basis including supply, erection, testing & commissioning of all equipments/material as per details mentioned below:-

Bid Specn. No.	Name of Substation	Transformation Capacity MVA	Earnest Money (Rs.)	Schedule date of submission & time	Schedule date of opening & time
SD-819	220/132/33kV Substation Babina (Jhansi)	2x160 (220/132KV) + 2x40 (132/33KV)	Rs. 87,00,000.00 (Eighty Seven Lakhs Only) To be submitted in the form of Bank Guarantee on a non-judicial stamp paper of Rs. 10,000.00 in favour of SE, ESDC-I, UPPTCL, Lucknow as per Prescribed format given in the bid document or through RTGS/ NEFT in the UPPTCL A/C mentioned below.	29.05.2018 15:30 hrs	30.05.2018 15:30 hrs

In case of public holiday on 30.05.2018, the opening date will be on the next working date.

The package in general includes but not limited to design, engineering, manufacturing, handling, safe storage and supply & erection of transformers, breakers, isolators, L.A.s, P.T.s, C.T.s, control and protection panels, SAS system equipments, panels based on IEC 61850 protocol, metering system, main and auxiliary structures, control and power Cables, station grounding, Air-conditioning. Lighting system and all associated essential electrical and civil works, including earth filling foundations, anchor bolts, cable trenches, drainage, water supply, control room building, fencing, roads, residence etc, as per latest national/international standards and terms and conditions of 'Form-A' of UPPTCL. However the 160MVA and 40MVA Transformers shall be provided by UPPTCL and their supply shall not be in the Scope of Tenderer. Similarly construction of approach road and boundary wall of substation shall also not be in the scope of this tender.

The package also includes testing and commissioning of the entire substations in a time bound schedule and all items & accessories required for completion and commissioning.

Complete E-tender documents against this Bid specification can be downloaded from e-procurement website U.P. Govt. <u>etender.up.nic.in</u> and tenderer will require to pay a non-refundable fee of Rs. 11,800/- (inclusive of 18% GST) towards cost of Etender documents through RTGS/ NEFT in "UPPTCL SBI A/C No. 30231982762 (IFSC Code: SBIN0003347)". E-tenders can be submitted only on e-procurement website <u>etender.up.nic.in</u> up to schedule date & time. Tenderer (s) are requested to get them registered with U.P. Electronics Corporation so as to obtain digital signatures for participation.

The bid of the firm without E-tender document fee, against the purchase of document, and without EMD will not be opened. E-tender document fee will be deposited through RTGS/ NEFT in the UPPTCL account mentioned above and a proof of such deposit e.g. UTR No., Name of Account, Scanned copy of pay-in slip countersigned by the tenderer should be uploaded along with E-tender documents. Earnest money deposit (EMD) will be deposited through RTGS/ NEFT in UPPTCL account mentioned above and a proof of such deposit e.g. UTR No., Name of Account, Scanned copy of pay-in slip countersigned by the tenderer should be uploaded along with E-tender documents or a proof of such deposit e.g. UTR No., Name of Account, Scanned copy of pay-in slip countersigned by the tenderer, should be uploaded along with E-tender documents OR in the form of Bank Guarantee in favour of **Superintending Engineer**, **Electricity Substation Design Circle-I**, **UPPTCL**, **Lucknow**. If EMD is deposited in the form of Bank Guarantee, scanned copy of EMD B.G. alongwith a scanned copy of mail in confirmation of the same from the bank issuing the B.G. will be uploaded with the E-tender document. **No tender document including tender fee**, **EMD B.G. and other commercial papers are required to be submitted in hard copy or through messenger**. Part-II (A) & (B) containing prices of Electrical & Civil works respectively shall be opened separately at a later date and bidders shall be to be informed accordingly.

Undersigned reserves the right to accept or reject any offer without assigning any reason. Please visit our web site <u>www.upptcl.org</u> as well as e-procurement website <u>www.etender.up.nic.in</u> for any other corrections/ amendments/ modifications/ extensions till the date of submission of E-tender.

SUPERINTENDING ENGINEER, ELECTRICITY SUBSTATION DESIGN CIRCLE-I, 13TH FLOOR, SHAKTI BHAWAN EXTENSION, 14 ASHOK MARG, LUCKNOW-226001. E-mail: <u>seesdc1@upptcl.org</u>

UPPTCL website - <u>www.upptcl.org</u> E-Procurement website - <u>www.etender.up.nic.in</u>

"SAVE ELECTRICITY IN THE INTEREST OF NATION"

SUBSTATION DETAILS:

1. 220/132/33KV SUBSTATION BABINA (JHANSI) (SAS based):

- a) 2x220KV Feeder Bay
- b) 2x160 MVA Transformer Bays including 220 KV & 132 KV sides
- c) 1x220KV Bus Coupler Bay
- d) 1x220KV Bus Transfer Bay
- e) 2x40MVA Transformer Bays including 132 KV & 33 KV sides
- f) 2x132KV Feeder Bay
- g) 1x132KV Bus Coupler Bay
- h) 8x33KV Feeder Bay
- i) 1x33KV Bus Coupler Bay

SECTION – I: INVITATION FOR PREQUALIFICATION

1	GENERAL	1
2	PACKAGE DESCRIPTION	1
3	Request for Qualification	1
4	Scope of Works	1
5.	Qualification of the bidder	4
6	Completion Period	7
7	Liquidated damages for delays in supply / Completion Period	7
8	Terms & Conditions	7
9	ELIGIBLE APPLICANTS	7

SECTION - II: INSTRUCTIONS TO APPLICANTS

1	GENERAL	9
2	ELIGIBILITY AND QUALIFICATION CRITERIA	9
3	PREQUALIFICATION AND TENDERING	9
4	CLARIFICATION REGARDING APPLICATION	11

SECTION - III: PREQUALIFICATION DATA

GENERAL	12
PACKAGE COMPLITION PERIOD	12
CONTRACT TYPE AND CONDITIONS	12
SUBMISSION OF APPLICATION	12
QUALIFICATION CRITERIA	12
JOINT VENTURES	14
CONFLICT OF INTEREST	14
UPDATING PREQUALIFICATION INFORMATION	14
GENERAL CONDITION	15
	GENERAL PACKAGE COMPLITION PERIOD CONTRACT TYPE AND CONDITIONS SUBMISSION OF APPLICATION QUALIFICATION CRITERIA JOINT VENTURES CONFLICT OF INTEREST UPDATING PREQUALIFICATION INFORMATION GENERAL CONDITION

APPENDIX A APPLICATION PROFORMA (FORMS 0 TO 11)

DRAWINGS

SECTION-IV GENERAL

- 2. PARTICULARS OF SUBSTATION
- 3. BILL OF MATERIAL(BAY WISE MAJOR EQUIPMENTS)
- 4. SINGLE LINE DIAGRAM

<u>SECTION – V TERMS AND CONDITIONS</u>

- 1. INSTRUCTIONS TO BIDDERS
- 2. SPECIAL CONDITIONS OF SPECIFICATIONS
- 3. SPECIFICATIONS FOR HANDLING, ERECTION, TESTING & COMMISSIONING
- 4. GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS
- 5. GENERAL CONDITIONS FOR SUPPLY OF PLANT AND THE
- 5. GENERAL CONDITIONS FOR SUPPLY OF PLANT AND TH EXECUTION OF WORKS-FORM-'A'
- 6. DRAWINGS OF AUXILIARY STRUCTURES

SECTION- VI TECHNICAL SPECIFICATIONS

- 1. TRANSFORMERS
- 2. CIRCUIT BREAKERS
- 3. CURRENT TRANSFORMERS
- 4. CAPACITOR VOLTAGE/ POTENTIAL TRANSFORMERS
- 5. ISOLATORS
- 6. POST INSULATORS
- 7. LIGHTENING ARRESTORS
- 8A. CONTROL & RELAY PANELS SUITABLE FOR SAS
- 8B. SUBSTATION AUTOMATION SYSTEM
- 9. BATTERY, BATTERY CHARGER, DCDB
- 10. LTDB
- 11 ENERGY METERS
- 12. POWER AND CONTROL CABLES
- 13. MAIN AND AUXILLIARY STRUCTURES
- 14. ANCHOR BOLTS
- 15. CLAMPS AND FITTNGS
- 16. DISC INSULATORS AND CONDUCTORS
- 17. FIRE FIGHTING EQUIPMENTS
- 18. LIGHTING
- 19. D G SET

<u>SECTION- VII</u> <u>TENDER SCHEDULES</u>

1.	Schedule A	:	BID Form
2.	Schedule B	:	Pre-qualifying details in following schedules :
	B-1	:	Experience details of Equipments of manufactures on
			whom the order have been placed by UPPTCL
	B-2		Experience details of Equipments of manufactures on
			whom the order have not been placed by UPPTCL
3.	Schedule C	:	Declaration
4.	Schedule D	:	Proforma for joint undertaking by the collaborator /
			associates with Bidder
5.	Schedule E	:	Schedule of General particulars
	E-1	:	For Bidder
	E-2	:	For Manufacturers
6.	Schedule F	:	Schedule of deviations from "Special Conditions of
			Specification"
7.	Schedule G	:	Schedule of deviations from "Technical Specifications"
8.	Schedule H	:	Schedule of deviations from "Instructions to Bidders"
9.	Schedule I	:	Schedule of deviations from General requirements of
			Specifications"
10.	Schedule J	:	Schedule of deviations from "General Condition of
			Contract" Form -A"
11.	Schedule K	:	Deviation from Tech. Specn. For handling, testing &
			commissioning.
12.	Schedule L	:	List of Recommended spare tools & tackles
13.	Schedule M	:	List of recommended test sets & testing instruments
14.	Schedule N	:	List of Recommended spare parts for five years & prices.
15.	Schedule O		List of drawing /literatures enclosed with the Bid.
16.	Schedule P	:	Schedule of quoted guaranteed deliveries/ completion
			period
17.	Schedule Q	:	Schedule of offered quantities.
18.	Schedule R	:	Schedule of Guaranteed technical Particulars

SECTION- VIII	CIVIL WORKS
	Bill of Quantity

INVITATION FOR PREQUALIFICATION

1. GENERAL

Uttar Pradesh Power Transmission Corporation Ltd. (UPPTCL) intends to construct One no. **220/132/33KV New substation Babina (Jhansi).**

The purpose of this Pre-Qualification Document is to solicit interested contractors to pre-qualify for the EPC Turnkey Contracts described herein for the implementation of the Package.The attached drawing of the Single Line Diagram is preliminary and for information only.

2. PACKAGE DESCRIPTION

UPPTCL is proceeding for the implementation of construction of 220/132/33KV substation with SAS system.

The above package consists of following works:-

- i) Design and engineering, supply, erection testing and commissioning of electrical equipments.
- ii) Design and engineering, supply, erection testing and commissioning of substation automation system.
- iii) Design and engineering, supply of civil works for above works including supply of materials.

160MVA and 40MVA Power Transformers shall be provided by UPPTCL and their supply shall not be in the Scope of Tenderer. Approach Road and Boundary Wall of above substation shall be constructed by UPPTCL hence same shall not be in the scope of this package.

3. REQEST FOR QUALIFICATION:-

This Consists of following

- I) SCOPE OF WORKS
- II) Minimum Qualification
 - a) Technical
 - b) Financial
 - c) Criteria for joint venture

4. SCOPE OF WORKS

The overall scope of works covers all activities related to design, engineering, manufacture, testing at works, supply of all required equipments and materials with accessories and auxiliaries to site, storage at site, insurance, construction including all civil works, handling, erection, testing, commissioning, putting into successful operation & handing over as single source responsibility on turnkey basis, the 220KV substation, particulars of which are specified at Annexure-I.

THE CONTRACTOR'S SCOPE OF WORK SHALL INCLUDE BUT NOT BE LIMITED TO THE FOLLOWING :

- a) Design & engineering of all systems, sub-systems, equipments, materials and services including Substation Automation System (SAS).
- b) Manufacturing, assembly, inspection, testing, packing, forwarding, loading, unloading, transportation, transit insurance & supply of all required structures, equipments & materials at site including port & custom clearance, if required.
- c) Receipt, storage, insurance, preservation & conservation of all structures, equipment & materials at site.
- d) Fabrication & re-assembly (if any), erection, testing & commissioning of individual equipments, sub-systems / systems.
- e) Commissioning, putting into successful operation & handing over of complete substation.
- f) Providing engineering data, drawings and O & M manuals for purchaser's reference & records.
- g) Furnishing T&P and Spares on F.O.R. site basis.
- h) Training to Purchaser's personnel.
- i) All Civil works including levelling, developing and dressing of land, security wall with gate & guard room, chain link fencing, control room building, generator room, Mulsifyre room, transformer plinth, main & auxiliary foundations, cable trenches with racks & covers, roads, drainage system, sump well & sump house, store shed, water supply, overhead tank, pipe line and pump house, deep tube well and other required works specified under detailed civil specifications, hereinafter.
- j) Over all co-ordination with internal / external agencies, obtaining approval of the electrical inspector/ labour inspector and other concerned authorities in respect of works to be carried out under the contract.
- k) The Contractor shall take electricity connection of his own for construction power from respective distribution company and shall pay the charges for connection and electricity consumed at prevailing rates. If electricity connection is not available, the contractor shall arrange the D.G. sets etc. for construction power without any extra cost to UPPTCL.

4.1 SUBSTATION AUTOMATION SYSTEM

- 4.1.1. The substation automation system shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned substation automation system. KEMA certificate/ equivalent certificate from development centre authorized by UCA working group for having products including all IEDs and Ethernet switches conforming to IEC 61850 is to be furnished as pre qualification requirement.
- 4.1.2. The Substation Automation System (SAS) shall be installed to control and monitor all the sub-station equipment from remote control centre (RCC) as well as from local control centre.

The Bay Control and Protection IEDs shall communicate on the IEC61850 standard for Communication Networks and shall comply with the

- ➢ IEC61850-5 for communication data modelling,
- IEC61850-6 for Sub-station Configuration Description Language for communication &
- ▶ IEC61850-7-1 to 7-4 for Data Model and Services.

The SAS shall contain the following main functional parts:

- ✤ Bay control Intelligence Electronic Devices (IEDs) for Control and Monitoring.
- ✤ Bay Protection Intelligent Electronic device (IEDs) for Protection.
- Station Human Machine Interface (HMI)

- Redundant managed switched Ethernet Local Area Network communication infrastructure with hot standby. 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.
- ✤ Gateway for remote control via industrial grade hardware (to RCC) through IEC60870-5-101 protocol. All the IEDs shall be directly connected to the Ethernet Interbay LAN without use of any gateways.
- 2 nos. Gateway shall be provided with minimum 4 Data ports, 2 nos. for IEC 101 & 2 nos. for IEC 104 protocol in each gateway for State Load Dispatch Centre (to SLDC), RCC, the gateway should be able to communicate with SLDC on IEC 60870-5-101 & 104 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 SLDC system for exchange of desired data. The exact I/O point shall be decided during detailed engineering. The bidder shall ensure that proposed automation system is compatible with the existing SCADA network. The bidder will quote for the equipment required for data transfer to the existing SCADA network to interface communication equipment.
- Provision for 2 pair of modem for IEC 101 protocol should also be provided.
- Remote HMI.
- Peripheral equipment like printers, display units, key boards, Mouse etc.
- 4.1.3. 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.
- 4.1.4. It shall include communication gateway, intelligent electronic devices (IED) for bay control and inter IED communication infrastructure. An architecture drawing for SAS is enclosed.
- 4.1.5. The communication gateway shall facilitate the information flow with remote control centres. The bay level intelligent electronic devices (IED) for protection and control shall provide the direct connection to the switchgear without the need of interposing components and perform control, protection, and monitoring functions.

5.0 QUALIFICATION OF THE BIDDER

Qualification of bidder will be based on meeting the minimum pass/fail criteria specified below regarding the Bidder's technical experience and financial position as demonstrated by the Bidder's responses in the corresponding Bid Schedules. Technical experience and financial resources of any proposed subcontractor shall not be taken into account in determining the Bidder's compliance with the qualifying criteria except for the requirement stipulated herein below for Transformer, Circuit Breaker and Capacitor Bank. 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 5.3 below).

The UPPTCL may asses 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) bidder's work/manufacturing facilities visit ; (iii) manufacturing capacity, details of works executed, works in hand, anticipated in future & the balance capacity available for the present scope of work; (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.

UPPTCL reserves the right to waive minor deviations if they do not materially affect the capability of the Bidder to perform the contract.

5.1 For 220kV Substation

5.1.1 <u>Technical Experience</u>

The bidder must have successfully erected, tested and commissioned one substation of 132kV Class or above with power transformer on EPC basis having at least four (4) Circuit breaker bays during last five (5) years as on the date of bid opening and which must be in satisfactory operation for at least one (1) year as on the date of bid opening, provided.

A) 220kV class Power Transformer, Circuit Breaker and 132kV class 40MVAR Capacitor Bank being offered, are from manufacturer(s) who have designed, manufactured, type tested and supplied the Power Transformer, Capacitor Bank and Circuit Breaker of 220kV class or above class which must be in satisfactory operation for at least one(1) years as on the date of bid opening.

OR

- B) 220kV class Power Transformer ,Circuit Breaker and 132kV class 40MVAR Capacitor Bank being offered, are from manufacturer(s) who have established production line in India for these equipment(s) based on the technological support of parent company or collaborator for above equipment can also be considered provided
 - i) Such manufacturer have designed, manufactured, type tested, and supplied the 220kV or above class Power Transformer, Circuit Breaker and 132kV class 40MVAR Capacitor Bank
 - ii) The Parent company (Principals) or Collaborator needs qualifying requirements stipulated under clause 5.1.1(A) mentioned above and
 - iii) 220kV class Power Transformer, Circuit Breaker and 132kV class 40MVAR Capacitor Bank manufacturer(s) furnishes
 - a) A legally enforceable undertaking (Jointly with the Parent Company or collaborator) to guarantee quality, timely supply, performance and Warranty obligations as specified for the equipment(s), and
 - b) 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 the contract performance guarantee to be submitted by bidder.
- 5.1.2 For the purpose of qualifying requirement one no. of Circuit breaker bay shall be considered a bay used for controlling a line or a transformer or a capacitor bank or a bus section or a Bus Coupler and comprising of at least one circuit breaker two dis-connector and three nos. of single phase CTs / Bushing CTs.

5.2 <u>Financial Position</u>

- a) Minimum Average Annual Turnover* (MAAT) for best three years i.e. 36 months out of last five financial years of the bidder should be Rs. **40.38 Crore.**
- b) Bidder shall have liquid assets (L.A) or / and evidence of access to or availability of credit facilities should be **Rs 6.73 Crores**.

*For bidders to qualify for more than one package, their financial position shall not be less than the sum of the requirement for the packages they propose to qualify for. In case bidder is holding company, MAAT & LA referred in clause 5.2 (a) and (b) above shall be that of holding company only (i.e. excluding its subsidiary/ group companies). In case bidder is a subsidiary of a holding company, MAAT and LA referred to in clause 5.2 (a) and (b) above shall be that of subsidiary company only (i.e. excluding its holding company).

5.3 Joint Venture Firms

5.3.1

- a) In case a bid is submitted by a joint Venture (JV) of two or more firms as partner, all the partners of joint venture shall meet collectively the requirement of Para 5.2 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 5.2 above. However, a JV to be qualified the partners of the JV must also meet the following minimum criteria:
 - i) Any of the partner shall meet, not less than 15% of the financial criteria given at Para 5.2 above and 100% of the technical criteria given at 5.1.1 above.
 - ii) Each of the other partner(s) individually shall meet not less than 15% of the minimum criteria given at Para 5.2 above.

Failure to comply with this requirement will result in rejection of the Joint Venture bid. Subcontractor's experience and resources shall not be taken in to account in determining the bidder's compliance with qualifying criteria.

- b) In case of joint venture the following conditions shall also apply:
 - i) The bid, and in case successful bid, the specified form of agreement shall be signed so as to be legally binding on all the partners.
 - ii) One of the partner shall be nominated as lead partner and lead partner shall be authorized to incur liabilities and receive instructions for and on behalf of any and all can also be received by other partner based on authorization of lead partner .All the partners of the Joint Venture and entire execution of the contract shall be done with the lead partner and payment under the contract shall be received by the lead partner on behalf of joint venture, as per power conferred to him in the power of attorney. The authorization shall be evidenced by submitting the power of attorney signed by legally authorized signatory of all the partner on required stamp paper.
 - iii) All the partners of the Joint Venture shall be liable jointly and severally for the execution of the contract in accordance with the contract's Terms, and a copy of agreement entered into by the joint venture partners having such a provision shall be submitted with the bid.
 - The Bidder shall also furnish following documents / details with its bid:
 - (i) A certificate from banker (as per format) indicating separately various fund based / non fund based limits sanctioned to the bidder and the extent of utilization as on date. Such certificate should have been issued not earlier than three months prior to the date of bid opening. Whenever necessary UPPTCL may make queries with the bidder's bankers.
 - (ii) The complete annual reports together with Audited statement of accounts of the company for last five years of its own (separate) immediately preceding the date of submission of bid.

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

- II. Similarly, if the bidder happens to be a Group/Holding/Parent Company, the bidder should submit the above documents/information of its own (i.e. exclusive of its subsidiary) duly certified by any one of the authority mentioned in Note-I above certifying that these information/ documents are based on the audited accounts, as the case may be.]
- (iii) Bidder shall have adequate sub-station design infrastructure and erection facilities and capacity and procedures including quality control.
- (iv) 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.

6. **COMPLETION PERIOD:**

The substation has to be erected, tested and commissioned within 18 (eighteen) months from the date of letters of intent or from the date of handing over of land which ever is later.

On date of letter of intent land shall be available for immediate start of work. The progress shall be monitored as per approved project implementation schedule and PERT.

In case individual equipment/ material the date of receipt of goods at UPPTCL site shall be treated as the date of delivery. In case of part dispatches the delivery shall be deemed to have been affected when last component/ part of that equipment/ material of the serviceable lot / set has been delivered.

7. LIQUIDATED DAMAGES FOR DELAYS IN SUPPLY / COMPLETION PERIOD

In case of delay in completion period/handing over of substation, beyond agreed schedule, liquidated damages @ 0.5 % per week, subject to maximum of 10% of aggregate contract value shall be deducted from the bidder bills.

However, the liquidated damages, if any, shall be adjusted, against the balance amount of 20% & 10% available for electrical & civil works respectively, which are to be released after successful commissioning.

8. TERMS AND CONDITIONS

The terms & conditions of the contract shall be governed by the "General Conditions for Supply of Plant and Execution of Works FORM 'A'.

9. ELIGIBLE APPLICANTS

The Applications of the contractors/ firms, who had been debarred to trade by any other board or corporation of energy sector of any Indian state or any foreign country, shall not be considered. The Applicants have to declare that they have not been debarred as detailed above through their own statement duly supported by a notarized affidavit on a Non Judicial stamp paper of Rs. 100/- in this regard along with their application.

 If it comes to the notice of corporation, that the Applicant has given any fictitious information/ Performa or he is involved in mafia activities or he has terrorized the prospective Applicants or he has tried to stop them in participating the tender process then the tender process can be cancelled and under such circumstances the losses to the corporation shall be recovered from the concerned Applicant.

- 2) For agreement with successful bidder, the photo of proprietor in case of proprietor ship firm, the photo of all the partners in case of partnership firm along with their partnership deed and photo of authorized person along with authority letter by board of Director of company, in case of company, registered under company Act 1956 shall be required.
- The request must clearly state "Request for Prequalification for The Supply, Installation and testing and commissioning of the contract package for the 220 KV Substation as per annexure-I.
- 4) Complete E-tender documents against this Bid specification can be downloaded only from e-procurement website U.P. Govt. <u>etender.up.nic.in</u> and tenderer will require to pay a nonrefundable fee of Rs. 11,800/- (inclusive of 18% GST) towards cost of E-tender documents through RTGS/NEFT in "UPPTCL SBI A/C No. 30231982762 (IFSC Code: SBIN0003347)". E-tenders can be submitted only on e-procurement website <u>etender.up.nic.in</u> up to schedule date & time. Tenderer (s) are requested to get them registered with U.P. Electronics Corporation so as to obtain digital signatures for participation. E-tender document fee will be deposited through RTGS/ NEFT in the UPPTCL account mentioned above and a proof of such deposit e.g. UTR No., Name of Account, Scanned copy of pay-in slip countersigned by the tenderer should be uploaded along with E-tender documents.
- 5) The Applicant shall also provide an Earnest Money Deposit to the amount of Rs. 87,00,000.00 (Eighty Seven Lakhs Only) through RTGS/ NEFT in UPPTCL account mentioned above and a proof of such deposit e.g. UTR No., Name of Account, Scanned copy of pay-in slip countersigned by the tenderer, should be uploaded along with E-tender documents OR in the form of Bank Guarantee on a non-judicial stamp paper of Rs. 10,000.00 as per U.P. stamp act, for the package valid for one (1) year as per the attached format in favour of "Superintending Engineer, Electricity Substation Design Circle-I, UPPTCL, Lucknow. If EMD is deposited in the form of Bank Guarantee, scanned copy of EMD B.G. alongwith a scanned copy of mail in confirmation of the same from the bank issuing the B.G. will be uploaded with the E-tender document. No tender document including tender fee, EMD B.G. and other commercial papers are required to be submitted in hard copy or through messenger.
- 6) The Earnest Money Deposit will be refunded to the unqualified applicants immediately and to the qualified applicants after award of the contract
- 7) The bid of the firm without E-tender document fee, against the purchase of document and without EMD will not be opened.

SECTION-II

INSTRUCTIONS TO APPLICANTS

1. GENERAL

- 1.1 The Employer, Uttar Pradesh Power Transmission Corporation Ltd. (UPPTCL) intends to proceed with this package for which this Invitation for Prequalification is issued.
- 1.2 The Employer intends to prequalify firms or joint ventures to tender for the contract package outlined in the Prequalification Detail.
- 1.3 Package completion period is outlined in the Prequalification Detail.
- 1.4 General information on the location and scope of the works to be covered by the contract package is outlined in Annexure-I.

2. ELIGIBILITY AND QUALIFICATION CRITERIA

- 2.1 Prequalification will be based on the applicant meeting the minimum pass/fail criteria regarding the applicant's general and particular experience, personnel and equipment capabilities, and financial position, specified in the Prequalification Data, as demonstrated by the applicant's responses in the forms attached to the Letter of Application and other requested documentation. Specific requirements for joint ventures are also set forth in minimum qualification.
- 2.2 When the applicant intends obtaining highly specialized inputs (essential for execution of the contract) from specialized subcontractors, application forms shall be completed for such subcontractors and their inputs.
- 2.3 Experience of subsidiary companies or holding companies of bidder shall not be considered as experience of the bidder.

3. PREQUALIFICATION AND TENDERING

- 3.1 The employer reserves the right to:
 - a) amend the scope and value of contract to be tendered, in which event only those prequalified applicants who meet the amended requirements will be invited to tender for the contract.
 - b) reject or accept any application without assigning any reason thereof; and
 - c) cancel the prequalification process and reject all applicants.

The Employer shall neither be liable nor be under any obligation to inform the applicant of the grounds for such action.

- 3.2 Applicants will be advised in writing by fax or electronic mail, of the result of their application and of the names of the prequalified applicants, without giving any reason for the Employer's decision.
- 3.3 Only firms and joint ventures that have been prequalified under this procedure will be invited to tender. A firm may apply for prequalification either individually and as part of a joint venture. However, a prequalified firm or a member of a prequalified joint venture may participate as a tenderer in only one tender, either individually or as a partner in a joint venture, for the contract.

- 3.4 Joint ventures must comply with the following requirements:
 - a) The formation of a joint venture after prequalification, and any change in a prequalified joint venture, will lead to disqualification.
 - b) Any tender shall be signed so as to legally bind all joint venture partners, jointly and severally, and any tender shall be submitted with a copy of the joint venture agreement mentioning details for joint and several liabilities with respect to the contract.
- 3.5 The prequalification of a joint venture does not necessarily prequalify any of its partners individually or as a partner in any other joint venture or association.
- 3.6 Delivery of the prequalification application:
- 3.7 Pre-qualified Tenderers will be required to provide a fresh earnest money deposit and the successful tenderer will be required to provide a security and performance bank guarantees. Details of these securities and guarantees will be specified in the tender documents.
- 3.8 Applicants will be intimated, in due course, of the results of their applications. Only firms or joint ventures prequalified under this procedure will be invited to bid.

4. CLARIFIACTION REGARDING APPLICATION

4.1 Prospective applicants may request in writing clarification of the package requirements and the criteria for qualification at any time up to five (5) days prior to the deadline set for the submission of applications. The written responses will be sent to all prospective applicants that have received the prequalification documents.

All queries should be sent to the following postal addresses:

Postal address:

Superintending Engineer, Electricity Substation Design Circle-I, UP Power Transmission Corporation Limited 13th Floor, Shakti Bhawan Extension, 14-Ashok Marg, Lucknow-226001, U.P.

- 4.2 All information requested for prequalification shall be provided in English. Information should be submitted in the formats specified in the application forms in these prequalification documents
- 4.3 The application for prequalification shall consist of the following:
 - a) The letter of Application
 - b) The forms and documentation specified in the Prequalification Data
 - c) Earnest money deposit as specified in Section I
 - d) Proof of deposit of non-refundable fee as specified in Section I.

- 4.4 Failure to provide information which is essential to evaluate the applicant's qualifications or to timely provide clarification or to substantiate the information supplied will result in disqualification of the applicant.
- 4.5 Submission of applications for prequalification must be received in sealed envelopes, which shall be delivered either by hand or by registered mail, to the address specified in the Prequalification Data not later than the date and time specified in the Prequalification Data, and shall bear the identification specified in the Prequalification Data.
- 5.0 The responses to tender bid shall be valid for not less than six (6) months from the last date of submission.

SECTION-III

PREQUALIFICATION DATA

1. GENERAL

The Employer intends to award the contract package described in Section I.

2. PACKAGE COMPLETION PERIOD

Completion of the Package 18 Months from the date of L.O.I. or from the date of handing over of land, which ever is later.

3. CONTRACT TYPE AND CONDITIONS

- 3.1 The contract will be a fixed price lump sum turnkey contract. UPPTCL Conditions of Contract will generally be used as basis of contract.
- 3.2 The contractor will be required to provide irrevocable performance bank guarantees from an approved scheduled bank in India in favour of the Employer.

4. SUBMISSION OF APPLICATIONS

- 4.1 As elaborated in Clause 3.6.2 of Section-II (Instructions to Applicants).
- 4.2 All the information requested for prequalification will be answered in the English language by all applicants and joint ventures.
- 4.3 Failure to provide information that is considered essential to evaluate the Applicant's qualifications, or to provide timely clarification or substantiation of the information supplied, will result in disqualification of the Applicant.

5. QUALIFICATION CRITERION

- 5.1 Prequalification will be based on meeting all the following minimum pass/fail criteria regarding the Applicant's general and particular experience, personnel and equipment capabilities, and financial position, as established by the Applicant's responses in the forms attached to the Letter of Application (specific requirements for joint ventures are given under Clauses 6.1 and 6.2 below).
- 5.2 <u>General Experience</u>: The Applicant shall meet the minimum criteria outlined in Section I of the Invitation for Prequalification, for the contract package.
- 5.3 <u>Personnel Capabilities</u>: The Applicant must have suitably qualified personnel to fill the following positions. The Applicant will supply information on a prime candidate and an alternate for each position, each of whom should meet the experience requirements as specified below:

Position	Total experience (years)	In similar works and financial magnitude (years)	As manager of similar works and financial magnitude (years)
Project manager	15	10	5
Site project Manager	15	10	5
Other			

- 5.4 <u>Financial Position</u>: The Applicant shall establish that he has access to, or has available, liquid assets, unencumbered real assets, line of credit, and other financial means sufficient to meet the contract cash flow for a period of three months, net of the applicant's commitments for other contracts,
- 5.5 The audited balance sheets for the last five fiscal years (of the bidder) shall be submitted and must establish the soundness of the Applicant's (each member of Joint Venture) financial position, showing long-term profitability. Where necessary, the Employer will make inquiries with the Applicant's bankers.
- 5.6 <u>Quality Assurance</u>: The Applicant (each member of Joint Venture) must have an ISO 9000-2001 standard Quality Assurance System. For main components to be subcontracted if the Subcontractors are not ISO 9000-2001 certified, the Applicant shall implement his own Quality Assurance System in the Subcontractor's Workshops.
- 5.7 <u>Litigation History</u>: The Applicant should provide accurate information on any litigation or arbitration resulting from contracts completed or under execution by him over the last five fiscal years. A consistent history of awards against the Applicant or any partner of a joint venture may result in failure of the application.
- 5.8 <u>Restriction to trade or black listing History</u>: The Applicant should provide accurate information on any restriction to trade or his black listing resulting from contracts completed or under execution by him over the last five fiscal years. A consistent history of restriction or black listing against the Applicant or any partner of a joint venture may result in failure of the application.

6. Joint ventures

6.1 If the Applicant comprises a number of firms combining their resources in a joint venture, the legal entity constituting the joint venture and the individual partners in the joint venture shall be registered in eligible source countries and shall otherwise meet the requirements of Clause 5.3 of Section-I (Invitation for Pre-Qualification). The leader of the joint venture and all other partners shall definitely be as per clause no. 5.0 (Qualification of the bidder) of section I.

The joint venture must satisfy the criteria of Clause 5.3 of Section-I. For this purpose the following data of the joint venture to meet the qualifying criteria must be given with the bid:

- a) particular experience (Sub-Clause 5.2);
- b) personnel capabilities (Sub-Clause 5.3).
- c) adequate resources to meet financial commitments on other contracts (Sub- Clause 5.4);
- d) financial soundness (Sub-Clause 5.5);
- e) quality assurance (Sub-Clause 5.6);
- f) litigation history (Sub-Clause 5.7); and

g) restriction and black listing history (Sub-Clause 5.8).

Any bid shall be signed so as to legally bind all partners, jointly and severally, and any bid shall be submitted with a copy of the joint venture agreement providing the joint and several liability with respect to the contract.

6.2 The prequalification of a joint venture does not necessarily prequalify any of its partners individually or as a partner in any other joint venture or association.

7. CONFLICT OF INTEREST

7.1 Any Applicant (including any of the members of a joint venture) availing consultancy from the Employer's consultant for this package shall not be eligible to tender or participate in a tender in any capacity whatsoever.

8. UPDATING PREQUALIFICATION INFORMATION

8.1 Bidders are required to update the financial information used for prequalification at the time of submitting their bids, to confirm their continued compliance with the qualification criteria and verification of the information provided. A bid will be rejected if the Applicant's qualification thresholds are no longer met at the time of bidding.

9 GENERAL CONDITION

- 9.1 Only firms and joint ventures that have been prequalified under this procedure will be invited to bid.
- 9.2 Bidder will be required to provide bid security in the form of a bank guarantee from an approved scheduled bank in India acceptable to the Employer and the successful bidder will be required to provide performance security. Formats of acceptable forms and also that of bank guarantees will be supplied with the bidding documents.
- 9.3 The Employer reserves the right to:
 - a) amend the scope of the package that will be bid only among those prequalified bidders that meet the requirements of the amended scope
 - b) reject or accept any application without assigning any reason thereof; and
 - c) cancel the prequalification process and reject all applications without assigning any reason thereof.

APPENDIX A

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APPLICATION PROFORMA

1. GENERAL

The Application Proforma contains the following forms which must be essentially submitted along with bid, duly filled :

Application Form (0)	Letter of Application
Application Form (1)	General Information
Application Form (2)	General Experience Record
Application Form (2A)	Joint Venture Summary
Application Form (3)	Particular Experience Record
Application Form (3A)	Details of Contracts of Similar Nature and Complexity – Substations
Application Form (4)	Summary Sheet : Current Contract Commitments/Works in Progress
Application Form (5)	Personnel Capabilities
Application Form (5A)	Candidate Summary
Application Form (6)	Equipment / System Requirements
Application Form (7)	Financial Capabilities
Application Form (8)	Litigation History
Application Form (9)	Restriction and black listing History
Application Form (10)	Bank Guarantee format for Earnest Money Deposit
Application Form (11)	Declaration Regarding GST

APPENDIX A

APPLICATION FORM (0)

LETTER OF APPLICATION

APPLICATION FORM (0)

Letter of Application

(Letter head paper of the Applicant, or partner responsible for a joint venture, including full postal addresses, telephone no., facsimile no., and email address)

Date:

To:

Superintending Engineer, Electricity Substation Design Circle-I, Uttar Pradesh Power Transmission Corporation Ltd. 13th floor Shakti Bhawan Extension 14, Ashok Marg Lucknow 226001, Uttar Pradesh

Dear Sirs,

1. Being duly authorized to represent and act on behalf of _____

Hereinafter "the Applicant," and having reviewed and fully understood all the prequalification information provided, the undersigned hereby applies to be prequalified by yourselves as a bidder for the contract:

- 2. Attached to this letter are copies of original documents defining¹:
- a) The Applicant's legal status;
- b) The principal place of business; and
- c) The place of incorporation (for applicants that are corporations), or the place of registration and the nationality of the owners (for applicants that are partnerships or individually owned firms).
- d) Power of Attorney
- 3. UPPTCL and its authorized representatives are hereby authorized to conduct any inquires or investigations to verify the statements, documents, and information submitted in connection with this application, and to seek clarification from our bankers and clients regarding any financial and technical aspects. This Letter of Application will also serve as authorization to any individual or authorized representative of any institution referred to in the supporting information, to provide such information deemed necessary and requested by yourselves to verify

¹ For application by joint ventures, all the information requested in the prequalification documents is to be provided for the joint venture, if it already exists and for each party to the joint venture separately. The lead partner should be clearly identified. Each partner in the joint venture will sign the letter.

statements and information provided in this application, or with regard to the resources, experience, and competence of the Applicant.

4. UPPTCL and its authorized representatives may contact the following persons for further information ² if required.

Contact 1	Telephone 1	Email
Contact 2	Telephone 2	Email

- 5. This application is made in the full understanding that :
 - a) Bids by prequalified applicants will be subject to verification of all information submitted for prequalification at the time of bidding;
 - b) UPPTCL reserves the right to:
 - Amend the scope under this package ; in such event, bids will be called only from prequalified bidders that meet the revised requirements; and
 - Reject or accept any application, cancel the prequalification process, and reject all applications; and
 - c) UPPTCL will not be liable for any such actions and will be under no obligation to inform the Applicant of the grounds for them.

Applicants that are not joint ventures should delete Para. 6 and 7.

- 6. Appended to this application, we give details of the participation of each party, including capital contribution and profit/loss agreements, to the joint venture of association. We also specify the financial commitment in terms of the percentage of the value of the contract, and the responsibilities for execution of the contract.
- 7. We confirm that in the event that we bid, that bid as well as any resulting contract will be:
 - a) Signed so as to legally bind all partners, jointly and severally; and
 - b) Submitted with a joint venture agreement providing the joint and several liabilities of all partners in the event the contract is awarded to us.

² Applications by joint ventures should provide on a separate sheet equivalent information for each party to the application.

8. The undersigned declare that the statements made and the information provided in the duly completed application are complete, true, and correct in every detail.

Signed	Signed
Name	Name
For and on behalf of (name of Applicant or lead partner of a joint venture)	For and on behalf of (name of partner)

Signed	Signed
Name	Name
For and on behalf of (name of partner)	For and on behalf of (name of partner)

Signed	Signed	
Name	Name	
For and on behalf of (name of partner)	For and on behalf of (name of partner)	

APPENDIX A

APPLICATION FORM (1)

GENERAL INFORMATION

APPLICATION FORM (1)

General information

All individual firms and each partner of a joint venture applying for prequalification are requested to complete the information in this form. Nationality information should be provided for all owners or directors or applicants that are partnerships or individually-owned firms.

Where the Applicant proposes to use named subcontractors for critical components of the works, or for works or for work contents in excess of 10 percent of the value of the whole works, the following information should also be supplied for the specialist subcontractor(s).

1.	Name of firm			
2.	Head office address			
3.	Telephone	Contact		
4.	Fax	Email		
5.	Place of incorporation/registration	Year of incorporation/registration		

Nationality of Owners/Directors³

Name		Nationality		
1.				
2.				
3.				
4.				
5.				

³ To be completed by all owners/directors or partners or individually-owned firms.

APPENDIX A

APPLICATION FORM (2)

GENERAL EXPERIENCE RECORD

APPLICATION FORM (2)

General experience record

Name of Applicant or partner of a joint venture

All individual firms and all partners of a joint venture are requested to complete the information in this form. The information supplied should be the annual turnover of the Applicant (or each member of a joint venture), in terms of the amounts billed to clients for each fiscal year (of the bidder) for work in progress or completed.

Use a separate sheet for each partner of a joint venture.

Applicants are not required to enclose testimonials, certificates, and publicity material with their applications; they will not be taken into account in the evaluation of qualifications.

Annual turnover for last five years			
Fiscal year	Turnover (in Rs.)		
1.			
2.			
3.			
4.			
5.			

Signature of the bidder with seal

Liquid asset as per PQ

Liquid asset	(in Rs.)			
1.				

Liquid asset shall comprise the following:-

Description	(in Rs.)
Cash	
Bank Balance	
Fixed Deposit	
Credit Facility	
Total Liquid Asset	

Signature of the bidder with seal

Banker certificate (to be given by the bank)

SI. No.	Type of facility	Sanction limit as on date	Utilised limit as on date
1.	Cash credit		
2.	Trade credit		
3.	L.C.		
4.	Others		

Signature of the bidder with seal

Signature of the Banker with seal

APPENDIX A

APPLICATION FORM (2A)

JOINT VENTURE SUMMARY

APPLICATION FORM (2A)

Joint Venture Summary

Names of all partners of a joint venture			
1. Lead partner			
2. Partner			
3. Partner			
4. Partner			
5. Partner			
6. Partner			

Total value of annual turnover, in terms of work billed to clients, in Rs. at the end of the period reported:

Annual turnover data (EPC only: in Rs.)						
Partner	Form 2 page no.	Year 1	Year 2	Year 3	Year 4	Year 5
1. Lead Partner						
2. Partner						
3. Partner						
4. Partner						
5. Partner						
6. Partner						
	Total:					

APPENDIX A

APPLICATION FORM (3)

PARTICULAR EXPERIENCE RECORD

APPLICATION FORM (3)

Particular experience record

Name of Applicant or partner of a joint venture

To prequalify, the Applicant shall be required to pass the specified requirements applicable to this form, as set out in the "minimum qualification".

On a separate page, using the format of Form (3A), each applicant or partner of a joint venture is requested to list:

- All contracts that they have successfully managed of a similar nature and complexity for a power utility.
- All contracts that they have successfully executed, including design, manufacture installation and commissioning, of a similar nature and complexity for a power utility.

The Applicant should specify works undertaken during the last five (5) financial years. The information is to be summarized, using Forms (3A), for each contract completed or under execution by the Applicant or by each partner of a joint venture.

These declarations shall be required to be certified by owners/users of the packages under their official signature. Such certificates shall accompany the application.

Where the Application proposes to use named subcontractors for critical components of the work, or for work contents in excess of 10 percent of the value of the whole work, the information in the following forms should also be supplied for each specialist subcontractors.
APPLICATION FORMS (3A)

DETAILS OF CONTRACTS OF SIMILAR NATURE AND COMPLEXITY

APPLICATION FORM (3A) Substations

Details of Contracts of Similar Nature and Complexity

Nan	Name of Applicant or partner of a joint venture			
Use	a separate sheet for each contract.			
1.	Name of contract			
2.	Country			
3.	Name of employer			
4.	Employer address			
5.	Nature of works and special features relevant to the contract for which the Applicant wishes to prequalify			
6.	Contract role (check one)			
	□ Sole □ Subcontractor □ partner in a joint venture			
7.	Value of the total contract			
8.	Date of award			
9.	Date of completion			
10.	Contract duration (years and months)			
	Years Months			
11.	Specified requirements			
	Nominal voltage kV			
	Short circuit current kA			
	Size & type of power transformer			
	Size & type of shunt reactor			
	Type and capacity			
	Bus configuration			
	Number of circuits			
	Environment			
12.	Sourcing of Equipment and Materials			

APPLICATION FORM (4)

SUMMARY SHEET: CURRENT CONTRACT COMMITMENTS/WORKS IN PROGRESS

APPLICATION FORM (4)

Summary Sheet: Current Contract Commitments/Works in Progress

Name of Applicant or partner of a joint venture

Applicants and each partner to an application should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Name of contract	Value of outstanding work	Estimated completion date
1.		
2.		
3.		
4.		
5.		
6.		

APPLICATION FORM (5)

PERSONNEL CAPABILITIES

APPLICATION FORM (5)

Personnel Capabilities

Name of Applicant or partner of a joint venture

For specific position essential to contract implementation, applicants should provide the names of at least two candidates qualified to meet the specified requirements stated for each position. The data on their experience should be supplied in separate sheets using Form 5A for each candidate.

1.	Title of position
	Name of prime candidate
	Name of alternate candidate
2.	Title of position
	Name of prime candidate
	Name of alternate candidate
3.	Title of position
	Name of prime candidate
	Name of alternate candidate
4.	Title of position
	Name of prime candidate
	Name of alternate candidate
5.	Title of position
	Name of prime candidate
	Name of alternate candidate

APPLICATION FORM (5A)

CANDIDATE SUMMARY

APPLICATION FORM (5A)

Candidate Summary

Name of Applicant or partner of a joint venture

Position		Candidate □ Prime □ Alternate
Candidate information	1. Name of candidate	2. Date of birth
	3. Professional qualifications	
Present employment	4. Name of employer	
	Address of employer	
	telephone	Contact (manager/personnel officer)
	Fax	Email
	Job title of candidate	Years with present employer

Summarize professional experience over the last 25 years, in reverse chronological order. Indicate particular technical and managerial experience relevant to the package.

From	То	Company/Package/Position/ Relevant technical and management experience

APPLICATION FORM (6)

EQUIPMENT / SYSTEM CAPABILITIES

APPLICATION FORM (6)

Equipment/System Capabilities

Name of Applicant or partner of a joint venture

The Applicant shall list the number, type, and capacities of all major construction equipment and systems at his disposal and expected to be available for the execution of the contract.

APPLICATION FORM (7)

FINANCIAL CAPABILITIES

APPLICATION FORM (7)

Financial Capabilities

Name of Applicant or partner of a joint venture

Applicant, including each partner of a joint venture, should provide financial information to demonstrate that they meet the requirements stated in the Instructions to Applications. Each applicant or partner of a joint venture must fill in this form. If necessary, use separate sheets to provide complete banker information. A copy of the audited balance sheets should be attached.

Banker Name of banker		
Address of banker		
	Telephone	Contact name and title
	Fax	Email

Summarise actual assets and liabilities for the previous five fiscal years. Based upon known commitments, summarise packaged assets and liabilities for the next two years.

Financial information	Actual : Previous	Actual : Previous five fiscal years				Packaged Next two fi years	iscal
	1	2	3	4	5	6	7
1. Total assets							
2. Current assets							
3. Total liabilities							
4. Current liabilities							
5. Profits before taxes							
6. Profits after taxes							

Specify proposed sources of financing to meet the cash flow demands of the Package, net of current commitments.

Source of financing	Amount (in Rs.)
1.	
2.	
3.	
4.	

Attach audited financial statements for the last five fiscal years (for the individual applicant or each partner of a joint venture).

Firms owned by individuals, and partnerships, may submit their balance sheets certified by a registered accountant, and supported by copies of tax return, if audits are not required by the laws of their countries of origin.

APPLICATION FORM (8)

LITIGATION HISTORY

APPLICATION FORM (8)

Litigation History

Name of Applicant or partner of a joint venture

Applicant, including each partner of a joint venture, should provide information on any history of litigation or arbitration resulting from contracts executed in the last five years or currently under execution. A separate sheet should be used for each partner of a joint venture.

Year	Award FOR or AGAINST applicant	Name of client, cause of litigation, and matter in dispute	Disputed amount (in Rs.)

APPLICATION FORM (9)

RESTRICTION AND BLACK LISTING HISTORY

APPLICATION FORM (9)

Restriction and Black Listing History

Name of Applicant or partner of a joint venture

Applicant, including each partner of a joint venture, should provide information on any restriction and black listing history resulting from contracts executed in the last five years or currently under execution. A separate sheet should be used for each partner of a joint venture. Firm has to submit an affidavit on Rs.100.00 Stamp Paper that the firm is not DEBARRED/BLACKLISTED in any Government utility in India as on the date of publication of bid and thereafter till the finalization of the tender.

Firms who have been debarred/blacklisted as on the date of publication of bid and thereafter till the finalization of the tender will not be considered.

The Applicant should provide accurate information on any restriction to trade or his blacklisting resulting from contracts completed or under execution by him over the five fiscal years.

Eligible Applications

The Applications of the contractors/firms, who had been debarred to trade by any other board or Corporation of energy sector of any Indian state or any foreign country as on the date of publication of bid and thereafter till the finalization of the tender, shall not be considered. The Applicants have to declare that they have not been debarred as detailed above through their own statement duly supported by a notarized affidavit on a Non-Judicial Stamp paper of Rs.100/- in this regard, along with their application.

- 1- If it comes to the notice of Corporation, that the Applicant has given any fictitious information/Performa or he is involved in mafia activities or he has terrorized the prospective Applicants or he has tried to stop them in participating the tender process then the tender process can be cancelled and under such circumstances the losses to the corporation shall be recovered from the concerned Applicant.
- 2- For agreement with successful bidder, the photo of proprietor in case of proprietorship firm, the photo of all the partners in case of partnership firm alongwith their partnership deed and photo of authorized person alongwith authority letter by board of Director of Company, in case of company, registered under company Act 1956 shall be required. Other points of this clause shall remain unchanged.

Year	Award against applicant	Name of client	cause of restriction and black listing

APPLICATION FORM (10)

BANK GUARANTEE FORMAT FOR EARNEST MONEY DEPOSIT

APPLICATION FORM (10)

FORM OF BANK GUARNATEE

(For depositing earnest money in case the amount for deposit exceeds Rs. 5,000.00)

To,

Superintending Engineer Electricity Substation Design Circle-I U.P. Power Transmission Corporation Limited, Lucknow.

Sir, WHEREAS, Messersa company
incorporated under the Companies Act, its registered office at /a firm
registered under the Partnership Act and having its business office at
carrying on business under the firm's name and style of
Messersat/Srison ofresident
ofSon of
son ofresident of
ofpartners carrying on business under the firm's name and style of
Messersatwhich is a registered partnership (hereinafter called
"The Applicant") has have in response to your Invitation for Prequalification against
specification number for pre-qualifying the tendering of an EPC Contract for
Supply, Erection, Testing and Commissioning of 220 KV Substations as per annexure-I,
offered to supply and /or execute the works as contained in the Applicant's letter No.

AND WHEREAS the Applicant is required to furnish you a Bank guarantee for the sum of Rs.....as earnest money against the Applicant's offer as aforesaid:

AND WHEREAS We(name of the bank), have, at the request of the Applicant agree to give you his guarantee as hereinafter contained:

NOW THEREFORE, in consideration of the promises We, the undersigned, hereby covenant that the aforesaid application of the Applicant shall remain open for acceptance by you during the period of validity as mentioned in the Application or any extension thereof as you and the Applicant may subsequently agree and if the Applicant shall, for any reason back out, whether expressly or impliedly, from his said application during the period of its validity or any extension thereof as aforesaid we hereby guarantee to you the payment of the sum of Rupeeson demand, notwithstanding the existence of any dispute between the U.P.P.T.C.L. and the Applicant in this regard AND We hereby further agree as follows

(a) That you may without affecting this guarantee grant time or other indulgence to or negotiate further with the application in regard to the conditions contained in the said application and hereby modify these conditions or add there to any further conditions as may be mutually agreed upon between you and the Applicant.

(b) That the guarantee herein before contained shall not be affected by any change in the constitution of our Bank or in the constitution of the Applicant.

(c) That any account settled between you and the Applicant shall be conclusive evidence against us of the amount due here under and shall not be questioned by us.

(d) That this guarantee commencer from the date hereof and shall remain in force till the Applicant, If his application is accepted by you, furnishes the security as required under the said specifications and executes a formal agreement as therein provided or (till four months after the period of validity) or the extended period of validity, as the case may be, of application, whichever is earlier.

(e) That the expressions "the Applicant" and "The Bank" and "the U.P.P.T.C.L". Herein used shall, unless such interpretation is repugnant to the subject or context, include their respective successors and assigns.

Yours faithfully

APPLICATION FORM (11)

DECLARATION REGARDING GST

UNDERTAKING BY BIDDER TOWARDS ANTI PROFITEERING CLAUSE OF GST ACT/RULES

(To be submitted on letter head)

...... (Designation of the agreement Authority of UPPCL/ UPPTCL) (Address)

- Subject: Undertaking towards compliance of Provision of Section-171 of the GST Act 2017 pertaining to Anti-Profiteering.
- Ref: Tender/WO/PO No...... dated..... for supply/work of...... (Brief description of work/supply)

Sir,

То

1. We..... (Name of bidder with address) have submitted Bid no.....dated......against aforesaid tender.

Or

We..... (Name of contractor with address) have accepted the WO/PO No...... dated for the above referred work/supply.

- 2. According to section 171 of CGST Act/SGST Act,"any reduction in rate of tax on any supply of Goods or Services or the benefit of input Tax Credit shall be passed on to the recipient by way of commensurate reduction in prices."
- 3. Accordingly, we hereby offer a discount of Rs..... % on quoted prices due to reduction in rate of tax or availability of benefit of Input Tax Credit. Further working on the basis of which, benefit of reduced prices is working out shall be provided to UPPCL/UPPTCL along with supporting documents/evidences.
- 4. We hereby confirm that, above discount is maximum possible benefit available and is in compliance with the aforesaid Section 171 of CGST/SGST.
- 5. In case it is found at a later date that, any additional benefit on account of GST is available to us, we hereby undertake to pass on the benefit to UPPCL/UPPTCL subsequently.
- 6. In case of failure from our part, of passing on the benefit, we hereby authorize UPPCL/UPPTCL to recover the amount from any amount due to us, or to take legal action against us for recovery of the amount due to us or to take legal action against us for recovery of the same.

Place:	Signature of Authorised Signatory of bidder/contractor.
Date:	Name:

Designation:

Seal:

SECTION-IV

- 1. PARTICULARS OF SUBSTATION
- 2. BILL OF MATERIAL
- 3. SINGLE LINE DIAGRAM

PARTICULARS OF 220KV SUBSTATION TO BE CONSTRUCTED

1.0	NAME OF SUB-STATION	:	220KV BABINA (JHANSI) SUBSTATION
2.0	LOCATION	:	District Jhansi Uttar Pradesh
•	CONCLONED		

3.0 CONSIGNEE : Executive Engineer Electricity Transmission Division Jhansi

4.0 The above Substation shall comprise of following bays -

- (a) 2x160 MVA Transformer Bays including 220 KV & 132 KV sides
- (b) 2x220KV Feeder Bay
- (c) 1x220 KV Bus Coupler Bay
- (d) 1x220 KV Bus Transfer Bay
- (e) 2x40MVA Transformer Bays including 132 KV & 33 KV sides
- (f) 2x132 KV Feeder Bay
- (g) 1x132 KV Bus Coupler Bay
- (h) 8x33KV Feeder Bays
- (i) 1x33KV Bus Coupler Bay

1.3 The bus system shall be as under:

- (a) 220 KV Double Main & Transfer Buses : (No. of Bays-06 +02 Spare), Bay width 18 meters, Conductor Span-3x36 meters)
- (b) 132 KV Single Main & Transfer Buses : (No. of Bays-07+04 Spare), Bay width 12 meters, Conductor Span-4x36 meters
- (c) 33KV single Main & Auxiliary Bus (No. of Bays-11), Bay width 6 meters, Conductor Span-2x36 meters
- (d) Jack Buses of different Voltage Levels as per design.

SECTION-V

- **1.** INSTRUCTIONS TO **BIDDERS**
- 2. SPECIAL CONDITIONS OF SPECIFICATIONS
- 3. SPECIFICATIONS FOR HANDLING, ERECTION, TESTING AND COMMISSIONING
- 4. GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATION
- 5. GENERAL CONDITIONS FOR THE SUPPLY OF PLANT AND THE EXECUTION OF WORKS - FORM-'A'
- 6. DRAWINGS OF AUXILIARY STRUCTURES

INSTRUCTIONS TO BIDDERS

INDEX

- S.NO. TITLE
 - **1.0 PREPARATION OF BID**
 - 2.0 SUBMISSION OF BID
 - 3.0 VALIDITY
 - 4.0 PRICE & PRICE STRUCTURE
 - 4.1 TAXES & DUTIES
 - 4.2 NATURE OF PRICES
 - 5.0 EVALUATION OF BID
 - 6.0 AWARD OF CONTRACT
 - 7.0 **DEVIATIONS**
 - 8.0 CANVASSING
 - 9.0 PRE-BID MEETING
- **10.0 COURT OF COMPETENT JURISDICTION**

INSTRUCTIONS TO BIDDERS

1.0 PREPARATION OF BID

1.1 Before Submission, of the Bid, the Bidder is advised to fully familiarize himself with the site conditions. The land for substation shall be made available to the Bidder on 'as is where is' basis. Further levelling and development of land shall be in the Bidder's scope. It shall be the responsibility of the Bidder to arrange all inputs required for detailed engineering and execution. The Bidders are, therefore, advised to visit the substation site, collect all necessary inputs and acquaint themselves with the topography, infrastructure etc. The Bidder shall be fully responsible for providing all equipment, materials system and services specified or otherwise which are required to complete the construction, successful testing and commissioning.

The Bidders are required to make them selves fully conversant with the technical specifications, drawings, Special Conditions of specification, Instruction to Bidder, General Technical requirement of specification, Specification for handling, erection, testing & commissioning including schedules and General Condition of Form-'A' as may be applicable so that no ambiguity arises at a later date in this respect.

- 1.2 Any inconsistency or ambiguity in the offers made by the Bidder shall be interpreted to the maximum advantage of UPPTCL and disadvantage to the Bidder. The Bidder shall have no right to question the interpretation of the Purchaser in all such cases and the same shall be binding on the Bidder.
- 1.3 The Bid should be prepared and submitted strictly in accordance with the instruction contained in these specifications. The Bid shall be complete in all respects. Bid must be submitted in the manner specified on the attached prescribed schedules and/or copies thereof. To complete the proposal, the Bidder must fill the Bid form, declaration, all schedules and data sheets, annexed with the specification item by item in accordance with the instructions and notes supplementary thereto. The interpolations, insertion, cutting and corrections made in the Bid offers should be duly initiated by the Bidder.
- 1.4 Each Bidder shall supply the data required on sheets annexed with the specifications by typing at appropriate places against each item to facilitate preparation of comparative statements. These sheets must be properly signed by authorized representative of the Bidder/manufacturer testifying the data submitted. All schedules must be duly filled in and shall be enclosed with each copy of the Bid, In case the Bidder does not supply any of the required information at the time of Bid, necessary loading may be made while evaluating the prices of his offer without giving him any further opportunity to supply or clarify the same. The Bidders are notified that in case the required information are not furnished in the specified Performa/schedules attached with the specification, the Purchaser shall not be responsible for any error in the evaluation of their Bids on this account, Further the failure to comply with this requirement may result in the rejection of the Bid at the discretion of the Purchaser.

1.5 A set of technical, descriptive and illustrative literature along with drawing must accompany with the tender so that a clear understanding of the equipment offered is obtained. The uploaded document should be clearly legible.

Telegraphic Bids shall not be considered under any Circumstance

1.6 CONDITIONS FOR THE SUPPLY OF EQUIPMENTS:

- 1.6.1 Equipments will be supplied only from those manufacturers who have successfully supplied similar or higher rating equipments to UPPTCL duly type tested in last 5 years.
- 1.6.2 Equipments e.g. SAS & related equipments shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned substation automation system, which must be in successful operation for minimum period of 2 years. KEEMA certificate / equivalent certificate from development centre authorized by UCA working group for having products including all IEDs and Ethernet switches conforming to IEC 61850 is to be furnished.
- 1.6.3 All the equipments, including SAS, shall be supplied from approved vendors of UPPTCL, the list of which shall be made available to the successful bidder.

2.0 SUBMISSION OF BID :

2.1 "The Bidder shall submit his electronic bid online on the E-Procurement website <u>etender.up.nic.in</u>. Any hard copies of the tender documents are not to be submitted. Bid Part–I shall comprise of Technical, Commercial and Equipment details, etc. and Bid Part –II shall comprise of the Price deails of Supply, Erection and Civil works of the Substation.

2.2 BID PART-I (E-TENDER DOCUMENTS FEE, EARNEST MONEY, TECHNICAL, COMMERCIAL DETAILS ETC.)

Bidder is required to deposit earnest money to the amount of Rs. 2.2.1 87,00,000.00 (Eighty Seven Lakhs Only) through RTGS/ NEFT in UPPTCL account mentioned above and a proof of such deposit e.g. UTR No., Name of Account, Scanned copy of pay-in slip countersigned by the tenderer, should be uploaded along with E-tender documents OR in the form of Bank Guarantee on a non-judicial stamp paper of Rs. 10,000.00 as per U.P. stamp act, for the package valid for one (1) year as per the attached format in favour of "Superintending Engineer, Electricity Substation Design Circle-I, UPPTCL, Lucknow. If EMD is deposited in the form of Bank Guarantee, The Applicant shall also provide an Earnest Money Deposit scanned copy of EMD B.G. alongwith a scanned copy of mail in confirmation of the same from the bank issuing the B.G. will be uploaded with the E-tender document.. No tender document including tender fee, EMD B.G. and other commercial papers are required to be submitted in hard copy or through messenger.

Any deviation from or addition to the text of the specified Performa of Bank Guarantee shall render the bank guarantee invalid for the purpose of opening of Bid Part-II.

- 2.2.2 Offers without earnest money shall not be considered under any circumstances.
- 2.2.3 Besides the Earnest money, other relevant information and the following documents, duly filled in must also accompany the Bid Part-I.

2.3 BID PART-I (SCHEDULES)

1.	Schedule A	:	Bid Form
2.	Schedule B	:	Qualifying details in following schedules :
	B-1	:	Experience details of Equipments of manufacturers on whom the orders are placed by UPPTCL
	B-2	:	Experience details of Equipments of manufacturers on whom the orders have not been placed by UPPTCL
4.	Schedule D	:	Performa for joint undertaking by the collaborator / associates with Bidder
5.	Schedule E	:	Schedule General Particulars
	E-1	:	For Bidder
	E-2	:	For Manufacturers
6.	Schedule F	:	Schedule of deviations from "Special Conditions of Specification"
7.	Schedule G	:	Schedule of deviations from "Technical Specification"
8.	Schedule H	:	Schedule of deviations from "Instructions to Bidders"
9.	Schedule I	:	Schedule of deviations from "General technical requirements of specifications"
10.	Schedule J	:	Schedule of deviations from "General condition of Contract" form "A".
11.	Schedule K	:	Schedule of deviations from "Technical specifications for handling, erection, testing and commissioning"
12.	Schedule L	:	List of Recommended spare tools & tackles
13.	Schedule M	:	List of recommended test sets & testing instruments
14.	Schedule N	:	List of recommended spare parts and their prices
15.	Schedule O	:	List of drawings& literatures enclosed with the Bid
16.	Schedule P	:	Schedule of Guaranteed completion/delivery period
17.	Schedule Q	:	Schedule of offered quantities.
18.	Schedule R	:	Schedule of Guaranteed technical Particulars
19.	Complete tec	hni	ical details, Make, specification, type test reports, 3 years
	performance	rej	ports and literature of the equipments offered.

2.6 BID PART-II A & B (PRICES)

Only the prices and the following documents duly filled in must accompany Bid bid part-II A. & B

1.	Schedule F	:	Price incidence of Schedule of deviations from "Special conditions of Specifications".
2.	Schedule G	:	The Price incidence of schedule of deviations from "Technical Specifications."
3.	Schedule H	:	The Price incidence of schedule of deviations from "Instructions to Bidders."
4.	Schedule I	:	The Price incidence of schedule of deviations from "General Technical requirement of Specification."

5.	Schedule J	:	The Price incidence of schedule of deviations from
			"General Condition of Contract form A".
6.	Schedule K	:	The price incidence of schedule of deviations from
			Technical specifications for handling, erection, Testing and commissioning
7.	Schedule L	:	The prices of Recommended special tools and tackles.
8.	Schedule M	:	The prices of Recommended test sets and testing instruments.
9.	Schedule N	:	The prices of Recommended spare parts for five 5 years.
10.	Schedule Q	:	Schedule of Quantity and Prices.
	Q-1	:	For Supply of equipments and material
	Q-2	:	For handling, erection, testing & commissioning
	Q-3	:	For Supply of Light Luminaries
	Q-4	:	For Erection of Light Luminaries

- 2.6.1 On the date of Bid opening at scheduled time, part-I of the Bid shall be opened publicly in the presence of authorized representatives of the bidders. The date and time of opening of Bid part-II A & B shall be intimated separately, later on.
- 2.6.2 Any action on the part of the Bidders to revise the prices and/or change the structure of price(s) at his own instance after the opening of the Bid may result in rejection of the Bid and/or debarring the Bidder for participation in any other tender by the Corporation for one year in first instance.

3.0 VALIDITY:

The Bids shall be valid for a period of six (6) calendar months from the date of opening of the PART-I or any extended date of opening. Bid with lesser validity are liable to be rejected.

4.0 PRICE & PRICE STRUCTURE :

- 4.1 The equipment shall be installed at designated substation in U.P. hence the Bidder must quote F.O.R. Destination prices of all the items alongwith Exworks prices for dispatch to said substation in U.P. The unit F.O.R. destination price shall comprise of the following components.
 - (a) Ex-work price (b) Packing and forwarding charges.
 - (c) Freight (d) Transit insurance charges against all risks.
 - (e) Insurance charges for storage after receipt of equipment at destination store/substation against all risks till its commissioning/handing over(whichever is latter) and 45 days thereafter.

The Bidders must clearly specify these components individually besides the F.O.R. destination prices.

4.2 TAXES & DUTIES :

The prices of imported items, if any, shall be inclusive of all taxes, duties, license fees, import/ custom duties etc legally payable .Any such taxes, duties and levies shall be Bidder's account & no separate claim on this account shall be entertained by UPPTCL.

For bought out items as well as self manufactured items, all duties/levies/ taxes/cess etc. except GST on work contract shall be included by bidders in unit price & UPPTCL shall not entertain any claim on this head. Only GST shall be payable at the prevailing rate on work contract and the present rates of GST on work contract is 18%.

The bidders have to take into consideration the input tax credit (ITC) while quoting price.

The tax deduction at source (TDS) shall be decuted as per Act from the bills of the bidder.

4.2.1 **NATURE OF PRICES:**

The prices of all the items including ex-works prices, packing and forwarding, freight, insurance, erection, testing, & commissioning etc. shall remain **"firm"** in all respects throughout the currency of the contract.

5.0 EVALUATION OF BID:

- 5.1 In comparing Bids and making awards, the Purchaser may consider such factors as, compliance with specification, relative quality and adaptability of suppliers or services, experiences, record of integrity in dealing, ability to furnish repairs and maintenance service, the time of delivery, capability to perform, and available facilities such as adequate shops, equipment plant, technical organization etc.
- 5.2 In case prices of some items are given in lump-sum, where unit prices are required, Purchaser reserves the right to evaluate unit price on the basis of the quoted lump-sump prices.
- 5.3 In case, where a Bidder does not quote F.O.R. destination price asked for, their quoted unit prices shall be loaded by appropriate additional factors on Ex-work prices as below.
 - a) Packing charges @ 0.75% b) Forwarding charges @ 0.25%
 - c) Freight for 1st 500 Kms. @ 2% d) Freight
 - d) Freight for every next 250 Km. or part thereof @ 0.5% thereof.

(For this purpose distance shall be taken from equipments manufacturers' works to destination substation and in case, the distance is less than 500 Km. loading shall be done for a minimum distance of 500 Km.)

- (e) Transit Insurance @ 0.5%f) Insurance for storage after receipt of equipment at destination station @ 0.5%
- 5.4 No payment prior to dispatch of materials shall be made by the Corporation under any circumstances. Bidders are advised not to ask any such advance payment. Request for such advance payment will not be considered even if the Bidders are willing to pay interests charges thereon. Bidders asking for advance payment are liable to be rejected.
- 5.5 Any rebate/discount linked with quantity, terms of payments in any conditions shall not be considered for the purpose of evaluation and comparison of such offers viz-a-viz others. However, the same may be availed while placing order with such successful Bidders.
- 5.6 If the Bidder fails to quote prices for any of the item (s) / component(s) as asked for or confirm its supply free of cost, the highest prices as quoted by other Bidder for the same shall be added to arrive at F.O.R destination

computed prices of such Bidder for comparison purpose only.

- 5.7 The prices shall be compared inclusive of GST and any other taxes/duties.
- 5.8 Loading on any account as may be deemed necessary in the opinion of the Purchaser to bring the various offers at par to each other for comparison purposes, may be done at the discretion of the Purchaser.
- 5.9 The prices shall be compared inclusive of GST assuming the tender as work contract & the present rate of GST is 18%.

6.0 AWARD OF CONTRACT :

- 6.1 The Purchaser is not bound to accept the lowest Bid and may reject any or all the Bidders, without assigning any reason.
- 6.2 The successful Bidder, shall have to enter into a contract agreement with the Purchaser as per General conditions of form A and other special conditions attached with the Bid specifications.

6.3 SPLITTING OF ORDER :

The purchaser reserves the right to split the package among various bidders in any manner it chooses without assigning any reason.

- 6.4 For signing the contract a duly authorized representative of the successful Bidder shall be required to sign and accept the contract at Lucknow at a reasonable notice.
- 6.5 Bidders shall ensure to put initials on each and every page of the Bid. Last page of each document forming part of the Bid shall bear full signature under official seal fully disclosing the name, designation and relationship with the firm of the signatory. In case of a partnership concern, the Bid may be signed by all the partners of the firm or by one of them holding power of attorney (copy to be furnished along with the offer). In case of Corporation/Companies, Bid may be signed either by the President or Secretary or any other person authorized to Bid in the legal name of corporation/ company (copy of such authority to be furnished along with the offer).

7.0 **DEVIATIONS** :

The offer should be strictly in line with conditions, specification and other requirements maintained in this Bid specification document. No deviations are permitted except under special circumstances. Should the Bidder wish to depart from the conditions, provisions and specifications of Bid documents in any way he must draw specific attention to such departure (s). All such deviations shall specifically be filled up in the relevant deviation schedule. If deviations are not specifically recorded in this schedule and submitted along with the Bid document it will be presumed that there are no deviations and this interpretation will be binding upon the Bidder.

Purchaser is, however, not bound to accept all or any deviations as mentioned in such schedule. Bidders are also advised not to enclose their own standard or printed conditions etc, as the same shall not be considered.

8.0 CANVASSING:

No Bidder shall canvass any Corporation's official of the Engineer, with respect to his own or other's Bid. Contravention of this condition will result in rejection of the Bid. This clause shall not be deemed to prevent the Bidder from supplying to the Engineer any further information/ clarification asked for, by the Engineer.

9.0 PRE-BID MEETING:

- 9.1 Bidders if deemed necessary, may be invited to attend a pre bid meeting to take place at a time decided by purchaser.
- 9.2 The purpose of the meeting will be to clarify issues on any matter that may be raised at that stage.
- 9.3 The bidder will be required to submit any quarry latest by 7 days before the meeting.
- 9.4 Minutes of pre bid meeting will be transmitted to all the qualified bidders.
- 9.5 Any amendment of the PART I documents which may become necessary as a result of pre bid meeting shall be made by the Engineer by issuing an addendum.

10.0 COURT OF COMPETENT JURISDICTION :

All disputes arising out of and touching or relating to the subject matter of agreement, shall subject to the jurisdiction of Local Courts of Lucknow and High Court of Judicature at Allahabad only.

SPECIAL CONDITIONS OF SPECIFICATIONS

INDEX

- 1.0 SCOPE
- 2.0 EXCLUSIONS
- 3.0 NATURE OF CONTRACTS
- 3.1 CIVIL/ELECTRICAL CONTRACTS
- 3.2 VETTING OF DOCUMENTS
- **3.3 AGGREGATE CONTRACT VALUE**
- 3.4 QUANTITY VARIATION
- 3.4 LIQUIDATED DAMAGES FOR DELAYS IN SUPPLY / COMPLETION PERIOD
- 4.0 TERMS & CONDITIONS
- 5.0 TENTATIVE SCHEDULE OF QUANTITIES OF EQUIPMENT & MATERIALS (ELECTRICAL)
- 6.0 TECHNICAL SPECIFICATIONS
- 7.0 PRICES
- 8.0 TAXES & DUTIES
- 9.0 TERMS OF PAYMENT
- 10.0 DEVIATIONS
- 11.0 COMPLETION PERIOD
- 12.0 EXPENDITURE UNDER CONTRACT
- 13.0 PROJECT IMPLEMENTATION SCHEDULE
- 14.0 PROGRESS REPORTS
- 15.0 COORDINATION AND REVIEW MEETING
- 16.0 DESIGN AND DRAWINGS
- 17.0 APPROVAL OF DRAWINGS
- 18.0 NAME PLATE, MARKING OF PARTS, LABELS
- **19.0 INSTRUCTION MANUALS**
- 20.0 DOCUMENTS AND ERECTION DRAWINGS
- 21.0 FURNISHING OF AS BUILD DRAWINGS, LAYOUTS AND MANUALS
- 22.0 TESTING AND COMMISSIONING ACTIVITIES
- 23.0 MATERIAL QUALITY
- 24.0 INSPECTION AND TESTING
- 25.0 PACKING
- 26.0 DESPATCH OF EQUPMENT
- 27.0 SECURITY DEPOSIT BANK GUARANTEE
- **28.0 PERFORMANCE GUARANTEE**
- 29.0 RESPONSIBILITY OF THE BIDDER FOR COMPLETENESS OF CONTRACT
- **30.0 PATENTS**
- 31.0 INSURANCE
- **32.0 TRAINING OF ENGINEERS**
- **33.0 SPARE PARTS**
- 34.0 LOCAL CONDITIONS
- 35.0 CONSTRUCTION MACHINERY
- 36.0 RESPONSIBILITY OF ERECTION / WORKS
- **37.0 EXTRA WORK SHIFT**
- **38.0 CARE OF FINISHED WORK**
- **39.0 CLEANING UP OF WORK SITE**
- 40.0 BIDDER'S EMPLOYEES AT SITE
- 41.0 REPLACEMENT OF DEFECTIVE PARTS / EQUIPMENTS / WORKS & RECTIFICATION OF DEFECTS
- 42.0 SURPLUS MATERIALS
- 43.0 RESPOSIBILITY OF CONTRACTOR DURING TWO YEARS MAINTENANCE PERIOD
- 44.0 WITHHOLDING OF PAYMENTS
- 45.0 NOTICE TO BIDDER
- 46.0 JURISDICITON

SPECIAL CONDITIONS OF SPECIFICATIONS FOR CONSTRUCTION OF 220 KV SUBSATAIONS

WITH SAS ON TURNKEY BASIS

1.0 SCOPE

1.1 The scope of work covers all activities related to design, engineering, manufacture, testing at works, supply of all required equipments and materials with accessories and auxiliaries to site, storage at site, insurance, construction including all civil works, handling, erection, testing, commissioning, putting into successful operation and handing over the 220KV substation as single source responsibility on turnkey basis.

1.2 THE BIDDER'S SCOPE OF WORK SHALL INCLUDE BUT NOT BE LIMITED TO THE FOLLOWING;

(a) Design & engineering of all systems, subsystems, equipments, materials and services.

(b) Manufacturing,, assembly, inspection, testing, packing, forwarding, loading, unloading, transportation, transit insurance & supply of all required structures, equipments & materials at site including port & custom clearance if required

(c) Receipt, storage, insurance, preservation & conservation of all structures, equipments & materials at site.

(d) Fabrication & reassembly (if any), erection, testing & commissioning of individual equipments, sub systems /systems.

(e) Commissioning & putting into successful operation.

(f) Providing engineering data, drawings and O&M manuals for Purchasers' reference & records

- (g) Furnishing T&P and spares on FOR site basis.
- (h) Training to Purchaser's personnel.

(i) All Civil works including levelling, developing & dressing of land, security wall with gate & guard room, chain link fencing, control room building, generator room, mulsifyre room, transformer plinth, main & auxiliary foundations, cable trenches with racks & covers, roads, drainage system, sump well & sump house, store shed, water supply, overhead tank, pipe line & pump house, deep tube well and other required works specified under detailed civil specifications hereinafter.

(j) Over all co-ordination with internal/ external agencies, obtaining approval of the electrical inspector and other concerned authorities in respect of works to be carried out under the contract.

2.0 EXCLUSIONS

- (a) Termination of incoming lines on the incoming gantry
- (b) Transmission lines / towers if any.

3.0 NATURE OF CONTRACTS

3.1 The Contract for construction of above 220 KV Substation on single source responsibility, on turnkey basis shall be awarded in two parts.

The one contract shall be called 'Civil Contract' covering all civil works under its scope. The other contract shall be called 'Electrical Contract' covering all works, other than civil works, required to complete total scope under these specifications.

The Bidder shall be fully responsible for the works to be executed under both the contracts and any breach under one contract shall be automatically deemed as a breach of other contract giving UPPTCL right to take appropriate action under any / both the contracts including right to recover damages from any/ both the contracts or terminate any / both the contracts.

Notwithstanding executing the separate contracts & breakup of contract prices the contracts shall all times be construed as a single source responsibility contract. Complete project management, overall co-ordination between civil & electrical works for timely commissioning of Substation shall be Bidder's responsibility.

3.2 **VETTING OF DOCUMENTS**

The Bidder shall bear all the charges in respect of vetting and execution of contract documents

3.3 AGGREGATE CONTRACT VALUE

The sum of contract values of "Civil Contract" and "Electrical Contract" shall be the aggregate contract value. The limits for quantity variation and penalties for delays shall be 10 % of the aggregate contract value as under:

3.4 QUANTITY VARIATION

The quantities of individual items/works under any or both the above contracts may vary to any extent, however the total value of such variations shall not exceed the 10% of the aggregate contract value.

Such variations in quantities / work, under any of the above contracts, upto 10 % of the concerned contract value shall be allowed by concerned Engineer of Contract(Agreement authority) under intimation to other Engineer of Contract(Authorized field officer by Engineer of contract). However if such variation is likely to exceed 10% of the contract value of any contract, the variation shall be allowed by concerned Engineer of Contract after taking prior concurrence of other Engineer of Contract in writing.

3.5 LIQUIDATED DAMAGES FOR DELAYS IN SUPPLY / COMPLETION

PERIOD

In case of delay in completion period/handing over of substation, beyond agreed schedule, liquidated damages @~0.5% per week, subject to maximum of 10% of aggregate contract value shall be deducted from the bidder bills.

However, the liquidated damages, if any, shall be adjusted, against the balance amount of 10% & 10% available for electrical & Civil works respectively, which are to be released after successful commissioning.

4.0 TERMS & CONDITIONS

The terms & conditions of the contract shall be governed by the "General conditions for Supply of Plant and Execution of Work FORM 'A', these 'Special conditions of specifications' and other sections of these Bid documents, except for specific modifications/ amendments duly incorporated in the contract. In case of any contradiction or inconsistency between provisions of these 'special conditions' and other sections of these Bid documents, the provisions contained in these special conditions shall prevail.

5.0 TENTATIVE SCHEDULE OF QUANTITIES OF EQUIPMENT & MATERIALS (ELECTRICAL)

- 5.1 The estimated quantities of equipments & materials required for proposed works at the Substation shall be as specified in Schedule of Quantities & Prices Schedule-Q
- **5.2** The quantities especially for cables/optical fibre, main & auxiliary structures, earthing rods, flats for earthing, conductors, disc insulators, PG clamps, tension & suspension fittings etc are for evaluation purposes. The quantities of these and other items may vary during detailed engineering and execution; however payment shall be made on the basis of unit rates.
- **5.3** For the items given as 'Lot' or 'Lump sum' the total prices as mentioned in price schedule shall be paid irrespective of the quantities of these items utilized during actual execution. Further the total prices of these items shall also include any other item not specified/ covered therein but required for completion of works. If any quantity of any lot item falls short during execution of work, it shall be responsibility of Bidder to make good the same without any extra cost to UPPTCL.
- **5.4.** The work shall be awarded on turnkey basis, The scope shall also include all such items/ works which are not specifically mentioned in these specifications but are required for completion of above 220 KV Substation, hence if Bidder considers that any item/ work is not specified / covered but is / are required for successful completion of work, the Bidder shall quote for such item/ work in the Schedule of quantities & prices either on lump sum basis or by mentioning estimated quantity & unit rate , otherwise it shall be deemed to have been included in the Bidder's scope without any extra liability on Purchaser.

5.5 The erection charges shall include supply of all non-consumable & consumable items required for complete erection, testing & commissioning of the equipments & systems which may or may not have been specifically mentioned in Price schedules.

6.0 TECHNICAL SPECIFICATIONS

6.1 UPPTCL procures all the equipments & materials for Substations. Keeping into consideration the interchange ability and future extension of substation, all equipments and materials to be supplied shall conform to the UPPTCL's current Bid specifications for similar equipments & materials.

The technical specifications of major equipments and accessory items are being enclosed hereinafter. In case of remaining items also UPPTCL's prevailing technical specifications shall be binding on the Bidder. All the equipments & materials shall be supplied as per specifications, technical particulars, drawings & makes approved by Purchaser without any price implication irrespective of the technical particulars & makes quoted in the Bid.

- **6.2** UPPTCL has standard design/ drawings for main & auxiliary structures which shall be provided to Bidder. The Bidder shall supply main & auxiliary structures conforming to these designs/ drawings. The equipment mounting bases shall also match with these auxiliary structures.
- 6.3 The handling, storage, erection, testing & commissioning shall be done as per relevant standards, manufacturer's instruction manuals & where such standards/ instructions are not available; these activities shall be carried out as per UPPTCL's norms & practices for similar voltage level substations constructed by UPPTCL.
- **6.4** The Bidder may propose alternative specifications for equipments, structures, materials and erection procedures for Purchaser's consideration/ approval. It shall be sole discretion of Purchaser to accept or reject such alternatives & Purchaser's decision shall be binding on Bidder.

6.5 EQUIPMENT MAKES

The Bidder shall supply the equipments of his own make for which the Bidder is also the manufacturer provided such equipment/s meet the pre-qualifying conditions for individual equipments.

The bought-out items shall also meet the pre-qualifying conditions for individual equipments and their makes shall be as per approval of Engineer of Contract.

7.0 PRICES

The Prices of all the items and services shall remain "firm" in all respects through out the currency of the contract.

The prices of spare parts shall remain firm and valid for a period of three years from the date of taking over of the substation by UPPTCL.

8.0 TAXES & DUTIES

- 8.1 No Excise duty & Sales / trade tax in any form shall be payable by UPPTCL on bought-out items which shall be dispatched by Bidder's sub-suppliers directly to the project site on sale-in-transit basis. All taxes and duties shall be deemed to be included in ex-works prices.
- 8.2 The prices of imported items, if any, shall be inclusive of all taxes, duties ,license fees, import/ custom duties etc legally payable .Any such taxes , duties and levies shall be Bidder's account & no separate claim on this account shall be entertained by UPPTCL
- **8.3** UPPTCL shall be entitled to deduct Income tax and other taxes/ surcharge /levies/ cess at source in accordance with provisions of Income tax/ other taxation laws as applicable from time to time.

8.4 ITC

The Bidder shall quote the prices after taking into account due credit under ITC scheme as per relevant Government policies wherever applicable. The UPPTCL shall not bear any liability on this account.

In case of turnkey contracts the following undertakings are required to be furnished by EPC contractor :-

- i. Certified that we are registered under the GST Act and our Registration no. is ------
- ii. Certified that the transaction on which the GST has been claimed has been/ will be included in the return submitted/ to be submitted to the Taxation authorities for the assessment of GST and amount claimed from the UPPTCL has been/shall be paid to the Taxation authorities.
- iii. Certified that we shall always indemnify the UPPTCL in case it is found at a later stage, that wrong or incorrect payment had been recovered on account of the GST paid/to be paid by us.
- iv. Certified that any loss due to non-availability of ITC or levy of penalty/interest on account of non-filing of return or non-compliance of any mis-statement given under the provisions of GST Act by the firm shall be recoverable from us.
- v. The provisions of the GST Act shall prevail upon wherever applicable in the terms and conditions of the tender document.

9.0 TERMS OF PAYMENT

Material shall be dispatched by road transport only and the terms of payment shall be as follows:

9.1 5% of the Ex-works price component of supply of electrical equipment/ material (including mandatory spares) shall be paid as an interest bearing initial advance after signing the contract Agreement and on submission of

(a) Advance Bank guarantee of 110% amount of mobilization advance having validity up to three months after scheduled completion period with six months claim period thereafter. However in case of delay of completion of S/S the validity

of this shall be extended by the period of such delay.

(b) Submission of an unconditional Performance Bank Guarantee towards faithful performance of the contract at the rate 10% of contract value.

(c) Submission of detailed Bar Chart and its approval by UPPTCL.

Note: This advance 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 fulfilment of above conditions and an interest will be charged at the rate of 10% per annum. Mobilisation advance and interest shall be adjusted proportionately against progressive payments. In case, the contractor opts above, it would be mandatory for him to submit the documents listed at Sl. No. (b) & (c) above within Twenty Eight (28) days of issuance of LOI.

(d) In case of mobilization advance, liability of GST, if any, as per GST Act shall be borne by the contractor.

9.2 In case of supply:

(i) 80% payment of supplied equipments after completion of foundation of equipments.

(ii) 10% payment after erection of equipments.

(iii) Balance 10% amount to be released after satisfactory commissioning of entire substation, 100% completion of Electrical & Civil works, adjustment of liquidated damages if any and issuance of taking over certificate.

Note:

(I) Supply schedule of equipments is to be adhered strictly as detailed below:

(II) Payment of above major equipment shall be done as per above supply schedule only, even if inspection/supply is made earlier.

(III) Mobilization advance along with interest shall be adjusted proportionately against progressive payments.

(IV) The supply of all equipments and material shall be in accordance with approved bar chart.

9.3 In case of erection & civil works :

(i) 90% of running bill subject to one bill per month.

(ii) Balance 10% amount to be released after satisfactory commissioning of entire substation, 100% completion of all electrical and civil works, adjustment of liquidated damages, if any and issuance of taking over certificate.

The material shall be delivered and works shall be executed strictly as per contractual delivery / completion schedule and the payment shall be due accordingly.

10.0 DEVIATIONS

Unless brought out clearly, the Bidder shall be deemed to conform strictly to the provisions of the Bid documents. All deviations from the specifications shall be clearly brought out in respective schedule of deviations. Any discrepancy between the specification and the catalogue of the Bid, if not clearly brought out in the schedule, will not be considered as a valid deviation.

11.0 COMPLETION PERIOD

"The substation has to be erected, tested and commissioned within 18(eighteen) months from the date of letter of intent or from the date of handing over of land whichever is later."

In case 220KV Transmission line for the substation is not complete / ready, date of readiness of substation after complete testing & commissioning of substation shall be taken as date of completion. However the contractor shall be responsible to energise the 220KV S/S as soon as the 220KV Line is completed and energised. The equipment warranty period shall start from the date of energization of the substation. During the period, after the completion of substation and before the energization of the substation, the ward and watch of the substation shall be the responsibility of the contractor.

The progress shall be monitored as per approved project implementation schedule & PERT.

In case of individual equipment/material the date of receipt of goods at UPPTCL site shall be treated as the date of delivery. In case of part dispatches the delivery shall be deemed to have been effected when last component/part of the equipment/material of the serviceable lot/set has been delivered.

12.0 EXPENDITURE UNDER CONTRACT

The Bidder shall furnish a cash flow chart within 30 days of issue of letter of intent indicating month wise financial liabilities of the Purchaser during the execution of the project which is fairly representative of the actual for supply, erection, testing and commissioning, individually and collectively.

13.0 PROJECT IMPLEMENTATION SCHEDULE

- **13.1** Within one month of issue of letter of intent the Bidder shall submit to the Purchaser design, manufacture, transport, delivery, erection and commissioning schedules for all equipment along with the detailed network for all phases of the work for the execution of the job and completion of the project. Such schedules shall be reviewed, up-dated ad submitted to the engineer, once every three (3) months thereafter by Bidder.
- **13.2** The Bidder shall furnish the following schedules of work/ [PERT charts/Bar charts] to match the specified commissioning schedule within one month of placement or order.
 - i) Master PERT Net Work giving major events and showing dependence of various major activities in the completion of the job.
 - Equipment system wise/sub-system wise detailed PERT Net Works for each of the major activities in the master PERT network covering activities of design and engineering, manufacturing, shop testing/procurement of materials/components, Purchaser's inspection, transport, storage at site,

erection, testing and commissioning.

- iii) Detailed PERT Net Work for civil works of each of the system/sub-systems covering task for civil construction, supervision and finishing. These PERTS will have complete coordination with PERTS for various equipment system / sub-systems.
- iv) Bar chart for completion of works for each system as specified in respective sections of each volume, for construction and erection, from start of work at site to completion of work by the Bidder, giving various phases of activities. Each bar chart shall also indicate:
 - a) The monthly expenditure likely to be incurred.
 - a) Manpower at site (by major categories) to indicate monthly deployment of work force at site.
 - c) Pre-commissioning tests and commissioning PERT Net Work for various systems and sub-systems.
- **13.3** All PERT Charts, Bar charts and schedules of activities shall be fully integrated and co-related with master Net Work and with each other.
- **13.4** Bidder shall submit a detailed list of all the drawings/documents/write-ups/back up calculation/design memoranda/instruction manuals proposed to be released for the complete job, volume and section wise, giving titles and contents of each drawings and documents soon after the placement of order.

14.0 PROGRESS REPORTS

- 14.1 All the progress reports submitted shall be fully co-related with the schedules/ PERT networks and shall bring out clearly the shortfalls and proposed measures to cover up the shortfalls. Monthly progress report (six copies) shall be submitted on the status of following activities as on the last day of each calendar month so as to reach UPPTCL by 10th of the succeeding month:
- i) Procurement of equipment/material
- ii) Manufacturing
- iii) Testing and inspection
- iv) Dispatch of equipment/material
- v) Receipt of material at site
- vi) Site activities
- vii) Payment received.

The progress report shall be distributed as directed by the Engineer.

- 14.2 Civil works/Erection, testing and commissioning.
- i) The Bidder shall submit at such times and in such forms as may be desired by the Engineer, schedules showing the programme and order in which the Bidder proposes to carry out the work with dates and estimated completion time for various parts of the work, prior to starting the erection work. The Bidder shall also furnish the outline of organization that he will set up for completion of the work

according to the approved Erection/ construction schedules when so directed by the Purchaser.

- ii) During the progress of work the Bidder shall submit a fortnightly progress report with photographs where required and such other reports on the erection work construction and organization as the engineer may direct and will report deviation from approved programme with reasons thereof and proposed measures to cover up the shortfall. He shall also submit programme for the next month.
- iii) If for any reason the work is held up, the Bidder shall bring it to the attention of the Engineer in writing without any delay.

15.0 COORDINATION AND REVIEW MEETING

- **15.1** The Bidder shall be called upon to attend design/or other coordination meetings with the Engineer, during the period of contract. The Bidder shall attend such meetings as and when required and fully cooperate with such persons and agencies involved during these discussions.
- **15.2** The Bidder shall attend all coordination/review meetings as and when called for by the Purchaser at his own cost and shall fully cooperate with the various agencies involved in the execution of the project.

16.0 DESIGN AND DRAWINGS

16.1 SUBSTATION LAYOUTS & DRAWINGS

Immediately upon receipt of acceptance of letter of intent the Bidder shall furnish following drawings to the Purchaser :

- i) Single Line Diagram
- ii) Site Plan showing positions of switchyard, control room, offices, store, residences, roads ,lawns etc
- iii) Foundation, Earthmat and cable trenches drawing along with standard design drawings of main & auxiliary structures, cable trenches cross sections etc.
- iv) Electrical layout and Sectional drawing. The Purchaser shall review the above drawings. In case Purchaser wants to suggest some modifications either due to technical requirements or design improvement, the bidder shall submit revised drawing after incorporation of purchaser's suggestions.

16.2 EQUIPMENT/SYSTEM DRAWINGS

The Bidder shall submit drawings / literatures of all the equipments/ materials in duplicate to Engineer of Contract for his review and approval within a month of issue / acceptance of letter of intent.

The drawings to be submitted are specified under technical specifications of respective equipments. These shall necessarily include General arrangement drawing, foundation details, schematic wiring diagram, terminal blocks drawing where ever applicable, whether specified under technical specifications of respective equipments or not.

The control and protection schematics, cable interconnection and termination drawings between different equipments shall be prepared by the Bidder and shall be submitted in duplicate to Engineer of contract for his approval at least three months prior to commencement of cable laying and termination work.

The Bidder shall submit Switchyard and Control room lighting layout clearly showing different circuits, position of junction boxes, fuses, MCBs, model number wattage and make of lighting fixtures, routes of cable laid in switchyard and diagram of wiring carried out in different building mentioning cable sizes. Separate lighting layouts shall be submitted for all other remaining areas of the substation incorporating above features. The above drawings shall be submitted in duplicate to Engineer of Contract for his approval at least three months prior to commencement of lighting works.

The equipments / materials shall be supplied and work shall be carried out as per approved drawings.

The Contactor shall furnish two sets of each of above approved drawing / literature to the Consignee and two sets to Engineer of Contract within 10 days of respective approval.. The Bidder shall furnish two sets of schematic wiring diagrams and terminal block drawings of each equipment along with two sets of cable schedules & cable interconnection drawings to concerned Testing & Commissioning division within 10 days of respective approval

The Bidder shall also furnish two sets of Erection, testing, commissioning and O&M manuals of each equipment / system to Consignee, one set to concerned Testing & Commissioning Division and one set to the Engineer of Contract.

16.3 SUBMISSION AND APPROVAL OF DRAWINGS/DOCUMENTS

16.3.1 The Bidder shall follow a well defined coding system for proper and quick identification of all systems / sub-systems / equipments /assemblies / sub-assemblies / accessories/other plant material/spare parts/special tools and plants and drawings for the execution of the plant and later for its operation and maintenance.

Copies of coding documents defining the above shall be supplied along with drawings to understand the system.

- **16.3.2** All drawings submitted by the Bidder shall be in sufficient details to indicate the type, size arrangement, weight of each component, details for packing and shipment, the external connections, fixing arrangements, dimensions required for installation arrangement, dimensions required for installation and interconnections with other equipment and other information specifically, as called for in the drawing schedules. All the equipments tapping points etc. shall be numbered according to pre-determined scheme/ system which shall be subject to approval of Purchaser.
- **16.3.3** Each drawing shall be clearly marked with the name of the Purchaser, unit designation, UPPTCL's Contract No. 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 drawings shall be in English. All the dimensions should be in metric units.

16.3.4 If any dimension figures on a drawing or a plan differs from those obtained by scaling the drawing or plan, the dimensions as mentioned in figures on the drawing or plan shall be taken as correct.

16.4 Submission and distribution of drawings/ documents

All the drawings which do not require approval shall be submitted along with reproducible in required number and those requiring approval shall be initially submitted for comments/approval before submitting along with reproducible as per "Document Distribution Schedule".

17.0 APPROVAL OF DRAWINGS

- 17.1 The Purchaser shall return to the Bidder one set of drawings, plans and technical data requiring approval after marking them with their comments/ corrections, if any, either (a) marked 'Approved' or (b) marked 'Approved subject to incorporation of comments" or (c) marked 'Not Approved' with comments requiring resubmission of drawings etc. in 14 days or (d) marked 'Approval not required', where drawing is for information only. In case of (a) no further revision of drawings will be required. In case of (b) Bidder can proceed with the work but will resubmit the drawings incorporating the corrections as per comments only within fourteen (14) days. In case of (c) Bidder can proceed with the work only after resubmitting the drawings within fourteen (14) days and getting approval under (a) or (b) categories above. In case of (d) the Bidder drawing is deemed to have been received only for information purpose.
- **17.2** The Purchaser shall have the right to ask the Bidder to make any change in the design/drawing which may be necessary to make equipment conform to the provisions and intent of the contract, without any extra cost to the Purchaser.

The drawings submitted shall be re-viewed by the Purchaser and shall be modified by the Bidder as required. The Bidder shall incorporate such modifications and/or corrections and submit the final drawings for approval/reference.

- **17.3** No deviation from the approved drawings shall be permitted without the written approval of the Engineer
- 17.4 The review of drawings/ data by the Purchaser will cover only general conformance of the data of the specifications and document, interfaces with the equipment provided under the specifications, external connections and the dimensions which might effect substation layout. This review by the Purchaser may not indicate thorough review of all dimensions, quantities and details of the equipment, wiring, 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 Bidder, as limiting any of his responsibilities specified under these specifications and documents.

Approval/ comments conveyed as above shall neither relieve the Bidder of his

contractual obligations and his responsibilities for correctness of dimensions, material of construction, quantities, design details, assembly fits, performance particulars, guarantees and conformity of the supplies with the specifications, schemes, systems and statutory laws, nor does it limit the Purchasers right under the contract.

- 17.5 Should any minor revision be made after 'approval', at the time of erection/ commissioning the Bidder shall redistribute prints and reproducible, clearly certifying the changes incorporated in the drawing and marking it in a block. Every revision shall be marked by a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.
- 17.6 The Bidder shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors and omissions in the drawings or other particulars supplied by him, whether such drawings or particulars have been approved by Engineer or not..

No extension of delivery periods shall be granted on this account.

18.0 NAME PLATE, MARKING OF PARTS, LABELS

- **18.1** All equipment shall have metal name plates fixed in suitable position with full particulars engraved legibly thereon, and not painted.
- 18.2 Each main and auxiliary item of plant is to have permanently attached to it, in a conspicuous position, a rating plate of non corrosive material upon which is to be engraved identifying manufacturer's name, equipment type or serial number, rating together with details of the loading/operating conditions under which the item or plant in question has been designed to operate and such diagram plates as may be required by the Engineer.
- **18.3** Each item of plant is to be provided with a name plate or label designating the service of the particular equipment. These inscriptions are, to be approved by the Engineer or as detailed in the appropriate sections of the technical specifications.
- **18.4** Such name plates or labels are to be white non hygroscopic material with engraved block lettering or, alternatively, in the case of indoor equipments, of transparent plastic material with suitably coloured lettering engraved on the back.
- 18.5 Each equipment in switchyard will have a clear marking of the name of bay, identification number, name of equipment. Such plates are to be fixed on control boxes of respective equipment to facilitate identification during routine operation/maintenance. A name plate giving name of bay shall be fixed at suitable location for identification of each bay.
- **18.6** All such name plates, instruction plates, lubrication charts, etc. shall be bilingual with Hindi inscription first followed by English. Provisions shall be made to fit in name plates, lubrication/connection diagram plates etc. .
- **18.7** In order to facilitate identification, the parts of the equipment shall be suitably marked.
- **19.0 INSTRUCTION MANUALS**

- **19.1** The Bidder shall submit to the Engineer 'Descriptive Manuals', i.e. system design concept, detailed catalogues of equipment and typical equipment instructions for this project, for all major systems and equipment, covered under this contract along with dispatch of equipment. These initial copies of descriptive manuals shall be in sufficient details, bringing out detailed internal construction, characteristics, performance parameters, principles of operation, maintenance requirements, replacement and renewals needed, erection and overhauling procedure, testing and operation procedure etc. for various equipment.
- **19.2** The integrated instruction manuals, fully defining the interfaces between various systems and complete in all respects shall be submitted by the Bidder one month before scheduled date of commissioning. The instruction manuals shall contain full details of designation and drawings of all the equipment furnished, the erection procedure, testing procedure, operation and maintenance procedure of the equipment, single line diagrams, and schematics. After the commissioning and initial operation of the plant, modifications/ additions/changes, wherever required shall be incorporated in the instruction manuals and drawings shall be submitted by the Bidder to the Purchaser.
- **19.3** The manuals shall be specific to the equipment supplied and not of general nature.

20.0 DOCUMENTS AND ERECTION DRAWINGS

The Bidder shall submit within a reasonable time but at least four (4) weeks before dispatch of equipment (as per distribution schedule) the following drawings/ documents and instruction manuals etc. to the consignee and the Engineer.

- i) List of item-wise equipment as proposed to be dispatched by the Bidder.
- ii) Erection drawings along with reproducible prints of each drawings.
- iii) Instruction books for proper handling/ checking of material on receipt at site/storage, erection and assembly of all equipment and necessary instruction for checking and recording proper assembly of the plant.
- iv) Instruction sheets for proper balancing, alignment, adjustment, checking and calibrations as may be necessary.
- v) Descriptive literature and drawings to illustrate the working principals, methods of assembly and dismantling of plants and equipment.
- vi) Testing/commissioning format for recording data during erection/testing/ commissioning and trial run. These formats/data sheets shall clearly indicate the results obtained during shop tests and permissible deviations.

21.0 FURNISHING OF AS BUILD DRAWINGS , LAYOUTS AND MANUALS

Notwithstanding any drawing, layout ,manual submitted earlier, the Bidder shall furnish four sets of following as build drawings ,layouts, manuals etc along with

their reproducible to the Purchaser one month prior to the handing over of substation;

(i) Single line diagram, Foundation Earth mat and Cable trenches layout, Electrical layout, Sectional drawing, Control / Relay / Battery / Carrier room drawings showing positions of panels etc.

Cable schedules and diagrams of cable interconnections between different equipments clearly showing cable numbers, terminal numbers, ferrule numbers and the purpose.

- (ii) Drawings of all equipments as detailed in technical specifications of respective equipments necessarily including schematic drawings and terminal block drawing where ever applicable whether mentioned in respective technical specifications or not.
- (iii) Switchyard and Control room lighting layout clearly showing different circuits, position of junction boxes, fuses, MCBs, model number wattage and make of lighting fixture, routes of cable laid in switchyard and diagram of wiring carried out in different building mentioning cable sizes.
- iv) Commissioning test results of all the equipments.
- (v) Erection, testing, commissioning, operation and maintenance manuals of all equipments/ systems and subsystems.
- (vi) Any other relevant drawing, layout or/and manual asked for by Purchaser.

In case Purchaser asks for any clarifications / explanation in respect of above drawings, layouts, manuals etc the Bidder shall promptly clarify/ explain the matter to full satisfaction of the Purchaser.

22.0 TESTING AND COMMISSIONING ACTIVITIES

The Bidder shall keep concerned Transmission division and Testing & Commissioning Division fully informed of testing and commissioning activities being undertaken by them.

The Bidder shall inform in writing to the Executive Engineers of respective Transmission Division and T&C Division of the scheduled weekly programme of carrying out testing and commissioning of various equipments/ systems/ subsystems. The programme of the next week must be informed at least four working days prior to commencement of that week.

The testing and commissioning must be carried out in presence of their representative unless allowed otherwise by them.

The copies of test results and commissioning report must be promptly furnished to the Transmission and T&C divisions.

23.0 MATERIAL QUALITY

23.1 All materials used in construction of the equipment/plants/works shall be new and shall comply with the standards and codes specified and shall be selected from the best available, considering strength, durability and engineering practices. It will not

deteriorate or distort under the prevailing extremes of atmospheric conditions and under the extreme service parameters. Where material/ workmanship have not been specifically described in these specifications the Bidder shall specifically obtain approval of the Engineer. The proposal for obtaining the approval shall clearly bring out the merit and demerit.

- **23.2** The workmanship and design shall be in accordance with the best engineering practice and shall be such as have been proved to be suitable for the intended purpose and for giving satisfactory performance under the prevailing climatic conditions and proposed system of supply. Liberal factors of safety shall be used throughout the design and special consideration shall be given for part subject to alternative stresses or shocks under service/operating conditions.
- **23.3** All consumables, lubricants, grease, control fluids etc. required for erection, operation, testing & commissioning shall have Indian equivalents, which can also be mixed with original lubricants for make-up purpose.

23.4 RAW MATERIAL :

The Bidder shall himself be responsible for timely arrangement/ procurement of all the raw materials required for the manufacture of all Bided items and shall furnish their test certificates to the Purchaser. However, depending on the policy of the Govt. of India, Corporation may issue essentiality certificates, for arrangement of such raw materials through CEA, DOE, DGTD or other, who may allot the same to the Bidder, at their discretion directly from any of the producers of such raw materials or other sources, but without any financial liability to the Corporation of affecting / linking the delivery of the equipment with the availability of raw material against such certificates or recommendations.

23.5 QUALITY CONTROL, PROGRAMME

To ensure that the equipment construction work and the services covered under this job are in accordance with the specifications and conform to the high standard of workmanship, it is obligatory on the part of the Bidder to adopt a suitable quality control program. Such a program shall include suitable hold point for check, for major equipments during manufacture at supplier's work during erection at site, and during the construction stage such that material checks for attaining proper strength and dimensional checks for attaining close tolerances required for equipment installation can be obtained.

In order to attain the above objectives, the Bidder shall draw out a plan listing all quality control checks in detail, including all hold points at which the quality checks shall be applied, also specifically mentioning those hold points where the Purchaser shall also participate in the quality check to assure him of the quality of the products supplied. Such a program shall be outlined by the Bidder for the acceptance by the Purchaser. The Bidder shall furnish detailed information regarding his quality control program and its strict implementation. Following information shall be included in the proposal along with others regarding quality control program.

- I. The quality control organizations and the proposal of its implementation.
- II. The system for controlling drawings and documents for correctness.

- **III**. The system of quality control for raw materials, process control, and maintaining tolerances during manufacturing, assembly and fabrication.
- IV. Quality control during purchase of components, sub- systems and assemblies.
- V. Methods for ensuring selection of proper vendors/ sub-vendors.
- VI. Inspection of testing at shop after assembly.
- VII. Control of accuracy during calibration of measuring and testing equipments.
- VIII. Preservation and quality control during the transit.
- **IX.** Procedure for inspection before erection and quality control during erection.
- **X.** System for storage and delivery.

Bidder shall be wholly responsible for the quality control and quality assurance for the manufacture, supply, erection, testing and commissioning etc.

23.6 During inspection, destructive testing and non destructive test evaluation shall be done, wherever applicable, in presence of Purchaser's representative in accordance with established norms. Directions of Purchaser shall be rigorously followed.

24.0 INSPECTION AND TESTING

- 24.1 The Purchaser reserves the right to inspect any machinery and material to ensure that approved Q.A.P. is being strictly implemented by the Bidder or his Sub Bidder / Supplier under this contract, and to reject any item found defective in workmanship or design, or otherwise unsuitable for the use and purpose intended or which is not in accordance with the intent of this contract. The Bidder should, on demand by the Purchaser, rectify or replace such defective or unsuitable equipment, or the Purchaser may, at the Bidder's expense, rectify or replace such defective or unsuitable equipment, whether before or after supply
- 24.2 That Bidder shall, for purpose of clause 15 of the annexed conditions of contract Form-A inform to the Purchaser places of manufacture, testing and inspection of various equipment offered by him. Unless specifically provided otherwise, all tests shall be carried out at the Bidder's work or for brought out items at sub-vendors works, before dispatch.
- 24.3 The Bidder shall advise the Purchaser at least 4 weeks in advance as to when the equipment will be ready for stage/ final inspection at the Bidder's work or at his Sub-Bidder's works

24.3.1 PENAL CHARGES

In case the equipment is not available for inspection at the time of arrival of inspection officers, the Bidder shall pay to UPPTCL towards futile journey a sum decided by Chief Engineer (Design & Procurement), UPPTCL and demanded by

"Engineer of Contract". This amount shall be paid within 10 days form the date of demand, Further action for inspection of the material shall be taken only after the said amount is deposited

24.4 During inspection the Purchaser's Inspecting Engineers at all time have access to all part of shops where the equipment is being manufactured and also shall be provided with all reasonable inspection facilities by the Bidder and / or sub-Bidders.

Even without scheduled inspection, the Engineer and/or his duly authorized representative shall have at all reasonable times access to the Bidder's premises, works or site and shall have the power to inspect and examine the materials and workmanship of the works during it's manufacture or erection.

- 24.5 All plants equipment/ parts, sub assemblies/ assemblies shall comply with the requirement of type tests and shall be subjected to the routine/ acceptance tests specified in the set of standards adopted and to such other tests as are stipulated in the respective technical specifications. The Purchaser reserves to himself the right of having at his own expense any inspection or special test of a reasonable nature at Bidder's premises or at site, in addition to those prescribed in applicable standards and the enclosed technical specifications.
- 24.6 The Engineer shall either depute his representative to witness the tests as applicable and inspect the material or shall waive the inspection. In case of waiver the Bidder or his sub-Bidder shall carryout the all applicable tests in absence of Purchaser's representative. In both the cases i.e. either inspection or waiver the test certificates shall be submitted to Engineer of contract for approval and issue of dispatch authorization In case of inspection the test certificates must bear signatures of the Purchaser's inspecting officer..

The Engineer of contract, within 10 days of receipt of test certificates, shall issue .approval/ dispatch authorization if test certificates are found satisfactory

In case test certificates are not found satisfactory the Engineer of contract, within 10 days of receipt of test certificates, shall communicate his objections and actions required to be taken in writing to the Bidder. The Bidder shall take remedial action and shall re-submit the test certificates or re-offer the material for inspection as asked for by the Engineer. Subsequent actions shall follow as in case of fresh offer for inspection. No extension of delivery / completion period shall be granted on this account.

24.7 REJECTON :

Purchaser reserves the right to reject any equipment if during the tests at works or site, the test value achieved do not comply with the respective standard/ specifications and exceeds that tolerable limits. Rejection of any equipment will not be held as a valid reason for delay in timely completion of the work

24.8 No equipment, to be furnished or used in connection with this contract shall be dispatched, until factory inspection and acceptance test have been carried out

satisfactorily and dispatch authorization issued by Engineer of Contract. Such factory inspection of the equipment or approval of acceptance tests shall not however, relieve the Bidder from full responsibility for supplying equipment conforming to the requirements of this contract, nor prejudice any claim, right or privilege which the Purchaser may have because of the use of defective or unsatisfactory equipment should Purchaser waive the right to inspect any equipment, such waiver shall not relieve the Bidder any way from his obligations under this contract. The inspection/waiver by Engineer and/ or approval of test certificates shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed quality assurance program, and the desired performance of the equipment.

24.9 In all cases where the contract provides for tests whether at the premises or works of the Bidder or of any Sub-Bidder, the Bidder shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably required to carry out effectively, such tests on the equipment in accordance with the contract and shall give facilities to the Engineer or to his authorized representative to accomplish inspection.

All the expenses incurred for testing including material consumed in testing shall be to the Bidder's account

- 24.10 Purchaser will not entertain any request for waiver of inspection on the ground that sub-vendors are not agreeing for the Purchaser's inspection. It is the responsibility of the Bidder to ensure that all the requirements of the Purchaser as envisaged in the technical specifications are incorporated.
- 24.11 The Bidder is required to record the following certificates on the invoices and challan of each and every consignment:

"Certified that material being dispatched against the above invoices and challan has been inspected and tested by the representative of Engineer of the contract on (date) and all the test results were satisfactory, as per approved test certificate enclosed."

Or

Certified that inspection of material being dispatched against the above invoice and challan has been waived off by Engineer of Contract vide letter No......Dt.....Dt....... (Copy enclosed) and all the acceptance and routine tests as per relevant standards and those provided in Contract, have been conducted and all the test results were found satisfactory as per test certificates enclosed."

25.0 PACKING

- **25.1** All equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of transportation facilities s in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.
- **25.2** The Bidder shall include and provide for security protection and packing the plant so as to avoid loss or damage during transport by any mode.

- 25.3 All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'up' and 'down' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the engineer.
- **25.4** The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
- **25.5** Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.
- **25.6** Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
- 25.7 All equipment/material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- **25.8** Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- **25.9** Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

26.0 DESPATCH OF EQUIPMENT

- 26.1 Detailed dispatch instructions will be intimated to the Bidder. All materials shall be dispatched by road.
- 26.2 The Bidder shall intimate, at least thirty (30) days in advance to the consignee as well as the concerned Superintending Engineer at site, the probable date when the equipment will be ready for dispatch from the works. Notification of delivery or dispatch in regard to each and every consignment shall be made to the Purchaser immediately after dispatch or delivery. The supplier shall further supply to the consignee a priced invoice and packing account of all stores delivered or dispatched by him. All packages, containers, bundles and loose materials forming

parts of each and every consignment shall be described fully in the packing account, and full details of the contents of packages and quantity of material shall be given to enable the consignee to check the stores on arrival at destination.

26.3 A list in duplicate containing details of equipment for verification at site shall also be placed inside each package and shall correspond with the advice note. One additional copy of each of the package lists shall also be sent to the consignee.

27.0 ADVANCE BANK GUARANTEE

The Bidder shall submit an unconditional, irrevocable Bank Guarantee from any Scheduled Bank for an amount of 110% (one hundred ten percent) of the amount of mobilization advance on non judicial stamp paper with value of Rs.5/- per thousand subject to maximum of Rs.10,000/- in the favour of "Superintending Engineer, Electricity Sub-station Design Circle-I, UPPTCL, 13th Floor, Shakti Bhawan Extension, Lucknoe" in the Performa annexed with validity up to 3 months after schedule completion period with 6 month claim period thereafter. This bank guarantee shall be known as advance bank guarantee. The bank guarantee shall be extended from time to time for any extensions in completion of substations.

28.0 PERFORMANCE SECURITY GUARANTEE:

- **28.1** The guarantee period of all the equipments (except Transformer) shall be 12 months from the date of taking over of plant as specified in Form 'A'. The date of taking over shall be the date of commissioning of S/s suitable for commercial use or 100% completion of electrical & Civil works which ever is later.
- **28.2** Damages for not meeting above performance guarantee shall be assessed and recovered from the Bidder at predetermined rates to be communicated by Engineer of contract.
- **28.3** Deposit for performance guarantee:

The Bidder shall deposit an amount of 10% (Ten percent) of the contract value on non judicial stamp paper of Rs.5/- per thousand subject to maximum of Rs.10,000/- in the favour of "Superintending Engineer, Electricity Sub-station Design Circle-I, UPPTCL, 13th Floor, Shakti Bhawan Extension, Lucknow" by way of bank guarantee issued by any Scheduled Bank in the approved Performa within twenty eight (28) days of the issuance of LOI, which should remain valid till one year after the commissioning of the substation or completion of substation in all respect whichever is earlier. Further before release of this bank guarantee, fresh bank guarantee equivalent to 10% cost of power transformers shall have to be deposited which shall remain valid for further period of four years and claim period of six months thereafter. The bank guarantee shall be extended from time to time for any extensions in guarantee period.

29.0 RESPONSIBILITY OF THE BIDDER FOR COMPLETENESS OF CONTRACT :

- **29.1** The Bidder shall be entirely responsible for the execution of the contracts in all respect in accordance with the terms of the General Conditions of the contract Form A, Technical Specifications and Schedules attached hitherto.
- **29.2** The Purchaser shall have the right to require the Bidder to make any changes in the general arrangement which may be necessary in the opinion of the Engineer to make the equipment to conform to the provisions and the intent of the contract specification without additional cost to the Purchaser.
- **29.3** Inspection carried out by Engineer and approved by the Engineer of the Bidder's/Sub-Bidder's drawings or of the materials or of other parts of the works involved in the contract or of tests carried out either by the Bidder or by the representative of the Purchaser shall not relieve the Bidder of any part of the Bidder's obligations in meeting all the requirements of the technical specification or of the responsibility for the correctness of Bidder's drawing and documents.
- 29.4 The equipment offered by the Bidder shall be complete in all respect with all mountings, fittings, fixtures and standard accessories, terminal connectors etc normally supplied with such equipments even though not specifically detailed in the specifications but essential for proper design, efficient operation and maintenance at no extra cost to the Purchaser unless specifically mentioned to be excluded in the list of excluded items of the contract. In the event of any controversy the decision of the Engineer of the contract shall be final and binding.
- **29.5** The scope of work under this Contract shall also include all such items which are not specifically mentioned in proposal/ contract but are necessary for completion of the substation, unless otherwise specifically excluded in this Contract.

30 PATENTS:

The Bidder shall pay all royalties and license fees and shall have the Purchaser harmless from loss or annoyance on account of over sight or claims of any kind, for violation or infringement of any letters of patent rights by the Bidder or any one directly or indirectly employed by him by reason of the use by him or them of any part, machine, manufacture and composition of material on the works in violation or infringement of such letters of rights.

31.0 INSURANCE :

31.1 The Bidder at his cost shall arrange, secure and maintain insurance as may be necessary and for all such amounts to protect his interests and interest of the Purchaser, against all risks during transit, storage at site and erection, testing and commissioning as detailed herein. The form and the limit of such insurance as defined herein together with the underwriter thereof in each case shall be as acceptable to the Purchaser. However, irrespective of such acceptance the responsibility to maintain adequate insurance coverage at all times during the period of contract shall be that of the Bidder's alone. The Bidder's failure in this regard shall not relieve him of any of his contractual responsibilities and obligations.

- **31.2** The titles of equipment and material, supplied by Bidder or Sub-Bidder to UPPTCL, shall pass on to UPPTCL on ex-works dispatch basis. The transfer of title to UPPTCL shall not in any way relieve the Bidder of his responsibilities during the period of contract. Any loss or damage to the equipment during handling, transportation, storage and erection, testing and commissioning shall be to the account of the Bidder. The Bidder shall be responsible for preferring of all claims and making good for the damage or loss by way of repairs and/ or replacement of the portion of the works damaged or lost. The Bidder shall provide the Purchaser with a copy of all insurance policies and documents taken out by him in pursuance of the contract. Such copies of the documents shall be submitted to the Purchaser immediately after such insurance coverage is taken The Bidder shall also inform the Purchaser in writing at least sixty (60) days in advance, regarding the expiry, cancellation and/or change in any of such documents and insure revalidation/renewal etc. as may be necessary well in time.
- **31.3** The risks that are to be covered under the insurance shall include but not limited to, the loss or damage in transit, theft, pilferage, riot, civil commotion, weather conditions, accidents of all kinds, fire, war risk (during ocean transportation only) etc. The scope of such insurance shall cover the entire value of the works from time to time.
- **31.5** Third Party Risk and Public Liability Insurance The Bidder shall take necessary insurance to indemnify third party risk arising out of the work and its operation to be done by him at his own cost. The Bidder shall also take public liability and property damage liability insurance cover for the entire period of construction as well as operation & maintenance period as given below:
- **31.6** Public Liability and Property Damage Liability Insurance covering all operations under the contract.
 - a) Limit for bodily injury or death up to and including Rs.2,00,000/- for one person and Rs.5,00,000/- for each accident or incident.
 - **b)** Limits for property damage up to and including Rs.5,00,00,000/- (i.e. Rs. 5 Crores) for each accident or incident.
- **31.7** Automobile Liability Insurance

On all self propelled vehicles used in connection with this contract, whether owned, non-owned or hired by the Bidder, limits of insurance shall be as follows:

- i) For public liability up to and including Rs.2,00,000/- for one person and Rs.5,00,000/- for each accident or incident.
- ii) For property damage up to and including Rs.2,00,000/- for each accident or incident.
- **31.8** The insurance shall remain valid till 45 days after date of taking over of the Substation.

32.0 TRAINING OF ENGINEERS

It shall be the responsibility of the Bidder to impart training to Purchaser's engineer without any cost to the Purchaser i.e. free of cost for 50 man weeks inclusive of all equipment/systems; periods for various equipments to be mutually agreed between the Bidder and the Purchaser under this job. Suitable documentation, drawing and spare part details etc. shall be made available by the Bidder to the trainees so as to fully equip them for preventive maintenance, capital maintenance and overhaul of various equipments independently and with precision and speed. The Bidder shall submit a proposal for training covering a total of 50 man weeks inclusive of those specified elsewhere, covering recommended man weeks for design, operation, and maintenance of each type of major equipment/system, for the approval of Engineer before taking up the Training programme.

All expenditure on travel and stay for the trainees shall be borne by the Purchaser. The Bidder shall make all suitable arrangements for stay of the trainees at their works/offices. It is important that during training free-exchange of know-how is provided so that the trainees are made fully conversant with the design, operation and maintenance of the plant/systems.

33.0 SPARE PARTS

- **33.1** Bidder shall recommend a set of spare parts required for normal maintenance of each equipment offered for a period of five years along with price of each spare part which shall remain valid for at least three years from the complication of guarantee period. The Bidder shall supply the spare parts promptly as and when required at reasonable prices through-out the useful life of the equipment.
- **33.2** The Bidder shall further guarantee that, if he goes out of production of spare parts then he will make available blue prints, manufacturer's drawings of spare parts and specifications of materials and any other details sufficient for manufacture of such spare parts at no cost to the Purchaser, to enable the Purchaser to fabricate or procure spare parts from other sources. Such fabrication or procurement of spares shall not constitute any infringement to the patent rights of the Bidder/ Sub-Bidder and shall not subject the Purchaser to payment of any royalty or other pecuniary benefits etc. The Bidder will adopt modern and efficient spare parts management system during the entire period since receipt of the spares at site.

34.0 LOCAL CONDITIONS

- 34.1 The Bidder is deemed to have informed himself of all local conditions and factors which may have any effect on the execution of the works covered under these documents and specifications. The Bidder is deemed to have familiarize himself with the Income Tax Act 1961, the Companies Act, 1956, Customs Act 1962, and other related acts and laws with latest revisions prevalent in India.
- **34.2** The Bidder shall obtain and pay for all permits and licenses or other privileges necessary to complete the work, certificate of which shall be delivered to the Engineer and will become the property of the Purchaser.
- 34.3 The laws, rules and regulations of all Government authorities in India, having

jurisdiction over the work shall govern the work of this contract with the same force and effect as if incorporated in full into the Contract Documents. Where such laws, rules and regulations conflict with the contract documents the more-stringent requirements as interpreted by the Engineer shall govern. Should such conflict require changes in the contract documents, the Bidder shall promptly notify the Engineer.

35.0 CONSTRUCTION MACHINERY

The Bidder shall bring his own construction/erection machinery for construction, erection and commissioning of plant.

36.0 RESPONSIBILITY OF ERECTION/WORKS

- **36.1** The erection work shall be carried out under the supervision of the engineer or his authorized representative. The Bidder may obtain technical assistance from the specialists of the manufacture of plant and equipment for proper erection but the responsibility for quality of workmanship will rest with the Bidder.
- **36.2** The Bidder shall keep competent representative(s) constantly in charge of construction and erection work on the premises during working hours. He shall arrive at site at least two weeks in advance of start of work to acquaint himself of the local conditions and to set up his site office and erection organization. He shall obtain the approval of the Engineer wherever necessary, shall receive and comply with his direction, carry out work according to approved drawings, specification and supervise the work of all men employed by the Bidder or his Sub-Bidder. He shall inform the Engineer of any inconsistency or discrepancy that may appear in drawings, and specifications and will resolve it to the satisfaction of the Engineer.
- **36.3** The Bidder's representative at site shall not be withdrawn without the previous consent of the engineer in writing.
- **36.4** If in the opinion of the Engineer the progress of erection work by the Bidder at any stage needs expedition so as to ensure completion of work within the stipulated time, the engineer shall have the right to instruct the Bidder to increase the Bidder's manpower in appropriate categories and/or the working hour per day and/or erection equipment and the Bidder shall comply with these instructions forthwith.

37.0 EXTRA WORK SHIFT

Night work shall be permitted with the written approval of the Engineer. The Engineer may also direct such extra shift for the Bidder to ensure completion of contract on schedule if in his opinion such work is necessary.

38.0 CARE OF FINISHED WORK

- **38.1** The Bidder shall effectively protect the work from action of weather and from damage or defacement and shall cover finished parts wherever required for their thorough protection. Face work shall be perfectly clean and free from defects.
- **38.2** The Bidder and his Sub-Bidder(s) shall be responsible during the execution of their work for protection of the works which has been completed by others. Suitable

means shall be used to protect finished work when moving equipment over it.

39.0 CLEANING UP OF WORK SITE

- **39.1** During erection, the Bidder shall without any additional payment, at all times keep the working and storage areas used by him free from accumulation of waste materials or rubbish. Upon completion of erection, he shall remove or dispose of in a satisfactory manner all temporary structures, waste and debris and leave the premises in a condition satisfactory to the Engineer.
- **39.2** All stripped wooden packing of the equipment shall become property of the Purchaser and they shall be delivered to the Purchaser as directed.

40.0 BIDDER'S EMPLOYEES AT SITE

- **40.1** The Bidder shall provide, at the proper time the necessary erectors, workmen, supervisors and other personnel duly qualified and experienced and in sufficient number for the erection, testing and commissioning and two years successful operation of the plant. The qualification and experience of different categories of personnel will require prior approval of the Purchaser.
- **40.2** The Bidder shall employ, at least one competent representative, whose name, qualification and experience shall have previously been communicated in writing to the Engineer by the Bidder for prior approval to supervise the erection of the plant and the carrying out of the works. The said representative or if more than one shall be employed, then one of such representatives shall be constantly present on site during working hours and any written orders or instructions which the engineer or his duly authorized representative whose name shall have been previously communicated in writing to the Bidder, shall be deemed to have been given to the Bidder.
- 40.3 The Engineer shall be at liberty to object to the representative or any person employed by the Bidder in the execution of the works, who shall misconduct himself or be incompetent or negligent and the Bidder shall remove the person so objected to, upon the receipt from the engineer, notice in writing requiring him to do so, and shall provide in his place a competent representative to be employed for the purpose of the work at site shall be made available when the Purchaser shall inform the Bidder in writing to that effect. The service of the Bidder's representative shall be made available for such period as the Engineer may require and he shall work at all reasonable times as may be necessary to complete the work within the period specified in the contract.
- **40.4** Bidder's representatives/employees shall abide by all general regulation, in force on the site and to any special conditions affecting the local administration, issued by the Purchaser or his duly authorized representative. All the employees of the Bidder living on the land belonging to the Purchaser shall be deemed to be aware of all dangers and risks incidental to the activities of the Purchaser and other Bidders and the conditions of the Purchaser's land and work from time to time, and the Purchaser will not be responsible for any injury arising there from. The Bidder shall discharge all the obligations under the Indian workman's compensation act and labour laws so far as it will affect the work under his control.

40.5 Employee identification

The Bidder or his representative shall present his employee identification to the Engineer. Suitable method of identification shall be developed by the Engineer/ Purchaser and the Bidder shall comply with the same.

41.0 **REPLACEMENT OF DEFECTIVE PARTS/ EQUIPMENTS/WORKS & RECTIFICATION OF DEFECTS:**

In case any defect is discovered during installation, testing and commissioning of equipment at site, the Bidder at his own cost shall rectify the defect/ replace the equipment or material promptly as to achieve the commissioning schedule.

In case any defect is discovered at site after taking over of the Substation by the Purchaser in the materials supplied or works done by Bidder, the Bidder at his own cost shall rectify the defect/ replace the equipment or material promptly as soon as informed by the Purchaser.

42.0 SURPLUS MATERIALS

42.1 On completion of work all the material left surplus from those supplied by the Bidder under the contract for which payment has been claimed shall be handed over to the Purchaser at site stores in good condition. The Bidder shall give full details of the materials supplied by him, quantities utilized on works (based on the applicable drawings) and the balance returned to the Purchaser and shall obtain a clearance certificate within one month after completion and taking over of the Substation. The returning of material and rendering of accounts for the material is a precondition for release of payment against final bills and also the deposit towards performance at later date.

In the event of surplus material being lost, destroyed or damaged while being in Bidder's custody before being taken over by the Purchaser, the Bidder shall be liable to make good the loss. In case the Bidder fails to return the balance surplus material, the cost shall be recovered from the Bidder's pending bills, bank guarantees or by any other available means.

42.2 Any material handed over to the Bidder by Purchaser shall also be returned by the Bidder to the Purchaser at the time of handing over of the Substation. The provisions specified at above clause 42.1 shall also be applicable for such materials.

43.0. WITHHOLDING OF PAYMENTS

The Purchaser may withhold the whole of or part of any payment due to the Bidder, for reasons including but not limited to the following :

- i) Non furnishing of drawing, manuals, documents such as project implementation schedule, progress reports, dispatch intimations, packing lists, erection, testing. commissioning intimations ,test reports etc
- ii) Defective work not remedied or guarantees not met.
- iii) Claims filed against the Bidder

- iv) Failure by the Bidder to make due payments for the material or labour employed by him.
- v) Damage to another Bidder directly employed by the Purchaser.
- vi) Insufficient progress.
- vii) Surplus material not returned.

When the grounds for withholding payments are removed, payments of the amounts due to the Bidder shall be made by the Purchaser.

44.0 NOTICE TO BIDDER

- 44.1 Any notice to Bidder as the Purchaser deems fit shall be served through registered post at registered or present office/ mailing address incorporated in the contract.
- 44.2 All such postings shall be deemed good service of such notices and the time mentioned in the conditions for doing any act after the notice shall be reckoned from the date on which such notice shall reach to the Bidder in normal course.

45.0. JURISDICITON

All disputes arising out of and touching or relating to the subject matter of contract shall be subject to the jurisdiction of Local Courts at Lucknow under the High court of Judicature at Allahabad only.

TECHNICAL SPECIFICATIONS FOR HANDLINGING, ERECTION, TESTING AND COMMISSIONING.

INDEX

- **1.00 SCOPE**
- 2.00 STANDARDS FOR ERECTION & COMMISSIONING
- 3.00 ERECTION OF MAIN GALVANISED STEEL STRUCT

AND AUXILIARY STRUCTURES

- 4.00 STRINGING OF BUSBARS
- 5.00 ERECTION OF EQUIPMENTS
- 6.00 LAYING OF EARTH MAT & EARTHING OF EQUIPMENT WITH THE MAIN EARTH MAT
- 7.00 SPECIFIC REQUIREMENT FOR EARTHING SYSTEM
- 8.00 GENERAL NOTES ON EARTHING
- 9.00 CABLE LAYING & TERMINATIONS
- 10.00 ERECTION OF METERING SYSTEM & SCADA
- 11.00 ERECTION OF ASSOCIATED SYSTEMS
- 12.00 TESTING AND COMMISSIONING

TECHNICAL SPECIFICATIONS FOR HANDLING, ERECTION, TESTING AND COMMISSIONING

1.00 SCOPE

This specification covers the handling, storage of material at site, erection, testing, commissioning, operation & handing over of all the equipment/sub systems/systems and complete sub-station as a whole on turn-key basis. The Bidder shall receive and store all the equipment at site on behalf of the Purchaser in storage yard/stores/sheds and transport the material to erection site and shall carryout erection, testing and commissioning of all equipment and accessory items as required. The Bidder shall be required to complete the work as per the completion schedule defined in the contract and the approved PERT chart.

- **1.01** In general the scope of work may be grouped as below :
 - (a) Design & Engineering, Preparation of layouts / drawings / cable schedules / inter connections etc.
 - (b) Unloading, handling & storage of all equipments & materials.
 - (c) Erection of 220/132/33 KV equipments (i.e. transformers, breakers, SAS system etc.etc.) and their inter connection with conductors (Jumpering).
 - (d) Erection of 250 KVA station transformers & marshalling boxes, along with laying and terminations of power cables.
 - (e) Erection of auxiliary power supply system including AC Distribution
 - Boards along with laying & terminations of power cables.
 - (f) Erection of 110 Volts batteries, battery charges and D.C. Distribution
 Boards.
 - (g) Erection of Energy Meters
 - (h) Erection of illumination system including its cable laying & terminations.
 - (i) Erection of Air Conditioning and ventilation system
 - (j) Erection of Fire protection system.
 - (k) .Erection of D.G. set.
 - (l) Erection of Mulsifyre system.
 - (m) Control Cable laying & terminations for complete sub-station
 - (n) Complete Civil Works as per civil works specifications.
 - (o) Testing & commissioning of complete sub-station installation, putting into Operation.
 - (p) Training to Purchaser's personnel including operating staff.
 - (q) Any other work required to complete the sub-station but not specifically mentioned.
- **1.02** The specific parameters such as ratings, dimensions of equipments/ panels / SAS panels, conductor types, earthing rod / flat sizes etc given hereinafter are subject to change as per actually procured equipment & approved design/ drawings.

2.00 STANDARDS FOR ERECTION & COMMISSIONING :

The erection, testing and commissioning of equipment covered by this specification shall comply with the latest editions of the relevant standards and code of practice. Some of the applicable standards are given below:

i)	Installation and maintenance of	IS:3072
iii)	ACSR conductors	IS: 398
iv)	Fittings for ACSR conductors	IS: 2121
v)	Current transformers	IS: 2705
vi)	Voltage transformers	IS: 3156
vii)	Lightning arrestors	IS: 3070
viii)	Power transformers	IS: 2026
		IS: 3639
ix)	Code of practice for installation and	IS: 10028
	maintenance of transformers	
x)	Circuit breakers	IS: 13118
xi)	Code of practice of structural steel	IS: 800
xii)	Code of practice of earthing	IS: 3043
xiii)	Code of practice for the protection of	IS: 2309
	buildings and allied structures	
	against lightning	
xiv)	National Electricity Safety code	IEEE: 80
xv)	Guide for safety procedure & Practices work	in electrical

- 2.01 The electrical installation shall meet all requirements of latest Indian Electricity Rules, Fire Insurance Regulations and other rules of local statutory bodies.
- 2.02 The Bidder shall erect, install, site test and place into commercial use all the equipment / systems in accordance with the manufacturer's specific installation instructions and as per approved drawings./documents
- **2.03** Equipment shall be installed in neat, workmanship like manner so that it is level, plumb, square, properly aligned and oriented. Tolerance shall be as specified in manufacturer's drawings or as stipulated by the Engineer. No equipment shall be permanently bolted down to foundation of structure until the alignment has been checked and found acceptable.
- 2.04 Manufacturer's drawings, instructions & recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment & care shall be exercised in handling to avoid distortion to stationary structures, marring of finish, damaging of delicate instruments or other electrical parts etc. Adjustments shall be made as

necessary to the stationary structures for the plumb & level, for the sake of appearance or to avoid twisting of frames or bending of hinged members.

Bidder shall engage manufacturer's Erection Engineers for major equipment to supervise the erection of the relevant equipment. Bidder shall erect & commission the equipment as per approved drawings and shall extend full co-operation to them. The Bidder shall be held responsible for any damage to the equipment consequent to not following manufacturer's instructions correctly

- 2.05 Where assemblies are supplied in more than one section, bidder shall make all necessary mechanical and electrical connections between sections including the connections between buses. Bidder shall also do necessary adjustments / alignments for proper operation of circuit breakers, isolators and their operating mechanisms All insulators & bushing shall be protected against damage during installation. Insulators or bushing chipped, cracked or damaged due to negligence or carelessness shall be replaced by the Bidder at his own expense well in time without affecting completion period.
- 2.06 Bidder shall take utmost care in handling instruments, relays & other delicate mechanisms. The blocking materials/mechanisms employed for the safe transit of the instruments & relays shall be removed after ensuring that the panels had been completely installed & no further movement of the same would be necessary
- 2.07 Inspection, storage, installation, testing & commissioning of transformer shall be in accordance with the Indian Standard code of practice. IS 1886 with latest edition and manufacturer's instructions. All commissioning test as applicable, vide appendix C of IS: 1885 with latest edition shall be carried out.

Induction motors shall be installed & commissioned as per IS code of practice IS: 900 with latest edition and manufacturer's instructions.

Care shall be taken during handling of insulating oil to prevent ingress of moisture or foreign matter in the testing, circulating, filtering or otherwise handling of oil. Rubber house shall not be used. Circulation & filtering of oil, heating of oil by regulated short circuit current during drying runs and sampling & testing of oil shall be in accordance with the manufacture's instructions & IS code of practice IS:1866 with latest edition.

- **2.08** Equipment furnished with finished coats of paint shall be touched up by the Bidder, if their surface has become dull or marred while handling.
- **2.09** The Bidder shall provide supervision, labour, tools, equipment, rigging materials and incidental materials, such as bolts, wedges,

anchors, concrete, inserts etc. required to completely install, test and adjust the equipment

- 2.10 The Bidder shall provide and make all necessary arrangement for the safety of his staff and labourers at the site of works. The Purchaser will not be in any way responsible for any accident, minor or fatal to any person at the site of works or for any damages arising there from, during erection and this shall be the Bidder's responsibility. The staff insurance charges if any shall be borne by the Bidder. All labour rules shall be followed by the Bidder at his own cost.
- 2.11 The Bidder shall provide and construct adequate storage shed for proper storage of equipments, where sensitive equipments shall be stored indoors. All equipments during storage shall be protected against damage due to acts of nature or accidents. The storage instructions of the applicable standards, equipment manufacturer/ Purchaser shall be strictly adhered to.

2.12 The Bidder shall ensure that ;

- **2.12.1** Modern and best technologies are adopted and latest equipments are used to ensure least pollution during construction activities.
- **2.12.2** The equipments are properly stored, transported, handled and placed in position to eliminate the chances of damages to the equipment.
- **2.12.3** All safety measures are taken for ensuring that no accidents occur during construction activities.
- **2.12.4** Best construction practices/norms are adopted to ensure safety, reliability and stability of substation structures.
- **2.12.5** Due care is taken to prevent erosion and drainage problems due to construction activities.
- **2.12.6** First aid kits are kept in order to tackle accidents.
- **2.12.7** No tree shall be cut until the Bidder has made necessary arrangement with the authorities concerned and permission is given to the Bidder to fell/cut such trees. The Bidder shall arrange to remove the obstacle as soon as possible with prior concurrence of the engineer.
- **2.12.8** Due care is taken to minimize the noise level (below 75 db) by construction equipment. Statutory provisions related to noise level shall be complied.

3.0 ERECTION OF MAIN GALVANISED STEEL STRUCTURES AND AUXILIARY STRUCTURES :

All structures shall be erected as per approved drawing. The Bidder shall carefully check the location and layout of anchor bolts embedded on foundations to ensure that structures can be properly erected. Any discrepancy in the anchor bolts/foundations shall be corrected before erection. Bidder shall carryout erection in the sequence agreed by the Engineer. The method of erection shall be modified whenever required by the Engineer.

After steel structure has been erected all burrs and abraded spots on bolt heads, and nuts, shall be spot painted with approved Zinc rich paint compound. Before paint is applied, the surface shall be dry and free from dust, dirt, scales and grease. No cutting, heating or enlarging of the holes shall be carried out without the prior approval of the Engineer.

4.00 STRINGING OF BUSBARS :

- **4.01** The Erection and Stringing of main, transfer, jack buses and connections with equipment terminal connectors and feeders shall be done as per the approved layouts/ drawings wherein the bus-sections, spans, Jumpering arrangements, conductors etc shall also be specified.
- **4.02** General criteria for using the conductors at 220 KV substations is as under :

<u>S. No.</u>	<u>Bus/ Feeder</u>	220 KV <u>Switch</u> yard	132 KV <u>Switch</u> <u>yard</u>	33 KV <u>Switch</u> yard
1	Main Bus	Tarantulla	Taran- tulla	Tarantulla
2	Transfer Bus/Auxiliary bus	Zebra	Zebra	Zebra
3	Jack Bus/Jumpers/Equipment Interconnection for			
А	Feeder	Zebra	Zebra	2xPan-

				ther
В	160/100 MVA T/F	Zebra	Zebra	
С	40 MVA T/F	-	Zebra	2xPan- ther
D	BC/TBC	Zebra	Zebra	Zebra

than

Sizes (Diameter in mm) for various conductors are as follows :

Moose -	31.775	Panther –
		21.00
Zebra -	28.575	Tarantulla- 36.61

4.03 SAG TENSION REQUIREMENTS :

The sag and tension requirements for all the bus bars shall be prepared by the Bidder and detailed calculations and charts shall be submitted to the Purchaser before starting the stringing work.

- **4.04** The bus bars are divided in sections and each section shall accommodate specified number of bays. The buses shall be continuous and no joints unless specifically approved by the Engineer shall be allowed at any section point between total span.
- **4.05** Each section of the bus bars shall be strung with special dead end clamps, single insulator strings. The jack buses shall constitute of single specified conductor per phase with single strain insulator fittings at both ends. The number of 70KN Disc Insulators for different type of strings shall be as under :

<u>S.No.</u>	<u>TYPE OF STRING</u>	No.	OF	DISC
		INSU	LATOR	<u>S</u>
1	220 KV Single Tension String	16		
2	132KV Single Tension String	10		
3	33KV Single Tension String	4		
4	220 KV Single Suspension String	14		
5	132KV Single Suspension String	9		
6	33KV Single Suspension String	3		

4.06 The droppers from bus bars and jack buses to connect the equipment shall be fixed through suitable P.G. clamps as per standard practice.

5.00 ERECTION OF EQUIPMENTS:

5.01 Erection, Testing and commissioning of 220 /132 KV and 33 KV equipments shall be done as per the applicable standards, manufacturer's instructions, technical specifications of respective equipment & the associated drawings/ manuals. If services of supplier's engineer are required for erection / commissioning. Purposes, same shall be arranged by the Bidder.

5.02 INTERCONNECTION OF EQUIPMENT :

The interconnections of the equipment in the various bays shall be done with the jumpers of conductors as per drawings duly approved by the Purchaser.

All materials required for interconnection (Jumpering) viz clamps, terminal connectors, fittings, sag compensating springs, conductors, disc insulators, PG clamps and any other required material shall be in the Bidder's scope of supply

5.03 ERECTION OF CONTROL/RELAY PANELS :

The Bidder shall carryout the erection of all control/ Relay Panels as per design and drawing of centralized type SAS. The Simplex SAS panel, for control and monitoring of all the s/s equipments from remote control centre, shall be installed in control room. The arrangement for above will have to be designed and developed by the bidder. These panels shall be erected inside the control room for cable connections.

All these panels shall be provided with a bottom plate with slots for bottom cable entry. The slots shall be covered with a removable cover plate.

5.04 ERECTION OF THE D.C. SYSTEM :

The Bidder shall erect the D.C. Batteries, D.C. Boards and the Battery Charges inside the main control room building. The each D.C. board shall have 1 No. incomer of 100A and 20 Nos. outgoing of 15A. The Bidder shall carryout all the connections of the Batteries to the D.C. Board and D.C. Board to the control panel and those of the Battery Charger as per the approved drawings and requirements.

The D.C. Battery sets shall be of 55 cells of 110V, 500Ah. Such two sets of batteries shall be erected by the Bidder in the battery room adjacent to the Main Control Room in accordance with the supplier's instructions.

6.00 LAYING OF EARTH MAT & EARTHING OF EQUIPMENT
WITH THE MAIN EARTH MAT :

6.01 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 regulation existing in the locality where the system is installed. Lightning protection shall normally be provided by lightning Masts using Dr. Razveig's method.

Neutral points of systems of different voltages, metallic enclosures and frame works associated with all current carrying equipments and extraneous metal work associated with electric system shall be connected to a single earthing system unless stipulated otherwise.

6.02 Earthing shall be carried out as per design/ drawings approved by the Purchaser.

The earth mat design shall be made on the basis of actual measured soil resistivity value, fault level and switchyard area. The earth mat shall be required to be laid at least 500 mm depth below ground level.

M.S. rods of 40 mm dia shall be used for the earth mat, to be laid in the total area of the switch yard and 3 meter long M.S electrodes of 40 mm dia shall be fixed on joints all along the boundary of the switch yard vertically below the earth mat level.

- **6.03** The earthing of all the equipment/ structures placed in the switchyard will be done through suitable size riser of MS flats.
- **6.04** The general norms for earthing conductors and flats shall be as under which are subject to change as per approved design / drawings :

S.No.	<u>Item</u>	<u>Size</u>	<u>Material</u>
(i)	Main Earthmat Conductor & Earthing Electrode	40 mm dia	MS rod
(ii)	Earthing of Transformer, 245KV Circuit Breakers	75x10 mm	MS flat
(iii)	Earthing of L.A., Isolator, CVT, CT, Bus Support Main & Auxiliary structures, Pale Fencing ,gate, Lightening mast, Control Panel, Relay Panel, outdoor marshalling boxes, junction boxes & Lighting panels, Distribution Boards,	50x6 mm	MS flat

	PLCC equipments		
(iv)	Cable trenches	25x6 mm	MS flat
(v)	Lighting Poles	10 SWG	GS Wire

6.05 EARTHING CONDUCTOR LAYOUT:

Earthing conductors in outdoor areas shall be buried at a suitable depth below ground level as per the approved earth mat design.

Wherever earthing conductor crosses cable-trenches, underground service ducts, pipes, tunnels, railway track etc. it shall be laid minimum 200 mm below them and shall be re-routed in case it fouls with equipment/structure foundation.

Tap-connections from the earthing grid to the equipment/structure to be earthed , shall be terminated on the earthing terminals of the equipment structure.

Earthing conductors or leads along their run on cable trench ladder columns, beams, walls etc. shall be supported by suitable welding/cleating at intervals of 750 mm. Wherever it passes through walls, floors etc. galvanized iron sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

Earthing conductor around the building shall be buried in earth at a minimum distance of 1000 mm from the outer boundary of the building, in case high temperature is encountered at some location; the earthing conductor shall be laid minimum 1000 mm away from such locations.

Earthing conductors crossing the road shall be laid 200 mm below road or at greater depth to suit the site conditions.

Earthing conductors embedded in the concrete shall have approximately 25 mm concrete cover.

6.06 EQUIPMENT AND STRUCTURE EARTHING:

Earthing pads shall be provided for the apparatus/ equipment at accessible position. The connection between earthing pads and the earthing grid shall be made by two short earthing leads (one direct and another through the support structure) free from kinks and splices. In case earthing pads are not already provided on any item to be earthed, arrangement for same shall be made by the Bidder.

Whether specifically shown in drawings or not, steel/ RCC columns,

metallic stairs etc. shall be connected to the nearby earthing grid conductor by two independent earthing leads. Electrical continuity shall be ensured by bonding different sections of hand-rail and metallic stairs.

Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.

Metallic conduits shall not be used as earth continuity conductor. A separate earthing conductor shall be provided for earthing lighting fixtures, receptacles, switches, junction boxes, lighting conduits etc. Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam conduits, etc. and steel reinforcement in concrete, it shall be bonded to the same.

Light poles, junction boxes on the poles, cable and cable boxes/ gland lockout switches etc. shall be connected to the earthing conductor running along with the supply cable which in-turn shall be connected to earthing grid conductor at a minimum two points whether specifically shown or not in the drawing.

Railway tracks within switchyard area shall be earthed at both ends.

Earthing conductor shall be so buried to suitably earth the switchyard fence. All the gates and every third post of the fence shall be connected to earthing grid.

Flexible earthing connectors (formed by using lugs at the ends of AAC/ ACSR conductor) shall be provided for the moving parts.

All lighting panels, junction boxes, receptacles fixtures, conduits etc. shall be grounded in compliance with the provision of Indian Electricity Rules.

25mm x 6mm MS flat shall run on the top tier and all along the cable trenches and the same shall be welded to each of the racks. Alternatively the earthing conductor shall be welded along the rack supporting flat. Further this flat shall be earthed at both ends and at an interval of 30 meters. The M.S. flat above ground shall be finally painted with two coats of red oxide primer and two coats of Bus Green enamel paint.

6.07 JOINTING:

Earthing connections with equipment earthing pads shall be bolted type. Contact surfaces shall be free from scale, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anti corrosive paint/ compound.

Connection between equipment earthing lead and main earthing conductors and between main earthing conductors shall be welded type. For rust protections, the welds should be treated with red lead and afterwards coated with two layers of bitumen compound to prevent corrosion.

Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingression.

Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.

All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.

Bending of earthing rod shall be done preferably by gas heating.

All arc welding with large diameter conductors shall be done with low hydrogen content electrodes.

The GS flat of specified size shall be clamped with the equipment support structures at 1500 mm interval.

7.0 SPECIFIC REQUIREMENT FOR EARTHING SYSTEM:

7.1 <u>TRANSFORMER</u>:

- (i) The transformer tank shall be earthed at two distinct specified points provided on the tank with the help of 75x10mm M.S. Flat.
- (ii) The Marshalling box shall be earthed and connected to the earth electrode.
- (iii) The neutral of the transformer shall be solidly earthed, independent of the transformer tank which shall be connected to 40mm MS electrodes separately grounded. The neutral bushing shall be connected with 75x10mm MS Flat using two nos. copper flexible bands fastened with GI nuts & bolts.
- (iv) Each earthing lead from the neutral of power transformer shall be directly connected to two rod electrodes separately, which in turn, shall be connected to the main earth mesh. All accessories associated with transformer like cooling banks, radiators etc. shall be connected to the earthing grid at minimum two points.

7.2 LIGHTING ARRESTER:

- For earthing of LA first of all the 6 nos. electrodes shall be grouted and connected in rectangular form with the help of 75x10mm M.S. flat laid on its edge and then this rectangle so formed is connected to main earth grid at two places in opposite direction.
- (ii) The earthing of LA is to be done through discharge counter and shall be connected to earthing electrode.
- (iii) The structure of LA shall be earthed at two points.

7.3 CIRCUIT BREAKER :

- (i) The structure of each pole shall be earthed at two diametrically opposite points which shall be connected to nearest main earth grid with the help of 75x10 mm M.S. flat.
- (ii) The control box shall be separately earthed and connected to main earth grid.
- (iii) Stiffeners of M.S. Angle 50x50x6 mm shall be used wherever required.

7.4 ISOLATORS :

- i) Each pole structure shall be earth at two places.
- (ii) Earth switch of Isolator shall be separately earthed with the help of 75x10mm M.S. flat and will be clamped with structure with the help of cleats provided at 750mm distance.
- (iii) Isolator base to pie structure shall be connected with help of flexible bond.
- (iv) Control box for earthing switch shall also be earthed.

7.5 INSTRUMENT TRANSFORMER (CT/CVT/PT) :

- i) The secondary windings of instrument transformers shall be earthed at one point preferably at control panel by 8 SWG galvanized steel wire.
- (ii) The enclosing case and metal supporting frame work shall be earthed by 75x10mm M.S. Flat at two places.
- (iii) Earthing terminal of each capacitor voltage transformer shall be directly connected to rod earth electrode, which in turn, shall be connected to station earthing grid.
- 7.6 **POST INSULATOR :**

(i) Metal base of each insulator stack and supporting structure steel shall be earthed using one 75x10mm M.S. Flat.

7.7 SWITCH YARD FENCE AND GATE :

- (i) The two angle support of pale fencing gate shall be earthed with 50x6mm flat which will be connected to earthing electrode specially grouted for gate independent of main earth grid electrodes.
- (ii) After that the two electrodes shall be connected with 50x6mm flat which in turn will be connected to main earth grid at two places in opposite direction.
- (iii) The pale fencing and chain link fencing shall be earthed by 50x6mm flat at interval of 6m and connected to nearest main earth grid. This means that every alternate upright support shall be earthed.

7.8 EQUIPMENT STRUCTURE:

These will be earthed by 50x6mm M.S. flat at two diametrically opposite points and shall be connected to main earth grid near to it.

7.9. MAIN STRUCTURES WITHOUT LIGHTENING PROTECTION SHIELD WIRE:

 Any two diametrically opposite legs of each main structures with or without peak in yard shall be earthed by 50x6mm M.S. flat connected at base of the support which in turn will be connected to main earth grid at two places in opposite direction.

7.10 MAIN STRUCTURES WITH PEAK:

(i) Where peaks is provided on tower and earth wire from line tower inter connecting tower is connected to peak, the earth wire must be connected to earth mat using the same conductor as per earth wire.

7.11 CABLE TRENCH :

- (i) M.S. flat of 25x6mm shall continuously run on cable racks grouted in the trench. The flat shall be in contact with one wall after trench.
- (ii) The top rack angle of trench shall be connected with the M.S. flat 25x6mm already running on the bottom rack angle by another 25x6mm flat at every 750mm where the angles are grouted in the wall.
- (iii) The 25x6mm M.S. Flat running over the bottom rack shall be welded with each and every angle piece of bottom rack.
- (iv) The above flat shall be connected to main earth grid at an interval of 30m with 25x6mm flat.

7.12 LIGHTING POLE :

- (i) Each street light pole grouted in yard shall be earthed with the help of 10 SWG. Galvanized steel wires which will be bolted with the pole 300mm above ground level and the 2nd end shall be connected to main earth grid.
- (ii) Junction Boxes on the poles, flood lighting supporting structures etc. shall also be earthed by 10 SWG galvanized steel wire which shall be run along with the supply cable and shall be connected to main earth grid at two points.

7.13 **CABLES** :

- (i) Metallic sheaths, screens or shields and armour of all multi core cable shall be earthed at both end.
- (ii) Metallic sheaths and armour of single core cable shall be earthed only at switch gear end and kept insulated at other end.

7.14 CONTROL, RELAY AND OTHER PANELS :

- (i) All control and relay panels shall be connected first with one M.S. flat of 50x6mm at points marked in panels with the help of nuts & bolts and then the flat 50x6mm shall be connected with main earth grid all around control room building in two opposite direction.
- (ii) Battery chargers and Distribution boards shall also be connected with 50x6mm MS Flat and which in turn shall be connected to main earth grid around control room in two opposite direction.
- (iii) All other panels such as PLCC etc. shall also be earthed with 50x6mm M.S. flat and shall be connected to main earth grid

7.15 MISCELLANEOUS ITEMS:

The various other items which are not covered under the various heads as enumerated above shall also be covered under the scope of this work. Their earthing shall be done as directed by Engineer at site.

8.0 GENERAL NOTES ON EARTHING :

8.1 LAYING OF M.S. FLAT:

- (i) The M.S. rod, MS flat and G.I. Wire shall be laid below the ground level in each area as per drawing.
- (ii) MS Flat shall be laid inside ground on its edge as well as on flat depending upon situation.
- (iii) Where ever the earthing conductor crosses the trench it shall be in the bottom of trench.

8.2 WELDING:

(i) Surfaces to be welded shall be made absolutely free from grease, paint, oil and

scales etc.

- (ii) All welds shall be free from defects like blow holes, slug inclusion, lack of penetration etc. welds shall show uniform sections and weld size need not exceed thickness of thinner part joined.
- (iii) Welding electrode used shall be ISI mark only.
- (iv) Earthing strips if crossing each other or any other structure shall be welded on that point.
- (v) The MS flat shall be wrapped around the 40 mm round M.S. bar of main earth grid and shall be welded on both sides and width of flat on top as shown in relevant drawing no.8/004.
- (vi) M.S. Flat shall be lap jointed with over lapping being 150 mm. The welding shall be done along the length and breadth in all direction.

8.3 HOLES:

- i) (Holes in the M.S. Flat shall be either punched or drilled. However drilled holes shall be preferred.
- (ii) All burrs left after drilling or punching shall be removed completely.
- (iii) Holes adjacent to bends shall be drilled or punched after bending.
- (iv) Holes shall be invariably circular oval or lobbed forms of hole shall not be permitted.
- (v) The size of the hole shall be according to bolt provided in various equipments at the place of earthing. But in all cases the diameter of the hole shall be only 1.5mm more than the diameter of the bolt in place for earthing of equipment.

8.4 CUTTING & BENDING :

- (i) The M.S. Flat shall be given bend of 90^{0} over the foundation of structures while welding it with structure.
- (ii) While bending the M.S. flat, it should be ensured that fracture of material does not take place.
- (iii) Cold bending in case of smaller section such as 25x6 or 50x6mm and hot bending in case of 75x10mm can be done.
- (iv) All cuttings of flat should be done either by punch or by hacksaw blade but in no case there may be any burr on the edge end. It should be properly filed.

8.5 PAINTING :

(i) To avoid rusting all the under ground welds should be cleaned properly and

painted with two coats or black bituminous paint.

- (ii) All earthing leads above ground level shall be painted with one coat of red oxide primer and then with two coats of anti corrosive green paint.
- (iii) The G.I. structure at the place of welding shall be painted with zinc rich oxide paint.
- (iv) The M.S. angle wherever used as stiffener shall also be painted with two coats of anti corrosive paint.

8.6 OTHERS:

The other technical works shall also be carried out as per UPPTCL practice for 220/132 KV Substations and as directed by the Engineer.

9.0 CABLE LAYING & TERMINATIONS:

9.01 CABLE TAGS AND MARKERS:

- (i) Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.
- (ii) The tag shall be of aluminum with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire conforming to IS: 280. Cable tags shall be of rectangular shape for power cable and of circular shape for control cables.
- (iii) Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanized iron plate.
- (iv) Location of underground cable joints shall be indicated with cable maker with an additional inscription "Cable joints".
- (v) The marker shall project 150mm 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.
- (vi) 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 cable enter together through a gland plate.

9.02 CABLE SUPPORTS & CABLE TRAY MOUNTING ARRANGEMENTS

(i) The Bidder shall provide embedded steel inserts on concrete floors/ walls to secure supports by welding to these inserts or available building steel structures.

- (ii) The supports shall be fabricated from standard structural steel members.
- (iii) Insert plates will be provided at an interval of 750 mm wherever cables are to be supported without the use of cable trays, such as in trenches while at all other places these will be at an interval of 2000 mm.

9.03 CABLE TERMINATION AND CONNECTIONS:

- (i) The termination and connection of cables shall be done strictly in accordance with manufacturer's instructions, drawing and/or as directed by the Purchaser.
- (ii) The work shall include all clamping ,fittings, fixing, plumbing, soldering, drilling, cutting, taping, heat shrinking (where applicable) connecting to cable terminal, shorting and grounding as required to complete the job.
- (iii) Supply of all consumable/ non-consumable materials required for cable laying and terminations shall be included in erection prices.
- (iv) The equipment are generally provided with undrilled gland plates for cables / conduit entry. The Bidder shall be responsible for drilling of gland plates, painting and touching up. Holes shall not be made by gas cutting.
- (v) Control cable cores entering control panel / switchgear / MCCB / Miscellaneous panels shall be neatly bunched, clamped and tied with nylon strap or PVC perforated strap to keep them in position.
- (vi) The Bidder shall tag / ferrule control cable cores at all terminations, as instructed by the Purchaser. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number as well.
- (vii) Spare cores shall be similarly tagged with cable numbers and coiled up.
- (viii) All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.
- (ix) Double compression type nickel plated (coating thickness not less than 10 microns) brass cable glands shall be provided by the Bidder for all power and control cables to provide dust and weather proof terminations.
- (x) The cable glands shall conform to BIS: 6121. They shall comprise of heavy duty brass casting, machine finished and nickel plated, to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and of tested quality. Cable glands shall be of approved make.
- (xi) The cable glands shall also be suitable for dust proof and weather proof termination.
- (xii) If the cable end box or terminal enclosure provided on the equipment is found

unsuitable and requires modification, the same shall be carried out by the Bidder, as directed by the Purchaser.

- (xiii) Crimping tools used shall be of approved design and make.
- (xiv) Cable lugs shall be tinned copper solder less crimping type conforming to IS-8309
 & 8394. Bimetallic lugs shall be used depending upon type of cables used.
- (xv) Solder less crimping of terminals shall be done by using corrosion inhibitory compound. The cable lugs shall suit the type of terminals provided.

9.04 STORAGE AND HANDLING OF CABLE DRUMS:

Cable drums shall be unloaded, handled and stored in approved manner and rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.

9.05 **DIRECTLY BURIED CABLES:**

- (i) The Bidder shall construct the cable trenches required for directly buried cables. The scope of work shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective covers, back filling and ramming, supply and installation of route markers and joint markers. The bidder shall ascertain the soil conditions prevailing at site, before submitting the bid.
- (ii) The cable between LT station, control room, (DG set building and fire fighting pump house and mulsifyre room if any) shall be laid in the buried cable trenches in outdoor area.
- (iii) Cable route and joint markers and RCC warning covers shall be provided wherever required. The voltage grade of cables shall be engraved on the markers.

9.06 INSTALLATION OF CABLES:

- (i) Cabling in the control room shall be done on ladder type cable trays while cabling in switchyard area shall be done on angles in the trench.
- (ii) All cables from bay cable trench to equipments including all Interpol cables (power, control and optical fibre)for all equipment, shall be laid in PVC pipes and GI pipes as per site requirements of minimum 50 mm nominal outside diameter of class 4 as per IS:4985 and relevant standards which shall be buried in the ground at a depth of 250mm below finish formation level. Separate pipes shall be laid for control / optical fibre and power cables.
- (iii) Cables shall be generally located adjoining the electrical Equipment through the pipe embedded in the floor. In the case of equipments located away from cable trench either pipe shall be embedded in the floor connecting the cable trench and the equipment or in case the distance is small, notch/opening on the wall shall be

provided. In all these cases necessary bending radius as recommended by the cable manufacturer shall be maintained.

- (iv) Control cable shall be terminated in the concrete switchyard control room housing the relay / protection panels of SAS system. The optical fibre shall be laid and terminated to main panel of control room as per actual requirement.
- (v) Cable racks and supports shall be painted after installation with two coats of metal primer (comprising of red oxide and zinc chromate in a synthetic medium) followed by two finishing coats of aluminum paint. The red oxide and zinc chromate shall conform to IS:2074.
- (vi) Suitable arrangement shall be used between fixed pipe/cable trays and equipment terminal boxes, where vibration is anticipated.
- (vii) Power and control cables in the cable trench shall be laid in separate tiers The order of laying of various cables shall be as follows, for cables other than directly buried.
- a) Power cables on top tiers.
- b) Control/ instrumentation and other service cables in bottom tiers.
- (viii) Single core cables in trefoil formation shall be laid with a distance of three times the diameter of cable between trefoil centre lines. All Power Cables shall be laid with a minimum centre distance equal to twice the diameter.
- (ix) Trefoil clamps for single core cables shall be of pressure die cast Aluminum (LM-6), Nylon-6 or fibre glass and shall include necessary fixing GI nuts, bolts, washer etc. These are required at every 2 meter of cable runs.
- (x) Power and control cables shall be securely fixed to the trays/ supports with self locking type nylon ties with deinter locking facility at every 5 meter interval for horizontal run. Vertical and inclined cable runs shall be secured with 25mm wide and 2mm thick aluminum strip clamps at every 2meter of cable run.
- (xi) Cables shall not be bent below the minimum permissible limit. The permissible limits are as follows:-

Type of cable	Minimum bending radius.		
Power cable	12 x OD		
Control cable	12 x OD		
Where D is overall diameter of cable.			

- (xii) Where cables cross roads, drains and rail tracks, these shall be laid in reinforced spun concrete or steel pipes buried at not less than one meter depth.
- (xiii) In each cable run some extra length shall be kept at a suitable point to enable one (for LT cables)/ two (for H.T. cables) straight through joints to be made in case the cable develop fault at a later date.

- (xiv) Selection of cable drums for each run shall be so planned as to avoid using, straight through joints. Cable splices will not be permitted except where called for, by the drawings, unavoidable or where permitted by the Purchaser. If straight through joints are unavoidable, the Bidder shall use the straight through joints kit of reputed make.
- (xv) Control cable terminations inside equipment enclosures shall have sufficient lengths so that changing of termination in terminal blocks can be done without requiring any splicing.
- (xvi) Rollers shall be used at intervals of about two metres while pulling Cables.
- (xvii) All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kinks, sharp bends, etc. Cable ends shall be kept sealed to prevent damage. In cable vault, Fire resistant seal shall be provided underneath the panels.
- (xviii) Inspection on receipt, unloading and handling of cables shall generally be in accordance with IS:1255 and other Indian Standard Codes of practices.
- (xix) Wherever cable pass through floor or through wall openings or Other partitions, GI/ PVC wall sleeves with bushes having a smooth curved internal surface so as not to damage the cable, shall be supplied, installed and properly sealed by the Bidder.
- (xx) Bidder shall remove the RCC/ Steel trench covers before taking up the work and shall replace all the trench covers after the erection work in that particular area is completed or when further work is not likely to be taken up for some time.
- (xxi) Bidder shall furnish three copies of the report on work carried out in a particular week, indicating cable numbers, date on which laid, actual length and route, testing carried out, terminations carried out, along with the marked up copy of the cable schedule and interconnection drawing wherever any modifications are made.
- (xxii) Bidder shall paint the tray identification number on each run of trays at an interval of 10m.
- (xxiii) In case the outer sheath of cable is damaged during handling/ installation, the Bidder shall repair it at his own cost to the satisfaction of the Purchaser. In case any other part of the cable is damaged, the same shall be replaced by a healthy cable at no extra cost to the Purchaser, i.e. the Bidder shall not be paid for installation and removal of the damaged cable.
- (xxiv) All the terminations shall be appropriately tightened to ensure secure and reliable connections. The Bidder shall cover the exposed part of all cable lugs with insulating tape, sleeve or paint.

9.07 CABLE TRAYS:

i) The cable trays shall be of G.S. sheet and minimum thickness of sheet shall be 2mm.

- ii) The Bidder shall perform all tests and inspection to ensure that material and workmanship are according to the relevant standards. Bidder shall demonstrate all tests as per specifications and materials shall comply with all requirements of the specifications. The tests shall include the following ;
- a) Test for galvanizing (Acceptance test): The test shall be done as per approved standards.
- b) Deflection Test (Type Test)

A.2.5 meter straight section of 300mm, 600mm wide cable tray shall be simply supported at two ends. A uniform distributed load 76Kg/m shall be applied along the length of the tray. The maximum deflection at the mid-span shall not exceed 7mm.

10.0 ERECTION OF METERING SYSTEM AND SCADA:

The Bidder shall install metering system as per specifications on select feeders and SCADA (if required) and shall synchronize it with existing RLDS.

11.0 ERECTION OF ASSOCIATED SYSTEMS:

The Bidder shall carryout the complete erection of Illumination system, Diesel generating sets if required, Fire protection system, Oil filtration plant, Air conditioning and ventilation system and mulsifyre system -etc as per relevant specifications, applicable standards, manufacturer's and Purchaser's instructions

12.00 TESTING AND COMMISSIONING:

The Bidder shall carryout all the required and / or specified tests on equipments/ systems before commissioning and putting into operation.

An indicative list of tests is given below. Bidder shall perform any additional test based on specialties of the items as per the instructions of the equipment manufacturer and Purchaser without any extra cost to the Purchaser. The Bidder 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.

12.01 GENERAL CHECKS:

- (a) Check for physical damage.
- (b) Visual examination of zinc coating/plating.
- (c) Check from nameplate that all items are as per order/ specification.
- (d) Check for tightness of all bolts, clamps and connecting terminals using torque wrenches.
- (e) For oil filled equipment, check for oil leakage, if any. Also check for oil level and top up wherever necessary.

- (f) Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surface.
- (g) Check for surface finish of grading rings (Corona control ring).
- (h) Pressure test on all pneumatic lines at 1.5 times the rated pressure
- (i) Check for cleanliness of insulators & bushings.
- (j) All checks and tests specified by the manufacturer in his drawings / manuals as well as all tests specified in the relevant code of installation.

12.02 STATION EARTHING:

- a) Check for continuity of grid wires.
- b) Check for earth resistance of the entire grid as well as various sections of the same.
- c) Check for weld joint and application of zinc rich paint on galvanized surface.
- d) Check for soil resistivity.

12.03 CONDUCTOR STRINGING WORK, BUS WORK AND POWER CONNECTORS:

- a) Physical check for finish.
- b) Electrical clearance check.
- c) Testing of torque, by torque-wrenches on all bus bar power connectors another accessory.
- d) Milli-volt drop test on all power connectors.
- e) Sag and tension checks on conductors.

12.04 INSULATORS:

Visual examination for finish, damage, creepage distance etc.

12.05 TRANSFORMERS:

- a) Dielectric test of oil.
- b) Insulation resistance of all windings.
- c) Voltage ratio test on all taps.
- d) Vector group test.
- e) Operational test of OLTC.
- f) Buchholz relay operation test.
- g) Operation test of cooling equipment.

- h) Operation test of all protective devices and interlocks.
- i) Insulation resistance of control wiring.
- j) Measurement of core loss of all transformers.
- k) Measurement of winding resistance.
- 1) Calibration of temperature indicators and temperature relays.

12.06 MOTORS :

- a) Insulation resistance.
- b) Phase sequence & proper direction of rotation.
- c) Any motor operating incorrectly shall be checked to determine the cause & the conditions corrected.

12.07 INSULATION RESISTANCE TEST:

The insulation resistance test shall also be carried out on the following equipment

a)	All Bus installations	by 5000 Volt motor operated meager
b)	415 Volt power circuits	by 1000 Volt meager.
c)	110 Volt D.C. Control circuits	by 500 Volt meager.

12.08 PHASING OUT :

The phasing out of all supplies in the station system shall be carried out.

12.09 ANY OTHER TEST :

The Purchaser may ask for such additional tests on sites as in his opinion are necessary to determine that the works comply with the specification, manufacturers' instruction, I.S. Code of installation. The Bidder shall also have to conduct any additional test which Engineer shall deem necessary to satisfy the requirements of the governing parameters and constants of the substations

- **12.10** The Bidder shall provide all necessary tools, test equipment, test connections, labour & supervision for the above tests.
- **12.11** The Bidder shall give advance intimation of testing & commissioning program to Consignee division and concerned T&C division. The tests shall be performed in the presence of the authorized representative of the consignee &/or T&C division unless exempted in writing and in presence of manufacturer's Supervisory Engineer if applicable/available.
- 12.12 The Bidder shall provide one copy of check lists and formats for general checks, commissioning tests etc to Consignee division and one copy to Test & Commissioning Division of the Purchaser before commencement of such checks & testing. The Bidder shall record all test values & shall provide two copies of the

test data to Consignee division as well as to the Test & Commissioning Division of the Purchaser. Electrical circuits & equipment shall be energized or used at nominal operating voltage only after such reports have been accepted as satisfactory by the Purchaser.

GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS

INDEX

- 1.0 GENERAL
- 2.0 COMPLETENESS OF EQUIPMENTS
- 3.0 STANDARDS

- 4.0 **PROJECT DATA**
- 5.0 SYSTEM PARTICULARS
- 6.0 SYSTEM PARAMETERS
- 7.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT
- 8.0 TERMINAL CONNECTORS
- 9.0 SUPPORT STRUCTURES
- **10.0 COLOUR SCHEME AND CODES FOR PIPE SERVICE**
- 11.0 MATERIAL / WORKMANSHIP
- **12.0 SPACE HEATERS**
- **13.0 FUNGISTATIC VARNISH**
- 14.0 VENTILATION OPENING
- **15.0 DEGREE OF PROTECTION**
- 16.0 RATING PLATES, NAME PLATES AND LABELS
- 17.0 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS
- **18.0 PROTECTION**
- **19.0 SURFACE FINISH**
- **20.0 GALVANISING**
- **21.0 PROTECTIVE GUARDS**
- 22.0 TOOLS AND TACKLES
- 23.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT
- 24.0 TERMINAL BLOCKS AND WIRING
- 25.0 LAMPS AND SOCKETS

GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS

1.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification / RFP.

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under respective equipment sections and are not exclusive. However in case of conflict between the requirement specified in this section and requirements specified under respective equipment sections, the requirements specified under respective sections shall hold good.

Every effort will be made to supply all equipment as per the technical details furnished in the specification. However, due to the standard manufacturing practice of various equipment suppliers and depending on the selected vendor, there may be slight variations from indicated values at the contract stage. Such variations should not affect the quality and performance of the equipment.

It is not the intent to specify completely in technical specifications of equipments/ materials all 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. The Purchaser will interpret the meaning of drawing and specification and shall have the power to reject any work or material which in his judgment is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply, irrespective of whether these are specifically brought out in this specification and/or commercial order or not.

2.0 COMPLETENESS OF EQUIPMENTS

Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories specified &/or 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. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the 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.

The Bidder shall supply type tested (including special test as per tech. specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification and/or IEC/ IS, same, shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

3.0 STANDARDS

- **3.1** Except as modified by this Bid specification, all material and equipment shall conform to the requirement of the latest editions of relevant ISS/ IEC and other applicable standards. The equipments shall be designed, engineered. manufactured, built and commissioned/ works shall be carried out in accordance with the acts, rules, laws and regulations in force in India.
- **3.2** In addition to meeting the specific requirements called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards which shall form an integral part of the specification. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation to the specification shall take precedence.
- **3.3** In the event of the Bidder offering equipment conforming to standards other than ISS/IES standards, the salient point of comparison between the standards adopted and relevant ISS/ IEC standards shall be indicated clearly in the proposal, along with English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser approval.
- **3.4** The standards mentioned in the respective equipment specifications are not mutually exclusive or complete in themselves. The equipment &/or work shall also conform to any other applicable standard, even if not specifically mentioned in these specifications.
- **3.5** Should the Bidder wish to depart from the provisions of the specifications, either on accounts of manufacturing practices or for any other reason, he shall clearly mention the departure and submit complete justification supported by information, drawings etc. as will enable to assess the suitability of equipment(s) offered. In the event of the Bidder's specifications, drawings, forms and tables etc. being found to disagree with the requirement of the Bid specifications at any stage, Bid specifications shall be binding, unless the departures have been duly approved in writing by the Purchaser.

3.6 REFERENCE OF STANDARS

Reference Abb	previation Name and Address
IEC	International Electro Technical Commission, Bureau Centraldela commission, Electro Technique international, 1, Rue de vereimbe Geneva, Switzerland
IS	Indian standard, Bureau of Indian Standard, Manak Bhavan, 9, Bahadur shah Zafar Marg, New Delhi – 110 002
BS	British Standards, British Standards Institution, 101, Pentonnvilla Road, N – 19 – ND – UK
ISO	International Organisations for Standardisation, Danish Board of Standardisation, Aurehoegvag – 12

Dk – 2900 Heelprup, Denmark.sss

4.0 **PROJECT DATA**

i.	Location,	UTTAR PRADESH
ii.	Altitude	not exceeding 1000 Meters
iii.	Climatic Conditions	
(a)	Design maximum ambient Air Temperature	50 [°] C
(b)	Minimum ambient air temperature in shade	$0^{0}C$
(c)	Relative Humidity	100%Max.
(d)	Wind Load	195 Kg./ Sq.m.
(e)	Seismic Level	0.3 g
(f)	Iso-ceraunic Level	50days/ year
(g)	Average annual rain fall	1200 mm

(h) Hot and humid tropical Climate conductive to rust and fungus growth

5.0 SYSTEM PARTICULARS

(i)	Rated System voltage	420 KV, 245KV, 145KV, 36KV
(ii)	System frequency	50 Hz, This may vary by \pm 5%
(iii)	Number of phases	Three
(iv)	Neutral	Effectively Earthed

(v) Auxiliary power supply:-

Auxiliary electrical equipment shall be suitable for operation on the following supply system.

(a)	Power device(Like drive motors)	400V, 3Phase, 4Wire 50Hz	
		Effectively earthed AC system.	
(b)	Lighting fixtures, space heaters,	250V, 2wire, 50Hz, AC supply	
	fractional Horse Power motors	with one point grounded.	
	and control devices.		
(c)	DC alarm, Control and Protective	2wire ungrounded DC supplies	

Devices from sub station batteries as under

- (i) 400 KV S/S : 220V DC
- (ii) 220/132KV S/S : 110V DC
- (iii) Communication

equipment : 48 V DC

The above supply voltage is subject to variation as follows :

All devices must be suitable for a continuous operation over the entire range of voltage variations :

(i)	AC	Voltage may vary by $\pm 10\%$.
		Frequency by $\pm 5\%$
		Combined Voltage & frequency by $\pm 10\%$.

(ii) DC

a) 220 V may vary between 187& 242 V

b) 110 V may vary between 93 & 121 V $\,$

c) 48 V may vary between 41 & 53 V

6.0 SYSTEM PARAMETERS

The following system parameters shall prevail.

Nominal system voltage	<u>220KV</u>	<u>132 kV</u>	<u>33 kV</u>
Highest system	245KV	145 kV	36 kV
Frequency	50Hz	50Hz	50Hz
Rated short time current	40KA for 3	31.5 kA	25 kA
	Sec.	for 3 sec	for 3 sec
Dry and wet one minute power frequency withstand voltage	460KV	275 kV	95 kV
Dry and wet impulse withstand voltage positive and negative	1050KVp	650 kVp	250 kVp
Minimum total creepage	25mm /kV	25mm /kV	25mm/kV
	(6125 mm)	(3625 mm)	(1300 mm)
System Earthing	Effectively	Effectively	Un- effectively
	Earthed	Earthed	

7.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT

All equipments shall perform satisfactorily under various electrical, electromechanical and meteorological conditions of the installation site.

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.

The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand.

All outdoor EHV equipments shall be suitable for hot line washing.

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

8.0 TERMINAL CONNECTORS

- **8.1** Each equipment shall be supplied with necessary terminals and connectors as required by the design for the particular installation. The terminal connector shall be suitable for the conductor used for particular installation, which are as under as per UPPTCL's practice :
- 8.2 The Erection and Stringing of main, transfer, jack buses and connections with

equipment terminal connectors and feeders shall be done as per the approved layouts/ drawings wherein the bus-sections, spans, Jumpering arrangements, conductors etc shall also be specified.

^{8.3} General criteria for using the conductors at 220KV substations is as under :

<u>S. No.</u>	<u>Bus/ Feeder</u>	220kV Switch <u>yard</u>	132kV Switch <u>yard</u>	33kV Switch <u>yard</u>
1	Main Bus	Tarantulla	Tarantulla	Tarantulla
2	Transfer Bus/Auxiliary bus	Zebra	Zebra	Zebra
3	Jack Bus/Jumpers/Equipment Interconnection for			
А	Feeder	Zebra	zebra	2x Panther
В	160 MVA T/F	zebra	tarantula	
С	60 MVA T/F	Zebra	-	2x Zebra
D	40 MVA T/F		zebra	2x Zebra
Е	TBC	Zebra	Zebra	Zebra
Sizes (I	Diameter in mm) for various con	nductors are as	follows :	
	Moose - 31.77	75 Pa	nther -	21.00
	Zebra - 28.57	75 Ta	rantulla -	36.61

Change, if any, shall be informed to the Bidder at the time of drawing approval.

- **8.4** Where copper to aluminium connections are required, bimetallic 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 part which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Bidder.
- **8.5** Low voltage connectors, grounding connectors and accessories for grounding all equipment are also included in the scope of work.
- **8.6** No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be used with aluminum body for Bimetallic clamps.
- **8.7** All casting shall be free from blow holes, surface blisters cracks & cavities. Sharp edges and corners shall be blurred and rounded off.
- **8.8** Low voltage connectors, grounding connectors and accessories for grounding all equipment are also included in the scope of work.
- **8.9** No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be used with aluminum body for Bimetallic clamps.
- **8.10** All casting shall be free from blow holes, surface blisters cracks & cavities. Sharp edges and corners shall be blurred and rounded off.

- **8.11** The clamps/ connectors 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 specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on hardware.
- **8.12** All current carrying parts shall be designed and manufactured to have minimum contact resistant.

9.0 SUPPORT STRUCTURES

The base design of all the equipments, to be installed on auxiliary structures, shall conform to the standard auxiliary structure designs presently being used in UPPTCL at 220/132/33 KV Substations. The details of such auxiliary structures are enclosed at annexure GTR-1.

10.0 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The Bidder shall propose a colour scheme for the those equipments/ items for which the colour scheme has not been specified in the specification. For the approval of purchase. The decision of Purchaser shall be final. The scheme shall include.

Finishing colour of Indoor equipment.

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All steel structures, plates etc shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade 631 of IS-5. All the indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the Purchaser.

11.0 MATERIAL/ WORKMANSHIP

11.1 GENERAL REQUIREMENT

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered equipment it is understood 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.

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 and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfil 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 Purchaser.

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

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and 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 personal on all exposed rotating and/ or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Bidder 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 Bidder shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Bidder has any special requirement for the specific application of a type of oil or grease not available in India. In such case he shall declare in the proposal, where such oil or grease in available. He shall help Purchaser in establishing equivalent Indian make and Indian Bidder. The same shall be applicable to other consumables too.

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 and shall have a raised up all around and shall have threaded in air connections, of so required.

11.2 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 a fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

12.0 SPACE HEATERS

The heaters shall be suitable for continuous operation at 240 V AC supply. On-off switch and fuse shall be provided for the heater.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made form below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of-coiled resistance wire centred in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sherns or that of insulator wire or other component in the compartments.

13.0 FUNGISTATIC 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 or part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

14.0 VENTILATION OPENING

In order to ensure adequate ventilation, compartments shall have ventilation openings provided 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.

15.0 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, junction boxes and Marshalling Boxes, panels etc to be installed shall be provided with 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-1)/IEC-947 (Part-1). Type test report/or degree of protection test. on each type of the box shall be submitted for approval.

16.0 RATING PLATES, NAME PLATES AND LABELS

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.

All such nameplates, Instructions plates, rating plates 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.

17.0 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 Bidder unless specifically excluded under the exclusions in these specifications and documents.

18.0 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be property treated and protected in a suitable manner.

19.0 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, creases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

All external painting shall be as per shade No. 631 of IS: 5.

20.0 GALVANISING

All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be 610 gm/ sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6 mm. For items lower than 6mm thickness, requirement of coating shall be as per relevant ASTM.

21.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotation and/of moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

22.0 TOOLS AND TACKLES

The Bidder 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.

23.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

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.

Control cabinets, junction boxes, marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braces 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.

Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

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.

All doors, removable covers and plates shall be provided gasket 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 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 filter, the screen shall be fine wire mesh made of brass.

All boxes/ cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Necessary number of cable glands shall be supplied and fitted on this gland plate. the gland shall project at least 25 mm 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.

23.1 EARTHING

Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire/ strip 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.

The following routine tests alongwith the routine tests as per IS 5039 shall also be conducted.

Check for wiring

Visual and dimension check

The enclosure of bay junction box, terminal box shall be type tested for IP-55 as per IS:13947. After IP-55 test, 2.5 kVrms for 2 (one) minute insulation resistance and functional test should be conducted.

23.3 AUXILIARY SWITCHES

All the auxiliary switches shall be fully type tested as per relevant IS.

24.0 TERMINAL BLOCKS AND WIRING

Control and instrument leads form the switchboards of from other equipment will be brought to terminal boxes or control cabinets in conduits. All inter phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece, complete with insulated/barriers stud type terminals, washers, nuts and lock nuts. Screw clamp overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, phoenix cage clamp type or equivalent. The insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

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.

The terminals shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable form escaping form the terminal clamp unless it is done intentionally.

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.

The terminal blocks shall be of extensible design.

The terminal blocks shall have locking arrangement to prevent it,s escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, nondeterioration type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator form carrying out the wiring without removing the barriers.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

a) All circuits except Minimum of 2 nos. of 2.5 sq. mm copper flexible

CT circuits

All CT circuits

b)

Minimum of 4 nos. of 2.5 sq.mm copper flexible

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.

At least 20% spare terminals shall be provided on each panel/ cubicle/box and these spare terminals shall be uniformly distributed on all terminal rows.

There shall be 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.

The Bidder shall furnish all wire, conduits and terminals for the necessary inter phase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.

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 Bidder shall also provide necessary filtering, surge protection, relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

25.0 LAMPS AND SOCKETS

25.1 LAMPS :

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

25.2 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.

25.3 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.

25.4 SWITCHES AND FUSES:

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolation 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 switch fuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selection clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by fuses.

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 to the fuse rating and voltage. All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

FORM 'A'

General Conditions for the Supply of Plant and the Execution of Works in Connection with the Schemes in the UPPTCL

1. In construing these General Conditions and the annexed Specification, the following words shall have the meanings herein assigned to them unless there is anything in the subject or context inconsistent with such construction;

"The Purchaser" or the Corporation shall means the UPPTCL and shall include his successors and assigns.

The "Bidder" shall mean the Bidder whose Bid shall be accepted by the Purchaser, and shall include such Bidder's heirs, legal representatives successors and assigns.

The "Sub-Bidder" shall mean the person named in the Contract for any part of the work or any person to whom any part of the Contract has been sublet with the consent in writing of the Engineer and the heirs, legal representatives successors and assigns of such person.

The "Engineer" shall mean the officer placing the order for the work, with the Bidder and such other officer as may be authorized and appointed in writing by the Purchaser to act as Engineer for the purposes of the Contract and in case no such officer has been so appointed, the Purchaser or his duly authorized representative.

"Plant", "Equipment", "Material", "Work" or "Works" shall mean respectively the plant and materials to be provided and work or works to be done by the Bidder under the Contract.

The "Contract" shall mean and include the General Conditions, Specifications, Schedules, Drawings, Form or Bid, Covering Letter, Schedule of Prices, or the final General Conditions, Specifications and Drawings and the Agreement to be entered into under clause 3 of these General Conditions.

"The Specification" shall mean the Specification annexed to these General Conditions and the Schedules thereto (if any).

The 'Site' shall mean the site of the proposed work as detailed in the Specification or an other place in Uttar Pradesh where work is to be executed under the Contract.

"Tests on Completion" shall mean such tests as are prescribed by the Specification to be made by the Bidder before the plant is taken over by the Purchaser.

"Commercial Use" shall mean that use of the work which the contract contemplates or of which it is commercially capable.

"Month" shall mean calendar month.

"Writing" shall include any manuscript, typewritten or printed statement under or over signature or seal as the case may be.

Words importing persons shall include Firms, Companies, Corporations and other bodies whether incorporated or not.

Words importing the singular only shall also include the plural and vice versa where the context requires.

2. The Bidder shall be deemed to have carefully examined the General Conditions, Specifications, Schedules and Drawings. If he shall have any doubt as to the meaning of any portion of these General Conditions or of the Specification, he shall, before signing the Contract, set forth the particulars thereof and submit them to the Engineer in writing, in order that such doubt may be removed.

3. A formal agreement shall, if required by the Purchaser, be entered into between the Purchaser and the Bidder for the proper fulfilment of the Contract.

Further, if required by the Purchaser, the Bidder shall deposit with the Purchaser as security for the due and faithful performance of the Contract such sums not being less than one per cent of the total value of the Contract as may be fixed by the Purchaser either in case or in any other form approved by the Purchaser. The security deposit shall be refunded to the to the Bidder on the satisfactory completion of tests and the taking over of the plant by the Purchaser.

The charges in respect of vetting and execution of the contract document shall be borne by the Bidder. The Bidder shall be furnished with an executed stamped counter-part of the Agreement. The import license fee will in each case have to be paid by the Bidder, import license may have to be taken in the Corporation's name.

After the Bid has been accepted by the Purchaser, all order or instructions to the Bidder shall, except as in otherwise provided, be given by the Engineer on behalf of the Purchaser.

Contract 4. The Bidder shall submit in duplicate, to the Engineer for his approval, drawings of the General Arrangement of the works to be carried out and of such detailed drawings, other than shop drawings as may be reasonably necessary.

Within fourteen days of the receipt of such drawings the Engineer shall signify his approval or otherwise of the same, and in the event of his disapproving the drawing, the contactor shall submit further drawings for approval.

Within a reasonable period of the notification by the Engineer to the Bidder of his approval of such drawings, three sets in ink on tracing cloth or ferrogalic prints mounted on cloth, of the drawings as approved shall be supplied to him by the Bidder and be signed by him and by the Bidder respectively and be thereafter deemed to be the "Contract Drawings".

These drawings when so signed shall become the property of the Purchaser and be deposited with the Engineer, and shall not be departed from in any way what so ever except by the written permission of the Engineer as hereinafter provided. During the execution of the works, one of the sets of drawings shall be available for reference on the site.

In the event of the Bidder desiring to possess a signed set of drawings he shall supply four sets instead of three sets and in this case the Engineer shall sign the fourth set return the same to the Bidder.

The Bidder if required by the Engineer shall supply in addition copies of any drawings other than shop drawings which may reasonably be required for the purpose of the Contract and may make a reasonable charge of such copies.

The Engineer, or his duly authorized representative, whose name shall have previously been communicated in writing to the Bidder, shall have the right, at all reasonable times, to inspect, at the factory of the Bidder, drawings of any portion of the work.

5. The Bidder shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors and omission in the drawings or other particulars supplied by him, whether such drawings or particulars have been approved by the Engineer or not, provided that if such discrepancies, errors or omissions are due to inaccurate information or particulars furnished to the Bidder by the Engineer, any alterations in the work necessitated Mistake in drawings.

drawings.

Bidder to inform himself fully.

Contract.

by reason of such inaccurate information or particulars shall be paid for by the Purchaser.

If any dimensions figured upon a drawing or a plan differ from those obtained by scaling the drawing or plan, the dimensions as figured upon the drawing or plan shall be taken as correct.

6. The Bidder shall not, without the consent, in writing of the Engineer or Purchaser, which shall not be unreasonably withheld assign or sublet his Contract, or any substantial part thereof other than for raw materials, for minor details, or for any part of the work of which the makers are named in the Contract, provided that any such consent shall not relieve the Bidder from any obligation, duty, or responsibility under the Contract.

7. In the event of any claim or demand being made or action being brought against the Purchaser for infringement or alleged infringement of letters-patent in respect of any machine, plant, work or thing used or supplied by the Bidder under this Contract or in respect of any method of using or working by the Purchaser of such machine, plant, work or thing, the Bidder will indemnify the Purchaser against such claim or demand and all costs and expenses arising from or incurred by reasons of such claim or demand **PROVIDED THAT** the Purchaser shall notify that Bidder immediately any claim is made and that the Bidder shall be at liberty if he so desires with the assistance of the Purchaser if required but at the Bidder's own expenses, to conduct all negotiations for the settlement of the same or any litigation that may arise there from and **PROVIDED THAT** no such machine, plant, work or thing shall be used by Purchaser for any purpose or in any manner other than for which they have been supplied by the Bidder and specified under this Contract.

7-AThe Bidder shall train at his works------Engineer/ Engineers of theTraining ofPurchaser in the manufacture and assembly of machinery and its parts for a period of ------Engineer.------. A separate agreement for such training shall be signed by the Engineer/ EngineersEngineer.selected for training, the Purchaser and the Bidder on the form appended hereto.Figure 1000 mining

8. The Plant shall be manufactured and constructed in the best and most substantial and most workmanlike manner and with materials of the best or of approved qualities for their respective uses. Quality of material.

9. The Bidder shall be responsible for securely protecting and packing the plant so as Packing. to avoid damage under normal conditions of transport.

10. The cost of delivering the whole of the material F.O.R. at the railway station Delivery. specified or on the site as the specification may define and the cost of packing and unless otherwise agreed, import duties and customs dues shall be borne by the Bidder.

11. Except as hereinafter provided, the Purchaser shall, unless otherwise specified be responsible for the proper fencing, guarding, lighting and watching of all works other than transmission lines comprised in the Contract and for the proper provision of temporary, roadways, footways, guards and fences as far as the same may be rendered necessary by reason of the work for the accommodation and protection of foot-passengers or other traffic and of the owners and occupiers of adjacent property and of the public.

The Bidder shall at all time provide sufficient fencing, notice boards lights and watchmen to protect and warn the public and guard the work of transmission lines and in case the Bidder fail to make such provision or the provision made by him is considered by the Purchaser to be inadequate, the Purchaser may make such provisions or further provisions as he may consider necessary and charge the cost thereof to the Bidder.

If during the period of erection of a plant the Bidder or his workmen or servants shall injure or destroy any part of a building or other structure contiguous to the work in progress or if any damage shall be caused from any cause whatsoever to other works (whether in progress or completed) forming part of the work for which the plant is being installed or if any imperfections become apparent in these works the causes of which imperfections are For all works.

Fencing and

lighting for

works other

transmission

transmission

than

lines.

For

lines.

attributable to the Bidder or his workmen or servants, the Bidder shall make good such damages and imperfections and if he fails to do so within a reasonable time, the Purchaser may cause the same to be made good and may deduct the cost thereof from any sum that may then or at any time thereafter become due to the Bidder or from his security deposit or the proceeds of sale thereof or of a sufficient portion thereof or may recover it otherwise.

12. No alterations, amendments, omissions, additions, suspensions or variations of the work (hereinafter referred to as "variations") under the Contract as shown by the Contract drawings of the Specification shall be made by the Bidder except as directed in writing by the Engineer; but the Engineer shall have full power, subject the proviso hereinafter contained, from time to time during the execution of the Contract by notice in writing to instruct the Bidder to make such variation without prejudice to the Contract, and the Bidder shall carry out such instructions and be bound by the same conditions as far as applicable, as through the said variations occurred in the Specification. If any suggested variations would, in the opinion of the Bidder, if carried out, prevent him from fulfilling any of his obligations or guarantees under the Contract, he shall notify the Engineer thereof in writing, and the Engineer shall decide forthwith whether or not the same shall be carried out, and if the Engineer confirms his instructions, the Bidder's obligations and guarantees shall be modified to such an extent as may be justified. The difference of cost, if any occasioned by any such variations, shall be added or deducted from Contract price as the case may require. The amount of such difference, if any, shall be ascertained and determined in accordance with the rates specified in the Schedules of Prices, so far as the same may be applicable and where the rates are not contained in the said Schedules or are not applicable, they shall be settled by the Engineer and Bidder, jointly, as far as possible, before such variations are carried out: Provided that the Purchaser shall not become liable for the payment of any charge in respect of any such variations, unless the instruction for the performance of the same shall have been given in writing by the Engineer.

In the event of the Engineer requiring any variations, such reasonable and proper notice shall be given to the Bidder as will enable him make his arrangements accordingly, and in cases where goods or materials have already been prepared or any designs, drawings or patterns have been made or work done that require to be altered, the Engineer shall allow such compensation in respect thereof as he shall consider reasonable:

Provided that no such variation shall except with the consent in writing of the Bidder, be such as will involve an increase or decrease of the total price payable under the Contract by more than 10 per cent thereof.

In every case in which the Bidder shall receive instructions from the Engineer for carrying out any work which either then or later will in the opinion of the Bidder, involve a claim for additional payment, the Bidder shall, as soon as reasonably possible after the receipt of such instructions, inform the Engineer of such claim for additional payment.

13. If the Bidder shall neglect to execute the work with due diligence and expedition, or shall refuse or neglect to comply with any reasonable orders given him in writing by the Engineer in connexion with work, or shall contravene any provision of Contract the Purchaser may give seven days' notice in writing to the Bidder, to make good the failure, neglect or contravention complained of and if the Bidder shall fail to comply with the notice within a reasonable time from the date of service thereof in the case of a failure, neglect, or contravention capable of being made good within that time, then and in such case the Purchaser shall be at liberty to employ other workmen and forth with perform such work as the Bidder may have neglected to do, or if the Purchaser shall think fit, it shall be lawful for him to take the work wholly, or in part out of the Bidder's hands and give it to another person on contract at a reasonable price or provided any other materials, tools, tackle or labour for the purpose of completing the work, or any part thereof, and in that event the Purchaser shall, without being responsible to the Bidder for fair wear and tear of the same, have the free use of all the materials, tools, tackle, or other things which may be on the site, for use at any time in connection with the work to the exclusion of any right of the Bidder over the same, and the Purchaser shall be entitled to retain and apply any balance which may be otherwise due on the Contract by him to the Bidder such part thereof as may be necessary, to the payment of the cost of executing such work as aforesaid.

Power to vary or omit work.

Negligence.

If the cost of executing the work as aforesaid shall exceed the balance due to the Bidder, and the Bidder fails to make good the deficiency the Purchaser may recover it from the Bidder in any lawful manner or the Purchaser may sell the said materials, tools, tackle or other things belonging to the Bidder, and the proceeds of such sale shall be applied towards the payment of such deficiency and the costs of and incidental to such sale and any balance remaining after crediting the same shall be paid to the Bidder on the certificate of the Engineer, provided that when all expenses, cost and charges incurred in the completion of the work are paid by the Bidder, all such materials, tools, tackle or other things remaining unsold shall be removed by the Bidder.

14. If the Bidder shall die or commit any act of bankruptcy, or being a corporation commence to be wound up except for reconstruction purposes or carry on its business under a Receiver, the executors, successors or other representative in law of the estate of the Bidder or any such Receiver Liquidator or any person in whom, the Contract may become vested shall forthwith give notice thereof in writing to the Purchaser and shall for one month during which he shall take all reasonable steps to prevent a stoppage of the works, have the option of carrying out the Contract subject to his or their providing such guarantee as may be required by the Purchaser but not exceeding the value of the work for the time being remaining unexecuted. In the event of stoppage of the works the period of the option under this clause shall be fourteen days only: Provided that should the above option not be exercised, the Bidder may be determined by the Purchaser by notice in writing to the Bidder and the Purchaser may exercise the same power which he could have under the proceeding clause if the work had been taken out of Bidder's hands under that clause.

15. The Engineer and his duly authorized representatives shall have and at all reasonable times access to the Bidder's premises, and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the plant during its manufacture there; and if part of the plant is being manufactured on other premises the Bidder shall obtain for the Engineer and for his duly authorized representative permission to inspect it as the plant was manufactured on the Bidder's own premises.

The Engineer shall, on giving seven days' notice in writing to the Bidder setting out any grounds of objections which he may have in respect of the work, be at liberty to reject all or any part or workmanship connected with such work which in his opinion are not in accordance with the Contract or are in his opinion defective for any reason whatever : Provided that, if such notice be not sent to the Bidder within reasonable time after the grounds upon which such notice is based have come to the knowledge of the Engineer he shall not be entitled to reject the said plant or workmanship on such grounds Unless specifically provided otherwise all tests shall be made at the Bidder's work before shipment.

The Bidder shall, if required give the Engineer notice of any materials being ready for testing, and the Engineer or his said representative if so desired shall, on giving twenty-four hours' previous notice in writing to the Bidder, attend at the Bidder's premises within seven days of the date on which the material is notified as being ready, failing which visit the Bidder may proceed with the tests which shall be deemed to have been made in the Engineer's presence, and he shall forthwith forward to the Engineer duly certified copies of the tests in duplicate.

In all cases where the Bidder provides for tests whether at the premises of the Bidder or of any Sub-Bidder, the Bidder, except where otherwise specified shall provide free of charges such labour, materials, electricity, fuel, water stores, apparatus and instruments as may reasonably be demanded to carry out efficiently such tests of the plant in accordance with the contract and shall give facilities to the Engineer or to his authorized representative to accomplish such testing.

If special tests other than those specified in the Contract are required they shall be paid for by the Purchaser as "variations" under clause 12.

Death, Bankruptcy etc.

Inspection.

Test at Bidder's premises.

When the tests have been satisfactorily completed at the Bidder's works the Engineer shall issue a certificate to the effect. In all cases where the Contract provides for test on the site the Purchaser, except where otherwise specified, shall provide, free of charges, such labour, materials, electricity, fuel, water, stores apparatus and instruments as may be required from to time and as may reasonably be demanded efficiently to carry out such test of the plant or workmanship in

16. No plant shall be forwarded until shipping instruction shall have been given to the Bidder.

accordance with Contract. In the case of the Bidder requiring electricity for tests on site such electricity shall be supplied to the Bidder in the most convenient form available.

Notification of delivery or dispatch in regard to each and every consignment shall be made to the Purchaser immediately after dispatch or delivery. The supplier shall further supply to the consignee a priced invoice and packing account of all stores delivered or dispatched by him. All packages, containers, bundles and loose materials forming part of each and every consignment shall be described fully in the packing account, and full details of the content of packages and quantity of materials shall be given to enable the consignee to check the stores on arrival at destination.

17. The suitable access to and possession of the site shall be afforded to the Bidder by the Purchaser in reasonable time, and the Purchaser shall have any foundations to be provided by him ready when required by the Bidder. Where a crane is available, its safe lifting capacity shall be stated in the Specification, and it shall be available for free use of the Bidder until the plant is taken over.

The work, so far as it is carried out on the Purchaser's premises, shall be carried out at such time as the Purchaser may approve and so as not to interfere unnecessarily with the conduct of the Purchaser's business, but the Purchaser shall give the Bidder all reasonable facilities for carrying out the work.

No person other than the Bidder, Sub-Bidders, and workmen and the Bidder's duly authorized agents shall, except with the special permission in writing of the Engineer or his representative, be allowed to do any work on the site in connection with the erection of the work, but access to the works shall at all times be accorded to the Engineer and his representatives and other authorized officials or representatives of the Purchaser.

The Bidder shall permit the execution of work by other Bidders or tradesmen whose names shall have been previously communicated in writing to the Bidder by the Engineer, and afford them every facility for the execution of their several works simultaneously with his own.

The Purchaser shall provide all the unskilled labour and facilities necessary for the execution of work included in the Contract unless otherwise specified.

18. All the work shall be carried out under the direction and to the reasonable satisfaction of the Engineer. If supervision of the erection or complete erection is included in the Contract, the Bidder shall be responsible for the correctness of the positions, levels and dimensions, of the work according to the drawings notwithstanding that he may have been assisted by the Engineer in setting out the same.

19. In respect of all matters which are left to the decision of the Engineer, including the granting or withholding of certificates, the Engineer shall, if required so to do by the Bidder, give in writing a decision thereon and his reason for such decision. If the decision is not accepted by the Bidder the matter will, at the request of the Bidder, be referred to arbitration under the provision for arbitration hereinafter contained but subject to this right of reference to arbitration such decision shall be final and binding on the Bidder.

Only applicable to complete erection contract.

Access to site

and work on

site.

Delivery of

plant.

Engineer's supervision.

Engineer's decision.
20. If the supervision of erection or complete erection is also included in the Contract, the Bidder shall employ at least one competent representative, and whose name or names shall have previously been communicated in writing to the Engineer by the Bidder to superintend the erection of the plant and the carrying out of the works. The said representative, or if more than one shall be employed then one of such representatives, shall be present on the site during working hours, and any written orders or instructions which the Engineer or his duly authorized representative whose name shall have been previously communicated in writing to the Bidder may give to the said representative of the Bidder shall be deemed to have been given to the Bidder.

The Engineer shall be at liberty to object to any representative or person employed by the Bidder in the execution of or otherwise about the works who shall in his opinion misconduct himself or be incompetent or negligent and the Bidder shall remove the person so objected to upon receipt from the Engineer of notice in writing requiring him to do so and shall provide in his place a competent representative at the Bidder's expense

The Purchaser shall provide suitable living accommodation on the site for the use of Bidder's representative unless the Bidder exempts him from this liability.

21. The Bidder shall be responsible for loss, damage or depreciation of the plant until the same is taken over under clause 35 or is deemed under that clause to have been taken over : Provided always that the Bidder shall not be responsible for any such loss, damage and depreciation occurring during such period that the plant is operated by the Purchaser's staff prior to being taken over in accordance with clause 35.

Until the plant is taken over is deemed to have been taken over as aforesaid, the Bidder shall also be liable for and shall indemnify the Purchaser in respect of all injury to person or damage to property resulting from the negligence of the Bidder or his workmen or sub-Bidders or from defective design, or work, but not from other cause :

Provided that the Bidder shall not be liable for any loss of profit or loss of Contract or any other claim made against the Purchaser not already provided for in the Contract, not for any injury or damage caused by or arising from the acts of the Purchaser or of any other person or due to circumstances over which the Bidder has no control, nor shall his total liability for loss, damage, or injury in this clause exceed the total value of Contract.

The Bidder will indemnify and save harmless the Purchaser against all actions, suits, claims, demands, costs, or expenses arising in connexion with injuries (other than such as may be attributable to the Purchaser or his employees) suffered prior to the date when the plant shall have been taken over under clause 35 here of by persons employed by the Bidder or his sub-Bidder on the work, whether at Common Law or under the Workmen's Compensation Act, 1923 or any other statute in force at the date of contract relating to the question of the liability of employers for injuries suffered by employees, and will if called upon to do so take out the necessary policy of insurance to cover such indemnity.

In the event of any claim being made, or action brought against the Purchaser involving the Bidder and arising out of the matters referred to and in respect of which the Bidder is liable under this clause, the Bidder shall be immediately notified there of and he shall with the assistance, if he so requires, of the Purchaser but at the sole expense of the Bidder conduct all negotiations for the settlement of the same or any litigation that may arise there from. In such case, the Purchaser shall, at the request and expense of the Bidder, afford all reasonable and available assistance for any such purpose.

22. The Bidder shall insure the plant, and shall keep it insured against loss by theft, destruction or damage by fire, flood, under exposure to the weather, or through riot, civil commotion, war or rebellion, for the full value of the plant from the time of delivery of f.o.b. British Port until the plant is taken over under clause 35. This insurance shall also cover loss by theft on site in the case of Contracts where the Bidder is responsible for complete erection, but not in other cases,

Bidder's representatives and workmen.

Liability for accidents and damage.

Only applicable complete erection Contract.

Insurance.

23. If during the progress of the work the Engineer shall decide and notify in writing to the Bidder that the Bidder has executed any unsound or imperfect work or has supplied any plant inferior in quality to that specified the Bidder on receiving details of such defects or deficiency shall, at his own expense, within such time as may be reasonably necessary for making it good, proceed to alter, reconstruct or remove such work, or supply fresh materials up to the standard of the Specification and in case the Bidder shall fail so to do, the Purchaser may, on giving the Bidder seven days' notice in writing of his intention so to do, proceed to remove the work complained of, and, at the cost of the Bidder, perform all such work or supply all such material, provided that nothing in this clause shall be deemed to deprive the Purchaser of or affect any right under the contract, which he may otherwise have in respect of such defects or deficiencies.

24. All costs, damages expenses which the Purchaser may have paid, for which under the Contract the Bidder is liable, may be deducted by the Purchaser from any moneys due or which may become due by him to the Bidder under the Contract, or may be recovered by suit or otherwise from the Bidder.

Any sum of money due and payable, to the Bidder (including security deposit returnable to him) under this contract may be appropriated by the Purchaser and set off against any claim of the Purchaser for the payment of a sum of money arising out of or under any other contract made by the Bidder with the Purchaser.

25 (1) Subject to any deduction which the Purchaser may be authorized to make under the Contract, or subject to any additions or deductions provided for under clause 12, the Bidder shall be entitled to payments as follows:

- (a) Eighty per cent of the F.O.R. Contract value of the plant in rupees on receipt by the Purchaser of the Bidder's invoice giving the number and date of railway receipt covering the dispatch of the plant from Indian Port and of the advice note giving case number and contents, together with a certificate by the Bidder to the effect that the plant detailed in the said advice note has actually been dispatched under the said railway receipt and that the Contract value of the said plant so dispatched is not less than the amount entered in the invoice.
- (b) Ten per cent of the F.O.R. Contract value of the plant on satisfactory completion of test and taking over of the plant.
- (c) Ten percent of the F.O.R. Contract value of the plant at the end of twelve month from the date of taking over.
- (d) For the erection of the plant, in proportion of the progress of the work on the receipt by the Purchaser of monthly invoices submitted by the Bidder supported by the certificates of the Engineer.

(2) If the time at which either of the instalments due under sub-clauses (b) and (c) of clause (1) hereof become payable there are minor defects in the plant which are not of such importance as to effect the full commercial use of the plant, then the Purchaser shall be entitled to retain only such part of the instalment then due as represents the cost of making good such minor defects and any sum so retained shall, subject to the provisions of clause 36 become due upon such minor defects being made good.

(3) If the Purchaser desires that the plant or any portion thereof should not be dispatched by the Bidder when it is due for dispatch, the Bidder shall store such plant or portion at his works and be responsible for all risk. For such storage the Purchaser shall pay to the Bidder at a rate to be mutually agreed upon between the parties but not exceeding 5s (Five shillings) per ton per week, payable quarterly plus interest at one per cent per annum above the current rate of the State Bank of India on 80 per cent of the Contract value of the plant or portion thereof so stored, for the period from the date on which the said plant or portion become due and is ready for shipment up to the date on which it is actually shipped.

Replacement of defective work or materials.

Deductions from contract price.

Terms of payment.

25. A. In the event of the supplier / Bidder / company not being able to supply the materials or to carry out works in accordance with the terms of this contract, the Government / Purchaser / Owner shall have the right to recover any sum advanced in accordance with the clause 25 from the supplier / Bidder / company and from his / its assets.

26. In any case where the Contract price includes a provisional sum to be provided by the Bidder for meeting the expense of extra work or for work to be done or materials to be supplied by a Sub-Bidder, such sum shall be expended or used, either wholly or in part, or be not used, at the discretion of the Engineer and entirely as he may decide and direct. If no part or only a part thereof be used then the whole or the part not used as the case may be, shall be deducted from the Contract price. If the sum used is more than such provisional sum the Bidder shall pay the excess. In the case of materials supplied on work done by a Sub-Bidder the total of the net sums paid to the Sub-Bidder on account of such materials or work and a sum equal to 10 per cent of such net sum allowed as Bidder's profit shall be deemed to be the sum used. None of the works or articles to which such sum of money refers shall be done or purchased without the written order of the Engineer. The Bidders shall allow the Sub-Bidders every facility for the supply of materials or execution of their several works simultaneously with his own and shall within fourteen days after the Engineer has requested him in writing so to do, pay the dues of such Sub-Bidders on account of such materials or work PROVIDED ALWAYS that the Bidder shall have no responsibility with regard to such work or articles unless he shall have previously approved the Sub-Bidder and/or the material or plant to be supplied.

27. Every application to the Engineer for a certificate must be accompanied by a detailed invoice (in duplicate) setting forth in the order of the Schedule of prices, particulars of the work executed, and the certificate as to such plant or work as in the reasonable opinion of the Engineer in accordance with the Contract shall be issued within fourteen days if possible or for other than (the first payment within such time of application for) the same as is reasonably necessary for communication with the site.

The Engineer may by any certificate make any correction or modification in any previous certificate which shall have been issued by him and payments shall be regulated and adjusted accordingly.

28. Payment shall be due and payable by the Purchaser in accordance with the provisions of clause 25 hereof at the end of the month following that in which invoices for the amounts due together with necessary documents are received by the Purchaser, provided that the Purchaser shall not be bound to make any payment represents at least 8 percent of the total Contract value of the plant.

29. (1) No certificate of the engineer on account nor any sum paid on account by the Purchaser, nor any extension of time granted under clause 31 shall effect or prejudice the rights of the Purchaser against the Bidder either under this Agreement or under the law or relieve the Bidder of his obligations for the due performance of the Contract, or be interpreted as approval of the work done or of the materials supplied.

(2) No certificate of the Engineer shall create liability in the Purchaser to pay for any alterations, amendments, variations or additional work not ordered in writing by the Engineer or absolve the Bidder of his liability for the payment of damages whether due, ascertained or certified or not of any sum against the payment of which he is bound to indemnify the Purchaser nor shall any such certificate nor the acceptance by him of any sum paid on account or otherwise affect or prejudice the rights of the Bidder against the Purchaser under this Agreements or under the law.

30. The Purchaser shall pay to the Bidder all reasonable expenses incurred by the Bidder by reason of suspension of the works of delay in shipment by order in writing of the Purchaser or the Engineer unless such suspension shall be due to some default on the part

Provisional sums.

Certificates of Engineer.

Due dates of payment.

Certificates not to affect rights of the Purchaser or Bidder.

Suspension of works.

of the Bidder or Sub-Bidder.

31. The time given to the Bidder for despatch, delivery, erection or completion, as the case may be, shall be reckoned from the date of receipt by the Bidder of the order, together with all necessary information and drawings to enable the work to be put in hand.

In all cases in which progress shall be delayed by strikes, lockouts, fire, accident, defective materials, delay in approval of drawings or any cause whatsoever beyond the reasonable Control of the Bidder, and whether such delay or impediment shall occur before or after the time or extended time, for dispatch, erection or completion, a reasonable extension of time shall be granted.

32. If the Bidder shall fail in the due performance, of his Contract within the time fixed by the Contract or any extension thereof, the Bidder agrees to accept a reduction of the Contract price by 1/2 (half) per cent per week reckoned on the Contract value of such portion only of the plant as can not in consequence of the delay be used commercially and efficiently during each week between the appointed or extended time as the case may be and the actual time of acceptance under clause 35, and such reduction shall be in full satisfaction of the Bidder's liability for delay but shall not in any case exceed 10 (ten) per cent of the Contract value of such portion of the plant.

33. Whenever possible all tests shall be carried out before shipment. Should, however, it be necessary for the final tests as to performance and guarantees to be held over until the plant is erected at site they shall be carried out in the presence of the Bidder's representative within one month of the completion of erection. If the result of these tests shall not come within the margin specified, the tests shall, if required, be repeated within one month from the date the plant is ready for re-test, and the Bidder shall repay to the Purchaser all reasonable expenses to which he may be put by such tests.

34. If the completed plant, or any portion thereof, before it is taken over under clause 35, be found to be defective, or fail to fulfil the requirements of the Contract, the Engineer shall give the Bidder notice setting fourth particulars of such defects or failure, and the Bidder shall forthwith make the defect good, or alter the same to make it, comply with the requirements of Contract. If the Bidder fails to do so with a reasonable time, the Purchaser may reject and replace, at the cost of the Bidder, the whole or any portion of the plant, as the case may be, which is defective or fails to fulfil the requirements of the Contract, such replacement shall be carried out by the Purchaser within a reasonable time and at a reasonable price, and where reasonably possible to the same specification and under competitive conditions. In case of such replacement by the Purchaser, the Bidder shall be liable to pay to the Purchaser the extra cost, if any, of such replacement delivered and /or erected as provided for the original Contract, such extra cost being the ascertained difference between the price paid by the Purchaser under the provisions above mentioned, for such replacement and the Contract price for the plant so replaced, and also to repay any sum paid by the Purchaser to the Bidder in respect of such defective plant. If the Purchaser does not so replace the rejected plant within a reasonable time, the Bidder shall be liable only to repay to the Purchaser all money paid by the Purchaser to him in respect of such plant.

In the event of such rejection, the Purchaser shall be entitled to the use of the plant in reasonable and proper manner for a time reasonably sufficient to enable him to obtain other replacement plant. During the period the rejected plant is used commercially the Bidder shall be entitled to a reasonable sum as payment for such use.

35. Where the specification calls for performance tests before shipment and these have been successfully carried out, the plant shall be accepted and taken over when it has been satisfactorily put into operation on site, or within one month of its being ready to be put into operation, whichever shall be the earlier and the Engineer shall forthwith issue a Taking-over Certificate.

In the event of final or any outstanding test being held over until the plant is erected such, taking-over Certificate shall be issued subject to the results of such final or Extension of time for completion.

Damages for delay in completion.

Tests on completion.

Rejection of defective plant.

Taking over.

outstanding tests shall be carried out in accordance with clause 33.

When the specification calls for tests on site the plant shall be taken over and the Taking-over Certificate issued immediately after such tests have been satisfactorily carried out.

If for any reason other than the default of the Bidder such last mentioned tests on site shall not be carried out within one month of notice by the Bidder to the Purchaser of the plant being ready for test the plant shall be deemed to have been taken over as on the last day of the such period and payments due to the Bidder shall if called upon so to do by the Purchaser, but at the Purchaser's expense, make the said test during the maintenance period and accept as aforesaid under the same obligations as specified in clause 33.

The Engineer shall not delay the issue of any Taking-over Certificate contemplated by this clause on account of minor deficiencies of material or defects in the plant which do not materially affect the commercial use thereof provided that the Bidder shall undertake to make good the same in due course.

36. For a period of 12 (twelve) calendar months commencing from the date on which the plant is taken over or is deemed to have been taken over under clause 35 (called "the maintenance period") the Bidder shall remain liable to replace any defective parts that may develop in plant of his own manufacture or those of his Sub-Bidders approved under clause 6 under the conditions provided for by the Contract under proper use and arising solely from faulty design, materials or workmanship provided always that such defective parts are not repairable at site and are not essential in the meantime to the maintenance in commercial use of the plant are promptly returned to the Bidder's works at the expenses of the Bidder unless otherwise arranged.

If it becomes necessary for the Bidder to replace or renew any defective parts of the plant under this clause, the provisions of the first paragraph of this clause shall apply the parts of the plant so replaced or renewed until the expiration of six months from the date of such replacement or renewal or until the end of the above mentioned period of twelve months, whichever may be the later. If any defects be not remedied within a reasonable time the Purchaser may proceed to do the work at the Bidder's risk and expense, but without prejudice to any other rights which the Purchaser may have against the Bidder in respect of such defects.

The repaired or new parts will be delivered in accordance with clause 10. The Bidder shall bear reasonable cost of minor repairs carried out on his behalf at site.

At the end of the maintenance period the Bidder's liability shall cease. In respect of goods not covered by the first paragraph of this clause, the Purchaser shall be entitled to the benefit of any guarantee given to the Bidder by the original supplier or manufacturer of such goods.

37. The Purchaser shall, throughout the continuance of the Contract and in respect of all matters arising in the performance thereof, serve all notices and obtain all consents, way-leaves, approvals, and permission required in connexion with the regulations and by-laws of any local or other authority which shall be applicable to the works.

All work shall be executed in accordance with the Indian Electricity Rules 1956, and any statutory modifications thereof, wherever are applicable, unless otherwise agreed to in writing by the Engineer.

38. If any dispute, difference or controversy shall at any time arise between the Bidder on the one hand and the U.P. Power Transmission Corporation Limited and the Engineer of the Contract on the other touching the Contract, or as the true construction, meaning and intent of any part or condition of the same, or as to manner of execution, or as

Maintenance.

Regulations of local authorities.

Arbitration.

to the quality or description of, or payment for the same, or as to the true intent, meaning interpretation, construction or effect of the clauses of the contract, specification or drawings or any of them, or as to any thing to be done, omitted or suffered in pursuance of the contract or specification, or as to the mode of carrying the contract into effect, or as to the breach or alleged breach of the contract, or as to any claims on account of such breach or alleged breach, or as to obviating or compensating for the commission of any such breach, or as to any other matter or thing whatsoever connected with or arising out of the contract, such question, difference or dispute shall be referred for adjudication to the Chairman U.P. Power Transmission Corporation Limited or to any other person nominated by him in this behalf and his decision in writing shall be final, binding and conclusive. This submission shall be deemed to be a submission to arbitration within the meaning of the Indian Arbitration Act, 1940 or any statutory modification thereof. The arbitrator may from time to time with consent of the parties enlarge the time for making and publishing the award.

Upon every or any such reference, the costs of and incidental to the reference and award respectively shall be in the discretion of the arbitration who shall be competent to determine the amount thereof or direct the same to be taxed as between solicitor and client or as between party and party and to direct by whom and to whom in what manner the same shall be borne and paid.

Work under the contract shall, if reasonably possible, continue, during the arbitration proceedings, and no payment due or payable by the Corporation shall be withheld on account of such proceedings. In case of refusal / neglect by such nominee Chairman, U.P. Power Transmission Corporation Limited may nominate another person in his place.

construction of such clause.

38 A. Any action taken or proceedings initiated on any of the terms of this agreements shall be only in the court of competent Jurisdiction under the High court of Judicature at Allahabad.
 39. The contract shall in all respects be constructed and operated as a Contract as defined in the Indian Contract Act, 1972, and all the payments there-under shall be made in the rupees unless otherwise specified.
 40. The marginal notes to any clause of this Contract shall not affect or control the Marginal Notes

FORM OF AGREEMENT

(Referred to in Clause 3)

AND WHEREAS the Purchaser has accepted the Bid of the Bidder for the provision and executing of the said work for the sum of upon the terms and subject to the conditions hereinafter mentioned NOW THESE PRESENT WITNESS and the parties hereto hereby agree and declare as follows: that is to say, in consideration of the payments to made to the Bidder by the Purchaser as hereinafter mentioned the Bidder shall duly provide the plant for the said works and shall do and perform all other works and things in the Contract mentioned or described or which are implied there from or therein respectively or may be reasonably necessary for the completion of the said works within and at the times and in the manner and subject to the terms, conditions and stipulations mentioned in the said Contract.

AND in consideration of the due provision, erection, execution, construction and completion of the said works and the maintenance thereof as aforesaid the Purchaser will pay to the Bidder the said sum of or such other sums as may become payable to the Bidder under the provisions of this Contract such payments to be made at such time and in such manner as is provided by the Contract.

IN WITNESS WHEREOF the parties hereto have signed this deed hereunder on the dates respectively mentioned against the signature of each:

Signed	Signed	
(for and on behalf of the Purchaser) By	(date)	(Bidder)
in the presence of and of	in the presence of and of	(date)
and of	and of	

FORM OF AGREEMENT

(Referred into Clause 7-A)

WHEREAS the U.P. Power Transmission Corporation Limited (hereafter called "the Corporation") have selected the Engineer for practical training and the Company / Firm have agreed to give the said practical training to the Engineer on the conditions herein after appearing

NOW THIS INDENTURE WITNESSES as follows

1. The Engineer binds himself to receive practical training on [†]..... for a term of at least ^{††}..... with the Company / Firms.

2. The Engineer covenants with the Corporation and the Company/Firms as follows:

(a) That his passage to and back on completion of his period of training will be paid by the Corporation admissible to^{†††}class of Government servants, subject to the conditions specified below.

(b) That he will during the said term receive from the Corporation no remuneration but the salary he has been receiving before proceeding on deputation and such allowances, if any, as the Corporation may decide.

(c) That he shall, during the period of deputation with the Company / Firm, be under the direct control of the Company / Firm and will abide by all their rules.

(d) That he shall keep diaries of work done and experience gained by him and will submit them periodically to the Chief Engineer of U.P. Power Transmission Corporation Ltd. for information.

(e) That he shall not absent himself without sanction of Company / Firm for any cause whatsoever.

(f) That in case of disobedience, insubordination, unsatisfactory work or breach of any of the conditions herein contained the company / Firm may, for reasons recorded in writing, terminate the training of the Engineer with the concurrence of the Corporation. In case it does so without such concurrence it shall be liable to pay all expenses and charges incurred by the Corporation subsequent to such termination provided that the Corporation considers the ground on which the training was terminated to be insufficient. After the grounds have been considered to be insufficient, if the Company / Firm refuses to resume the Engineer's training it shall further be liable to pay the passage of the Engineer back to India.

(g) That he shall not hold the Corporation liable for damages or compensation for any injury suffered by him through an accident or by reason of any wrongful act, neglect or default of the Company / Firm or its servants or agents or from any other cause while employed as such Engineer.

(h) That in the event of the period of training being terminated for the reasons specified in clause (f), the Engineer shall forfeit his claim to the return passage which will be granted only on satisfactory completion of the period of training in question.

IN WITNESS WHEREOF the parties hereto have hereunto set their hands the day and the year first above written.

Signed by

Signed by

()*	()*
	**	and	
(Engineer)		()*
In the presence	of	On behalf of the Corpor in the presence of	ration and the Company / Firm
1		1	
()*	()*
	**		**
2		2	
()*	()*
	**		**
 + Nature of training + Period ++ Class of Governmer * Name in Capital Letter ** Complete Postal addre 	nt servant rs ss of person signed.		

<u>GTR-1</u>

AUXILLIARY STRUCTURES

SI . No.	Туре	Strs. Drg.	Bill of material of	Meant for use for equipment	Wt. of Structures (Kg.)		Anchor bolts required for structures	Height in metres
			structures		With anchor bolts	Without anchor Bolts	(25 mm)	
1.	2.	3.	4.	5	6.	7.	8	9
1.	ABL	W-04712	2 Sheets	33 KV LI & BI	378.62	359.92	8	2.6
2.	BBL	W-04713	4 Sheets	132 KV LI & BI	531.122	512.68	8	2.6
3.	BTI	W-04722	4 Sheets	132 KV T.I.	639.556	584.23	24	2.6
4.	ALP	W-04747	2 Sheets	All L.A., 33 KV P.T. & 33 kV C.Ts & All P.I	130.246	121.03	4	2.6
5.	BCT	W-04746	2 Sheets	220/132 KV C.T., P.T. and CVT	198.352	179.91	8	2.6
6.	CBT	W-04748	4Sheets	220KV B.I. & T.I.	792.776	737.450	24	2.6
7.	CLI	W-04748	5Sheets	220KV L.I.	803.796	748.110	24	2.6

DRAWINGS

OF

AUXILIARY STRUCTURES













PROFORMA FOR PERFORMANCE BANK GUARANTEE U.P. POWER TRANSMISSION CORPORATION LIMITED

contract provide that in order to take 100% payment of the contract value the Bidder shall furnish to the Purchaser a Bank Guarantee in the sum of 10% value of each consignment dispatched valid for

AND WHEREAS instead of furnishing separate guarantees as aforesaid the Bidder wishes to furnish one guarantee in the sum of 10% value of the Contract valid for.....and reckoned from the date....

NOW THIS DEED WITHNESS AS FOLLOWS

1. In consideration of the premises the Guarantor hereby undertakes that the Bidder shall duly supply the aforesaid material of the correct quantity and strictly in accordance with the said contract failing which the guarantor shall pay to Purchaser on demand such amount or amounts as the guarantor may be called upon to pay to the maximum aggregate of Rs...... being 10% or the contract value.

2. The Guarantor shall pay to the Purchaser on demand the sum under clause 1 above without demur and without requiring the Purchaser invoke any legal remedy that may be available to it to compel the guarantor to pay the same or to compel such performance by the Bidder. Provided that where the guarantor considered the demand of the Purchaser unjustified, shall nevertheless pay the same though under protest to the Purchaser and shall not withhold payment on that account.

4. The guarantee herein contained shall not be affected by any change in the constitution of the Guarantor or of the Bidder.

5. Any account settled between the Bidder and the Purchaser shall be conclusive evidence against the Guarantor on the amount due and shall not be questioned by the Guarantor.

6. The neglect or forbearance of the Purchaser in enforcement of payment of any moneys the payment where of is intended be here by secured or the giving of time by the Purchaser for the payment there of shall in no way relieve the Guarantor of its liability under this deed.

7. The Purchaser and the Bidder will be at liberty to carry out any modifications in the said contract during the terms of the said contract and extension thereof, notice of which modification to the Guarantor is hereby waived.

8. The expressions 'The Purchaser' 'The Guarantor' and 'The Bidder' shall unless there by any thing refulgent to the subject or context include their respective successors and assigns.

IN WITNESS HEREOF

For and on behalf of guarantor has signed this deed, on the day and year first above written. Witness :

1.Signed by

2. For and on behalf of the Guarantor

PROFORMA OF GUARANTEE BOND FOR SECURITY DEPOSIT

(To be used by approved Scheduled Bank)

dated.....made between....

production of a Bank Guarantee for Rs.....only).

WeBank Ltd., (hereinafter referred to as "the bank") do hereby undertake to pay to the Corporation an amount not exceeding Rs.....against any loss or damage caused to or suffered or would be caused to or suffered by the Corporation by reasons of any breach by the said Bidder (s) of any of the terms or conditions contained in the said Agreement.

2. We.....Bank Ltd., do hereby undertake to pay the amount due and payable under this guarantee without any demur, merely on a demand from the Corporation stating that the amount claimed is due by way of loss or damage caused to or would be caused to or suffered by the Corporation by reason of any breach by the said Bidder (s) of any of the terms or conditions contain in the said agreement or by reason of the Bidder (s) failure to perform 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.....

4. We.....Bank Ltd., further agree with the Corporation that the Corporation shall have the fullest liberty without our consent and without effecting in any manner our obligations hereunder to very any of the terms and conditions of the said Agreement or to extend time of performance by the said Bidder (s) for time to time or to post pone for any time or from time to time any of the powers exercisable by the Corporation against the said Bidder (s) and to fore bear or enforce any of the terms and conditions relating to the s aid Agreement and we shall not be relieved from our liability by reason of any such variation, or extension, or extension being granted to the said Bidder (s) or for any forbearance, act or omission on the part of the Corporation or any indulgences by the Corporation to the said Bidder (s) or by any such matter or things whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

5. WeBank Ltd., lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Corporation in writing.

Dated......20

ForBank Ltd.,

FORM OF BANK GUARNATEE

(For depositing earnest money in case the amount for deposit exceeds Rs.5,000.00)

To, Superintending Engineer Electricity Substation Design Circle-I U.P.Power Transmission Corporation Limited, Lucknow. Sir, WHEREAS. Messers..... a company incorporated under the Indian Companies Act, its registered office at/ a firm registered under the Indian Partnership Act and having its business of office at.....sonresident ofcarrying on of business under the firm's and style name Messers......at...../Sri.....son of..... resident of.....at...../SriSon of.....Sonresident of ofresident of......of........... partners carrying on business under the firm's name and style of Messersat........which is a registered partnership (hereinafter called "The Bidder") has have in response to your Bid Notice against specification numberforfor to supply and /or execute the works as contained in the Bidder's letter No. AND WHEREAS the Bidder is required to furnish you a Bank guarantee for the sum of

AND WHEREAS the Bidder is required to furnish you a Bank guarantee for the sum of Rs.....as earnest money against the Bidder's offer as aforesaid:

AND WHEREAS We(name of the bank), have, at the request of the Bidder agree to give you his guarantee as hereinafter contained:

NOW THEREFORE, in consideration of the promises We, the undersigned, hereby covenant that the aforesaid Bid of the Bidder shall remain open for acceptance by you during the period of validity as mentioned in the Bid or any extension thereof as you and the Bidder may subsequently agree and if the Bidder shall, for any reason back out, whether expressly or impliedly, from his said Bid during the period of its validity or any extension thereof as aforesaid we hereby guarantee to you the payment of the sum of Rupeeson demand, notwithstanding the existence of any dispute between the U.P.P.T.C.L and the Bidder in this regard AND We hereby further agree as follows:

(a) That you may without affecting this guarantee grant time or other indulgence to or negotiate further with the Bid in regard to the conditions contained in the said Bid and hereby modify these conditions or add there to any further conditions as may be mutually agreed upon between you and the Bidder.

(b) That the guarantee herein before contained shall not be affected by any change in the constitution of our Bank or in the constitution of the Bidder.

(c) That any account settled between you and the Bidder shall be conclusive evidence against us of the amount due here under and shall not be questioned by us.

(d) That this guarantee commencer from the date hereof and shall remain in force till the Bidder, If his Bid is accepted by you, furnishes the security as required under the said specifications and executes a formal agreement as therein provided or (till four months after the period of validity) or the extended period of validity, as the case may be, of Bid, whichever is earlier.

(e) That the expressions "the Bidder" and "The Bank" and "the U.P.P.T.C.L".

Herein used shall, unless such inter-pretation is repugnant to the subject or context, include their respective successors and assigns.

Your faithfully

SECTION-VI

TECHNICAL SPECIFICATIONS OF

EQUIPMENTS AND MATERIAL

TECHNICAL SPECIFICATIONS – INDEX

SI. No.	Tech Specn. No.	ITEM
1.	TS-1A	250 KVA 33 /0.4 KV TRANSFORMERS
2.	TS-2A	245 KV/ 145 KV SF 6 CIRCUIT BREAKERS
3.	TS-2B	36KV SF6 CIRCUIT BREAKERS
4.	TS-3A	245 KV CURRENT TRANSFORMERS
5.	TS-3B	145 KV CURRENT TRANSFORMERS/33 kv current transformers
6.	TS-4A	245 KV CAPACITOR VOLTAGE TRANSFORMERS
7.	TS-4B	145 KV POTENTIAL TRANSFORMERS
8.	TS-4C	36 KV POTENTIAL TRANSFORMERS
9.	TS-5A	245 KV / 145 KV ISOLATORS
10.	TS-5B	36 KV ISOLATORS
11.	TS-6	245/ 145/ 36 KV POST INSULATORS
12.	TS-7	198/ 120/30KV SURGE ARRESTORS
13.	TS-8A	CONTROL & RELAY PANELS SUITABLE FOR SAS
14.	TS-8B	SUBSTATION AUTOMATION SYSTEM
15.	TS-9	0.2 ACCURACY ABT TRIVECTOR ENERGY METERS
16.	TS-10 A	110 V 500 AH BATTERIES
17.	TS-10 B	110V 500AH BATTERY CHARGER & DC DISTRIBUTION BOARD
18.	TS-11	L T DISTRIBUTION BOARD
19.	TS-12	CONTROL CABLE & POWER CABLE
20.	TS-13	LATTICE TYPE MAIN & AUXILIARY STRUCTURE
21.	TS-14	ANCHOR BOLTS
22.	TS-15	CLAMPS & FITTINGS.
23.	TS-16	ANTI FOG TYPE DISC INSULATORS, BUS BAR CONDUCTORS
24.	TS-17	FIRE FIGHTING EQUIPMENTS
25.	тѕ-18	LIGHTING SYSTEM
26.	TS-19	D. G SET
27.	TS-21	AUTOMATIC TRANSFORMER OIL BDV TEST SET
28.	TS-22	EARTHING EQUIPMENT KIT
29.	TS-23	MULSIFYRE SYSTEM

TECHNICAL SPECIFICATION FOR 250 KVA 33 /0 .4 kV CLASS POWER TRANSFORMERS

1.0 STANDARDS

The materials shall conform in all respects to the relevant Indian Standard Specifications with latest amendments indicated below:

Indian Standard	Title	International & Internationally Recognized Standard
ISS-2026	Specification for Power Transformer	IEC 76
ISS - 3347/1967	Specification for Transformer's Porcelain Bushings	DIN 42531,2,3
ISS – 335	Specification for Transformer Oil	BS 148, IEC 296
IS-4237	General requirement for switch-gear & control gear for voltages not exceeding 1000 V.	
ISS-6600/1972	Guide for Loading of Oil immersed transformers	IEC 76
ISS-1271	Insulating Material	
ISS-2099/1973	Specification for high voltage Porcelain Bushings.	BS 148 IEC 36 A
ISS-2393/1980	Cylindrical pins	
ISS-2633/1986	Methods of testing uniformity of zinc coated articles	
ISS-5	Colours of Ready Mixed Paints.	

Equipment conforming to other internationally accepted standards, which ensure equal or higher quality than the standards mentioned above would also beacceptable. In case the Bidder who wish 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 alongwith the offer.

2.0 PRINCIPAL PARAMETERS

2.1 The transformer shall be suitable for outdoor installation with three phase, 50 Hz, conventional type copper wound distribution transformer ,Core type, Oil immersed and naturally cooled (Type ON), 33 kV system in which Neutral is effectively earthed and they should be suitable for service under fluctuation in supply voltage from +10% to -15%. The transformer shall conform to the following specific parameters.

1.	Continuous rated cap	250 kVA	
2.	Rated Voltage HV	33 kV	
3.	Rated Voltage LV	0.4 kV	
4.	Frequency		50 Hz ±5%
5.	No. of phase		Three
6.	Method of connection	on HV	Delta
		LV	Star
7.	Vector Group		Dyll
8.	Type of cooling		ONAN
9.	Percentage impedant tap on kVA base corrating and applicable	ce voltage on normal responding to HV/LV e tolerance as per ISS .	% impedance
	(i) For 250 kVA		4.75%
	(Tolerance ± 10	%)	
10.	. Permissible tempera	ture rise over ambient.	
	i. of top oil measur	ed by thermometer.	40 deg. C.
	ii. of winding meas	ured by resistance	50 deg. C
11.	. Tap changing gear		
	i. Type		Off Load
	ii. Provided on		HV winding
	iii. Tap range		-5% to + 10%
	iv. Tap steps		2.5%
12.	. Insulation Levels for	windings	33 kV
	a) 1.2/50 micro impulse with	second wave shape stand (kVp)	170
	b) Power freque (kV rms)	ency withstand voltage	70
	c) Maximum co system voltag	ontinuous operating ge (kV rms)	36
13.	. Bushings		
(i	i) Voltage rating (a	mps)	36
(ii	Current rating (a	mps)	As per required

- (iii) Insulation Level
 - (a) Lightening impulse withstand 170 (kVp)
 - (b) One minute power frequency 70 withstand voltage (kV rms)

3.0 TECHNICAL REQUIREMENTS

3.1 DESIGN AND STANDARDIZATION

- 3.1.1. The transformer and accessories shall be designed to facilitate inspection ,cleaning ,repairs and for operation, where the continuity of supply is primary consideration. All apparatus shall also be designed to ensure satisfactory operation under such sudden variations of the load and voltage as may be prevalent with under working conditions on the system, including those due to short circuits.
- 3.1.2. The design shall incorporate every reasonable precautions and provision for the safety of all those concerned in the operation and maintenance of the equipment keeping in view the requirements of Indian Electricity Rules.
- 3.1.3. All materials used shall be of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions arising under working conditions without undue distortion or deterioration or the setting up of undue stresses in any part and also without affecting the strength and suitability of the various parts for the work which they have to perform.
- 3.1.4. Corresponding parts liable to replacement shall be interchangeable.
- 3.1.5. Cast iron shall not be used for chambers of oil filled apparatus or for any part of the equipment, which is in tension or subject to impact stresses. This clause is not intended to prohibit the use of suitable grades of cast iron for parts where service experience has shown it to be satisfactory, e.g. large value bodies.
- 3.1.6 All out door apparatus, including bushing insulators with their mounting, shall be designed so as to avoid pockets in which water can collect.
- 3.1.7 Where necessary, means shall be provided for the easy lubrication of all bearings for any mechanism or moving part, that is not oil immersed.
- 3.1.8 All mechanism, where necessary shall be constructed of stainless steel, brass or gun metal to prevent sticking due to rust or corrosion.
- 3.1.9 All taper pins used in any mechanism shall be of the split type complying with the relevant Standards.
- 3.1.10 All connection and contacts shall be of ample section and surface for carrying continuously the specified currents without undue heating and fixed connections

shall be secured by bolts or set screws of ample size, adequately locked. Lock nuts shall be used on stud connections carrying current.

3.1.11 All apparatus shall be designed to minimize the risk of accidental short circuit caused by animal, birds of vermin.

4.0.0 GALVANIZING

- 4.0.1 Galvanizing shall be applied by hot dipped process or by electro galvanizing process for all parts and shall consist of a thickness of zinc coating equivalent to not less than 610 gm zinc per square meter of surface. The zinc coating shall be smooth, clean and of uniform thickness and free from defects. The preparation for galvanizing and the galvanizing itself shall not adversely affect the mechanical properties of the coated material. The quality will be established by test as per relevant standard. Alternative to galvanizing, aluminizing may also be considered.
- 4.0.2 All drilling, punching, cutting, bending and welding of parts shall be completed and all burrs shall be removed before the galvanizing process is applied.
- 4.0.3 Surfaces which are in contract with oil shall not be galvanized or cadmium plated.

5.0 BOLTS & NUTS

Steel bolts and nuts exposed to atmosphere with suitable finish like cadmium plated or zinc plated shall be used for diameters above 6mm.

All Nuts and Bolts shall be locked in position with the exception of those external to the transformer. Bolts and Nuts external to the transformer shall be provided with double flat washer and one spring washer.

On out door equipment, all bolts, nuts and washers in contact with non ferrous parts which carry current shall be of phosphor bronze where the transfer of current is through the bolt.

If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, suitable special spanners shall be provided by the supplier.

6.0 PAINTING

The internal and external surfaces including oil filled chambers and structural steel work to be painted shall be shot or sandblasted to remove all rust and scale of foreign adhering matter or grease. All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant, oil insoluble, insulating varnish.

All steel surface exposed to weather shall be given a primary coat of Zinc chromate, second coat of oil and weather resistant varnish of a colour distinct from primary and final two coat of glossy oil and epoxy light gray paint in accordance with shade No.631 of IS:5. All paints shall be carefully selected to withstand extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

The minimum thickness of each coat of outside painting of tank shall be 20 microns and the total thickness shall be minimum 80 microns.

7.0 TRANSFORMER LOSSES

The Bidder shall indicate values of iron losses and copper losses at normal tap. He shall indicate whether losses are firm or subject to tolerance .Ceiling for tolerance shall be indicated. If ceiling is not specified it will be taken as +10 % as per IS-2026.

For the purpose cost evaluation, the following standard UPPTCL rates for capitalization the losses will be used :

Iron losses :	Rs	2,12,500.00	per kW
Copper Loss:	Rs.	86,700.00	per kW

Purchaser reserves the right to reject the transformer if the losses exceed declared losses beyond tolerance limit.

On testing if it is found that actual losses are more than the values of guaranteed losses indicated by him, the Purchaser shall deduct penalty charges for each kW above the guaranteed value at double the rate indicated above.

8.0 TEMPERATURE RISE

The transformers shall be capable of carrying out its full load normal rated current continuously under the highest temperature and at any tapings.

The temperature rise of hottest layer of oil shall not exceed 40° C as measured by thermometer and temperature rise of winding shall not exceed 50° C as measured by resistance method, on continuous full load with a maximum ambient temperature 50° C, when tested as per IS-2026 (Part-II)

Any transformer exceeding above temperature rise limit shall be rejected.

9.0 OIL

9.1 The transformers& all associated oil filled equipment shall be supplied complete with the first filling of transformer oil. The oil to be used shall conform to ISS:335.

10.0 LOADING OF TRANSFORMERS

The transformers shall be capable of operating continuously in accordance with IS 6600, or loading guide at their continuous maximum rating and at any ratio irrespective of the direction of flow of power and with the voltage of the untapped winding .

11.0 VOLTAGE RATIO

The voltage between phases on the higher and lower voltage windings of each transformer measured at no load and corresponding to normal ratio shall be 33 kV and 0.4 kV.

12.0 ELECTRICAL CONNECTIONS

Transformers shall be connected in Delta /Star in accordance with vector group symbol DY 11 . The star point on LV side is to be brought out to a fully insulated terminals , one in LV cable box and other on the transformer tank.

13.0 FREQUENCY

The transformers shall be suitable for continuous operation with frequency variation of \pm 5% from normal 50 c/s without exceeding specified temperature rise.

14.0 DUTY UNDER FAULT CONDITIONS

All the transformers shall be capable of withstanding without injury, the thermal & mechanical effects of an external short circuit between phases according to ISS without any damage.

15.0 FLUX DENSITY

The maximum flux density in any part of the core and yoke, at rated kVA voltage and frequency at any tap shall not exceed 1.5 Tesla. The bidder shall provide saturation curve of core material proposed to be used and calculation to demonstrate thr core is not over fluxed in any worst condition of transformer operation.

16.0 CORE

The core shall be constructed from high grade low loss, high permeability cold rolled ,non aging grain oriented silicon steel lamination , M4 or superior grade. Transformers with amorphous core material shall also be acceptable.

17.0 MAGNETIC CIRCUIT

The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and the production of flux components at the right angles to the plane of the laminations which may cause local heating.

Every care shall be exercised in the selection, treatment and handling of core steel to ensure that as far as is practicable, the laminations are plain and the finally assembled core is free from distortion ,burrs and beads..

Every lamination shall be insulated so as it will not deteriorate due to mechanical pressure and the action of hot transformer oil.

Oil ducts shall be provided where necessary to ensure adequate cooling. The winding structure and major insulation shall not obstruct the free flow of oil through such ducts. Where the magnetic circuit is divided into pockets by cooling. Ducts parallel to the plane of the laminations or by insulation material above 0.25 mm thick, tinned copper strip bridging pieces shall be inserted to maintain electrical continuity between pockets.

The framework and clamping arrangements shall be earthed.

The class and type of in insulation used on the core bolts and under the nuts and side places shall be stated in ordering schedule.

18.0 SUPPRESSION OF HARMONICS

The transformers shall be designed with particular attention to the suppression of harmonic voltages, especially the third and fifth. So as to eliminate wave from distortion and any possibility of high frequency disturbances, inductive effect or of circulating currents between the neutral points at different transforming stations reaching such a magnitude as to cause interference with communication circuits. For achieving this, delta connected stabilizing winding should be avoided.

19.0 VIBRATION AND NOISE

Every care shall be taken to ensure that the design and manufacture of all transformers and auxiliary plant shall be such as to reduce noise and vibration to the level of that obtained in good modern practice.

20.0 MECHANICAL CONSTRUCTION OF CORES

- 1. All parts of the cores shall be of robust design capable of withstanding any shocks to which they may be subjected during lifting, transport, installation and service. The bolts used in assembly or core shall be suitably insulated and clamping structure shall be so constructed that the eddy currents are minimum.
- 2. All structural members of the assembled cores shall be of steel. All casting shall be settled and structural steel adequately cleaned and painted before being built into the structure. Any non magnetic or high resistance alloy used shall be of established quality.
- 3. Adequate fitments shall be provided to enable the core and windings to be lifted.
- 4. Suitable provision shall be made for the storage of any removable portions of the lifting lugs on the transformer tank.
- 5. Adequate provision shall be made to prevent movement of the core and winding relative to the tank during transport and installation or while in

service. Core clamping bolts shall be effectively insulated with craft paper and fiber glass tubes.

6. The supporting frame work of the cores shall be designed as to avoid the presence of pockets which would prevent complete emptying of the tank through the drain valve or cause trapping of air during filling.

21.0 WINDINGS

- i) The windings shall be so designed to reduce to a minimum out of balance forces in the transformer at all voltages ratios.
- ii) The windings shall also be designed such that all coil assemblies of identical voltage rating shall be interchangeable and repairing of the winding can be made readily without special equipments.
- iii) The conductors used in the coils shall be best suited to the requirements, and all permanent current carrying joints in the winding and leads shall be welded or brazed.
- iv) The insulation of transformer windings and connections shall be free from insulating compositions liable to soften, ooze out, shrink or collapse during service.
- v) No strip conductor shall have a width exceeding six times its thickness.
- vi) The winding shall be compact and symmetrical about the centre line of core and shall be framed on suitable synthetic resin bonded paper sheets type I, Conforming to the relevant standards.
- vii) Kraft paper used for inter layer insulation of H.V. shall be of uniform density and thickness free from pin holes and free from any foreign particles. The Kraft paper shall have a minimum thickness of 4 mils. The end turns of each layer shall be properly and fully covered to avoid inter layer flashover. The kraft paper used for this purpose shall be in conformity with relevant standard (paper for Electrical purpose). Ordinary paper or Bamboo paper should not be used in any case. The insulation of coils shall be treated with suitable insulating varnish or equivalent compound or impregnated in transformer oil to develop the full Electrical Strength in the windings. All the materials used in the insulation and assembly of the windings shall be insoluble, non catalytic and chemically inactive in the hot transformer oil and shall not soften or otherwise be adversely affected under the operating condition.
- viii) Inter phase vertical barriers of proper insulating paper of adequate thickness should be provided in order to avoid inter phase flashovers. These barriers should be suitably fastened & supported to avoid their lateral movement. Wherever necessary barriers of insulating paper of adequate thickness should also be provided in order to avoid phase to earth flash over.

- ix) All threaded connections shall be provided with locking facilities. All leads from the winding to the terminal board and bushing shall be rigidly supported to prevent injury from vibration.
- x) Proper number of oil ducts and spacers should be provided between the sections of H.V. limbs for proper circulation of the insulating oil and to reduce hot spots on the winding.
- xi) The number of sections on each HV limb shall be minimum four.

22.0 TANK

The transformer tank and cover shall be fabricated from good commercial grade low carbon steel suitable for welding and of adequate thickness. The tank and the cover shall be welded construction. All seems shall be welded and where practicable shall be double welded. The tank shall have sufficient strength to withstand without permanent distortion (I) filling by vacuum (II) continuous internal gas pressure of 0.7 Atm with oil at operating level. The tank cover shall be bolted to the tank and the transformer design shall be such that the tank will not be split between the lower and upper cooler connection for untanking.

All bolted connections to the tank shall be fitted with suitable oil tight synthetic rubber and cork composition gaskets, which shall give satisfactory service under the operating conditions. Special attention shall be given to the methods of making the hot oil tight joints between the tank and cover as also the between the cover, the bushings and all other out lets to ensure that the joints can be remade satisfactorily and with case, with the help of semiskilled labour. Where compressible gaskets are used, steps shall be provided to prevent over compression.

Suitable guides shall be provided for positioning various parts during assembly or dismantling. Adequate space shall be provided between the cores and windings and the bottom of the tank for collection for any sediment. Lifting eyes or lugs shall be provided on all parts of transformers requiring independent handling during assembly or dismantling. In addition, the transformer tanks shall be provided with lifting lugs and basses properly secured to the side of the tank for lifting the transformer either by crane or by jacks. The design of the tank, the lifting lugs and bosses shall be such that the complete transformer assembly filled with oil can be lifted with the use of these lugs without any damage or distortions.

The tank shall be provided with 2 suitable copper alloy pads for the purpose of grounding suitably for $50 \times 6 \text{ mm G.I strip}$. The G.I earthing strip shall be clamped without drilling any hole into it, between two surface of the pads. Each tank shall be equipped with the following values with flanges for external connection.

- i) One drain cum lower filter value fitted on the transformer and placed to completely drain the tank. These values shall be equipped with a small sampling cock.
- ii) One filter value shall be located at the top of the tank on the side opposite

to this lower value. The opening of this value shall be baffled to prevents the drain of the oil.

23.0 UNDER CARRIAGE

The transformer tank shall be support on a structural steel base equipped with cast iron flat wheels suitable for moving the transformer complete (with oil)

The gauge of wheels shall be 1000 mm.

Pulling eyes shall be provided to facilitate moving of the transformer and they shall be suitably dragged in a vertical direction so that bending does not occur when the pull has vertical component.

24.0 TAP CHANGING MECHANISM

The transformers shall be provided with off-circuit tap selector switch on HV windings for HV variation from -5% to (+) 10% in steps of 2.5% to give a constant L.V.

These steps shall be controlled by hand and provisions shall be made for indication of tap position and locking on any particular tap.

25.0 All metal parts of the transformer with the exception of the individual core laminations, core bolts and associated clamping plates shall be maintained at some fixed potential and core should be earthed at points.

26.0 COOLING METHOD

Transformers shall have 'ONAN' cooling only.

27.0 PARALLEL OPERATION

The transformers shall operate satisfactorily in parallel among them selves when connected across the same H.V. and L.V. Bus Bars.

28.0 H.V. TERMINAL ARRANGEMENT

The H.V. terminals shall be brought into separate weather proof solid porcelain bushing conforming to IS-2099, IS-8605 and IS-3347 with suitable arcing horns.

The inner ends of the bushing shall be completely immersed in the oil. The H.V. bushings rods should be locked in position so that twisting of the H.T. leads is avoided during tightening of nuts of bushing rods.

L.V. TERMINAL ARRANGEMENT

The L.V. terminals shall be brought out on bushings provided inside the cable box suitable for $4 \times 1C - 400$ sq. mm per phase as well as neutral for, P.V.C armoured cables. The neutral of the L.V. side shall be brought out on a bushing inside the

cable box. In addition

to above, another neutral bushing shall also be provided on the transformer tank for separate earthing.

The size of the cable box and position of glands should be such that it is convenient to carry out cabling work i.e. to make connections, etc. and fixing of cable box covering and to attend operation and maintenance. The dimensions of cable box and position of glands should be shown clearly in the outline drawing of the transformer. All the L.V., as well as neutral bushing shall be interchangeable.

29.0 FITTINGS & ACCESSORIES

- i) Conservator tank having inter connections pipe, projecting 20 mm. above bottom of conservator to erect sump for collections of impurity, between conservator and main tank, 30 mm, dia drain value, oil fillings hole with cap on the top of the conservator.
- ii) Shut off value in inter connecting pipe between conservator and main tank.
- iii) Two nos. earthing terminals suitable for 50 x 6 mm G.I. strip.
- iv) Oil level gauge with toughened glass with minimum marking.
- v) Lifting lugs for core inside the transformers.
- vi) Lifting lugs for complete transformers
- vii) Thermometer pocket in accordance to IS:3639.
- viii) Dehydrating breather.
- ix) Air release plug on the transformer tank to release trapped air inside the tank when filling oil through conservator.
- x) One drain cum sampling value having narrow orifice with locking arrangement on the bottom of tank.
- xi) One filter valve on the Upper top side of the tank.
- xii) Lifting lugs for tank cover.
- xiii) Inspection hole.
- xiv) 4" dia dial type thermometer for oil temp. with max. pointer and set of contact for alarm.
- xv) One winding temp. indicator with max. pointer and two sets of contacts for alarm and trip purpose.
- xvi) Explosion vent with diaphragm.
- xvii) Anodised aluminum non-detachable engraved rating and diagram plate containing reference of purchase order and "Property of U.P. Power Transmission Corporation Ltd " apart from the essential details as per IS:2026/1977. No load/load losses must also be engraved on the diagram plate.

- xviii) Unidirectional flat rollers.
- xix) Terminal connectors for H.V. bushings suitable for ACSR conductor and horizontal take off.
- xx) Any other accessories normally required for such transformers.

30.0 TESTS

30.1 Type Tests

- (a) All the equipment offered shall be fully type tested by the bidder as per the relevant standards. The date of type test conducted shall be the latest and not earlier than 5 years as on the date of bid opening. The bidder shall furnish following type test reports along with the offer. The offer received without these type test reports shall be treated as Non-responsive and rejected.
 - a) Measurement of winding resistance
 - b) Measurement of voltage ratio and check of voltage vector relationship.
 - c) Measurement of Impedance Voltage / Short circuit impedance (Principal tapping) and load loss.
 - d) Measurement of no load loss and current.
 - e) Measurement of insulation resistance.
 - f) Dielectric tests.
 - g) Temperature rise
 - h) Pressure and vacuum tests.

The Bidder shall also give an undertaking that all the balance type tests as per relevant standard have also been conducted on the equipment offered. However, if any, of the remaining type tests have not yet been conducted, the supplier shall get them conducted within 8 weeks of placement of order and before start of manufacture, without any additional cost to Purchaser. No time extension shall be granted for these tests. The test reports for successful conduct of the tests shall be sent for approval to the Purchaser, immediately on conducting the tests, based on which clearance for manufacture shall be given".

- **b)** Following type test shall be conducted on one transformer of each rating from the first lot.
 - (i) Impulse voltage withstand test
 - (ii) Temperature rise test.
 - (iii) Short circuit test.

30.2 ROUTINE TEST

All standard routine test in accordance with IS:2026 shall be carried out on each transformer.

30.3 SITE TEST

After erection at site, transformer shall be subject to following tests:

- i) Insulation Resistance test
- ii) Ratio and Polarity test
- iii) Dielectric test
- **30.4** The Purchaser reserves the right of having other reasonable test carried out at his own expense either before dispatch or at site to ensure that the transformer complies with the requirement of this specification.

30.5 DRAWING & DATA

- 1. Adequate number of prints of drawing incorporating the following particulars shall be included in the proposal:
 - (i) General outline drawings showing dimensions, net weights and shipping weights, quality of insulating oil etc.
 - (ii) Sectional view showing the general constructional features of the transformers core, coils, tap charger.
 - (iii) Crane requirements for assembly & dismantling.
 - (iv) Dimensions of the largest part to be dispatched, the position in which it would be transported.
- **31.0** Drawing to be furnished by the Contractor for Purchaser's/engineers approval, after acceptance of his proposal, shall include the following particulars.
 - General outline drawing showing front and side elevations and plan views of the transformer and all accessories and external features with detailed dimensions, net and shipping weights, cranes lift for untanking, size of lifting lugs & eyes, bushing lifting dimensions, clearances between HV & LV terminals and ground, quantity of insulating oil etc.
 - ii) HV & LV bushing assembly drawings.
 - iii) Name plate drawings with terminal markings & connection diagrams.

32.0 SPARE PARTS

The supplier shall indicate in its proposal a detailed list of spares parts for five year satisfactory operation. The Prices of spares and gasket shall be quoted separately

<u>TS-2A</u>

TECHNICAL SPECIFICATION OF 245KV &145 KV SF6 CIRCUIT BREAKERS

1.1 STANDARDS

S.No.	Standard	Title
1.	IEC 62271-100 and IS-13118	Specification for alternating current circuit Breakers.
2.	IEC – 376	Specification for acceptance of new supply of SF6.
3.	IEC – 137	Bushing for A.C. Voltage.
4.	IEC – 71	Electrical Clearances.
5.	IEC – 694	Common clause for high voltage switch gear and control gear standard.
6.	IS-2147	Degree of Protection Provided for enclosures for low voltage switch gear and control gear.
7.	IS – 2516	Specification for circuit Breaker
8.	IS – 5578 & 11353	Making and arrangement for switch gear bus bar, Main Connections and auxiliary wiring.
9.	IS – 2629	Recommended Practice for hot dip galvanizing of iron and steel.
10.	IS – 2099	High voltage Porcelain bushings.
11.	IS-4379	Identification of the contents of Industrial Gas Cylinders.
12.	IS – 7285	Seamless high carbon steel cylinders for permanent and high pressure liquefiable gas.
1.2 PRINCIPAL PARAMETERS

1.2.1 FOR 245 kV SF6 Circuit Breakers

1.	Rated nominal system voltage	220KV
2.	Rated voltage	245KV
3.	Rating of C.B.	MVA
4.	Rated frequency	50 Hz
5.	System neutral earthing	Effectively earthed
6.	Type of C.B.	SF 6
7.	No. of poles	3 – (pole operated)
8.	Installation	Outdoor
9.	Rated normal current	3150 Amp.
10.	Rated short circuit breaking	1. RMS value of A.C. component current of the rated short circuit breaking current 40 kA for 3 Sec.
		2. D.C.component as per IEC-62210
11.	Rated duration of short circuit	3 Sec.
12.	Transient frequency voltage	The rated transient recovery voltage of the breaker shall be used on 4 parameter method as defined in IEC 62210
13.	Terminal faults	1 st pole of clear factor 1.3 value of 4 parameter as per IEC62210
14.	Short line fault	As per IEC
15.	Rated short circuit making capacity (peak)	100 kA
16.	Operation duly cycle	$0-t-co-t_1$ -co
		t = 0.3 Sec.
		$t_1 = 3 min.$
17.	Total breaking time	3 cycles
18.	1.2/50 microsecond lightning impulse withstand voltage to earth	1050 KV (min.)
19.	One minute power frequency dry withstand voltage to earth	460 KV (RMS)
20.	Temperature rise	Final Steady State Temperature rise of current carrying part shall not exceed the limits specified in IEC 62210 with a site reference ambient temperature of 50^{0} C
21.	Operating mechanism	Spring/Electro pneumatic.

22.	Type of tripping	Trip free
23.	Number of auxiliary contacts	12 Nos NO. and 12 Nos NC
24.	No. of trip coils	2 Nos.
25.	No. of closing coils	1 No.
26.	Breaking line charging current	125 Amps. at 245KV
27.	Interrupting capacity in KA for kilometric faults	40 KA (RMS)
28.	Arcing time (at 100% interruption capacity)	25 milliseconds.
29.	Minimum dead time	300 milliseconds.
30.	No. of break per phase	One
31.	Tripping and closing control circuit voltage	110 V.DC
32.	First pole to clear factor	1.3

1.2.2 FOR 145 kV SF6 Circuit Breakers

1.	Rated nominal system voltage	132KV
2.	Rated voltage	145KV
3.	Rating of C.B.	7900 MVA
4.	Rated frequency	50 Hz
5.	System neutral earthing	Effectively earthed
6.	Type of C.B.	SF 6
7.	No. of poles	3 – (gang operated)
8.	Installation	Outdoor
9.	Rated normal current	1250 Amp.
10.	Rated short circuit breaking	1. RMS value of A.C. component current of the rated short circuit breaking current 31.5KV for 3 Sec.
		2. D.C.component as per IEC-62271 - 100
11.	Rated duration of short circuit	3 Sec.
12.	Transient frequency voltage	The rated transient recovery voltage of the breaker shall be used on 4 parameters method as defined in IEC 62271-100
13.	Terminal faults	1 st pole of clear factor 1.5 value of 4 parameter as per IEC62210
14.	Short line fault	As per IEC
15.	Rated short circuit making capacity (peak)	80 KA

16.	Operation duly cycle	$0-t-co-t_1$ -co
		t = 0.3 Sec.
		$t_1 = 3 min.$
17.	Total breaking time	3 cycles
18.	1.2/50 microsecond lightning impulse withstand voltage to earth	650 KV (min.)
19.	One minute power frequency dry withstand voltage to earth	275 KV (RMS)
20.	Temperature rise	Final Steady State Temperature rise of current carrying part shall not exceed the limits specified in IEC 62271-100 with a site reference ambient temperature of 50 ⁰ C
21.	Operating mechanism	Mechanical spring/Electro pneumatic.
22.	Type of tripping	Trip free
23.	Number of auxiliary contacts	12 Nos NO. and 12 Nos NC
24.	No. of trip coils	2 Nos.
25.	No. of closing coils	1 No.
26.	Breaking line charging current	50 Amps. at 145KV
27.	Interrupting capacity in KA for kilometric faults	31.5 KA (RMS)
28.	Arcing time (at 100% interruption capacity)	25 milliseconds.
29.	Minimum dead time	300 milliseconds.
30.	No of break per phase	One
	No. of ofeak per phase	one

1.3 CIRCUIT BREAKER REQUIREMENTS

- i) The Circuit Breaker shall comprise of three identical pole units linked together electrically and pneumatically, complete with first filling of SF6 gas, 2 nos. unit air compressors with common local air receiver, air and gas piping, operating mechanism, complete with Terminal Connectors / anti pumping device and wiring etc.
- ii) The local air receiver, pipes and fittings shall have adequate mechanical strength and shall remain air tight. Each breaker shall also be provided with space heater (thermostatically controlled), operation counter, pressure gauges, and gas density detectors (Temperature compensated gas pressure switch).
- iii) The circuit breaker units shall be suitable for mounting at ground level with concrete plinth including standard supporting frame. Suitable steel structures, supporting column for mounting the circuit breaker shall also be supplied along with the breaker.

2.0 ADDITIONAL DUTY REQUIREMENTS

The SF6 circuit breaker shall be capable of meeting with the following additional duty requirements.

2.1 RECOVERY VOLTAGE & POWER FACTOR

The circuit breaker shall be capable of interrupting the rated power with recovery voltage equal to the rated maximum service voltage at rated frequency and at power factor not exceeding 0.15.

2.2 **RESTRIKING VOLTAGES**

The breaker shall be re-strike free. The breaker shall conform to the requirements of latest edition of IEC-62271-100 for re-striking voltage, rate of rise of re-striking voltage, natural frequency etc. The design of the breaker shall be such that even without using any shunt resistance across contacts, it shall break the currents up to guaranteed values without exceeding the over voltage as indicated in IEC-62271-100

2.3 LINE CHARGING CURRENT INTERRUPTING CAPACITY

The circuit breaker shall be designed so as to be capable of interrupting line charging currents without undue rise in voltage on the supply side and without any re-strike voltage and without showing signs of undue strain .

2.4 BREAKING CAPACITY FOR KILOMETRIC FAULTS

Clearing short line faults (kilometric faults), with the source impedance behind the bus, the breaking capacity shall be equivalent to fault current of 40 KA r.m.s. for 3 second for 245 KV Breakers & 31.5 KA rms for 3 second for 145 KV breakers.

2.5 **OUT OF PHASE CLOSING**

The breaker shall be capable of breaking 25% of the rated symmetrical short circuit breaking capacity at twice the rated voltage under out of phase i.e .phase opposition conditions as per IEC-267

2.6 TRANSFORMER CHARGING CURRENT BREAKING CAPACITY

The breaker shall be capable of small inductive currents i.e., breaking steady and transient magnetizing current those occurring while switching unloaded transformers having rating 160/100 MVA, 220/132/11kV auto transformers at 245kV & 40/20 MVA, 132/33 KV power transformers at 145 KV without giving rise to undue over voltage and without re-strike.

2.7 AUTOMATIC RAPID RECLOSING

The operating duty of the circuit breaker shall be "O-Dead Time-CO-Re-closing Time-CO" in accordance with latest edition of IEC-62271-100. The values of dead time and reclaiming time shall be 0.3 second and 3 min. respectively.

2.8 **TEMPERATURE RISE**

The maximum temperature attained by any part of the equipment when in service at site under continuous full load conditions and exposed to the direct rays of sun, shall be within the limits of concerned IEC.

2.9 CAPABILITY TO WITHSTAND MECHANICAL STRESSES

The complete circuit breaker assembly shall be able to withstand a wind force of 150kg/m² and 0.3 g of seismic accelerating force in any direction due to earthquake shocks for such occurrence.

3.0 **OPERATING MECHANISM**

3.1 GENERAL REQUIREMENTS

3.1.1.1 The circuit breaker operating mechanism shall be highly reliable and will have sufficient energy to provide full making and latching current ability of 80 KA on all the poles, simultaneously.

3.1.2.1 a) 245 KV BREAKERS

The circuit breakers shall be power operated by compressed air pneumatic mechanism wherein pneumatic pressure is used for tripping of the breaker and for closing the breaker. The mechanism shall be housed in a weather proof and dust proof mechanism housing. All the three poles shall have individual mechanism and will be operated simultaneously through electrical circuit.

b) 145 KV BREAKERS

The circuit breakers shall be power operated by compressed air pneumatic/ mechanical mechanism. The three poles of the breaker shall operate simultaneously through a mechanical coupling.

3.1.3.1 Provision shall be made for local electrical control and a local/remote selector switch with enough contacts in the cubicle of breaker. In local position the switch shall isolate the remote close and trip circuit completely.
 Provision shall be made for local electrical control and a local/remote selector switch with enough contacts in the cubicle of breaker in local position the switch shall isolate the close

and trip circuit completely. if technically compatible with design of breaker a manual emergency local tripping arrangement shall be provided on the breaker for use in an emergency of during maintenance. This emergency trip is intended for use should a failure of any part of D.C. control circuits including breaker trip coil take place preventing remote electrical tripping.

- 3.1.4.1 Operating mechanism shall be suitable for high speed re-closing and shall be trip free and with anti-pumping device (as per definition of clause-5, IEC-62271-100) for closing of breaker electrically and either mechanically or pneumatically. It shall be strong, rigid, positive and fast in operation. There shall be no objectionable rebound and the operating mechanism shall not require any critical adjustment.
- 3.1.5.1 Breaker shall be provided with ON/OFF mechanical indicator in a position, so that a man

standing on ground may easily see it, with the mechanism housing closed. An operation counter shall also be provided which shall be visible from the ground even with mechanism housing closed.

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

3.1.7 CONTROL

- **3.1.7.2** Electrical tripping of the breakers shall be performed by shunt trip coils. However, provision shall be made for local electrical controls for this purpose.
- **3.1.7.3** The mechanism shall normally be suitable for remote electrical operations from control room. Purchaser shall feed both the trip circuits from independent station batteries of 110 Volts DC.
- 3.1.7.4 The closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated DC voltage. The shunt trip coil shall operate correctly under all operating conditions of the circuit breaker and all values of supply voltage between 70% and 110% of voltage.

3.2.0 PNEUMATICALLY OPERATED MECHANISM

3.2.1 In case of 245 KV Breakers pneumatically operated mechanism shall obtain supply of compressed air system with two compressors. One compressor will always be in stand by mode. The schemes shall be such that if one compressor fails, other compressor shall take over.

In case of 145 KV Breakers pneumatically operated mechanism shall obtain supply of compressed air system with one compressor only.

Operating mechanism shall be capable of operations with (2) two trip coils by independent trip circuits, pressure switches, coils each connected to different sets of protective relays.

- 3.2.2 The breaker shall be provided with a compressor system. Independently adjustable switches with insulated contacts shall be provided on each circuit breaker for purposes of lower pressure alarm and lockout in case of insufficient pressure to complete a closing, opening or re-closing duty.
- 3.2.3 The pressure switches with adjustable contacts and isolating values to actuate a lockout device shall be provided. This lockout device, with provision for remote alarm indication shall be incorporated in each circuit breaker to prevent operation whenever the pressure of the air operating mechanism is below the required value for satisfactory operation. The scheme should permit operation of all blocking and alarm relays as soon as the pressure transient present during the rapid pressure drop has been damped and a reliable pressure

measurement can be made. Such facilities shall be provided for the following conditions :

- 1. Trip lockout pressure
- 2. Close lockout pressure
- 3. Low pressure alarm
- 4. Auto re-close lockout pressure
- 3.2.4 After failure of supply the local air receiver and operating mechanism shall be capable of two closing and two opening operations at rated fault currents.

3.3.0 SPRING OPERATED MECHANISM

- 3.3.1 Spring operated mechanism shall be complete with motor . 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.
- 3.3.2 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.
- 3.3.3 After failure of power supply to the motor one close open operation shall be possible with the energy contained in the operating mechanism.
- 3.3.4 Break 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 requires not more than 30 seconds for full charging of the closing spring
- 3.3.5 Closing action of circuit breaker shall compress the opening spring ready for tripping.
- 3.3.6 When closing springs are discharged after closing a breaker. Closing springs shall be automatically charged for the nest operation and an indication of this shall be provided in the local and remote control cabinet.
- 3.3.7 Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition. Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is already in the closed position.
- 3.3.8 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 if case the tripping energy is derived from the operating mechanism.

3.3 OPERATING MECHANISM HOUSING

3.3.1 Operating mechanism and all accessories shall be enclosed in a weather proof. Vermin proof mechanism cabinet of high strength epoxy base painted/ galvanized steel sheet construction

of appropriate thickness hinged doors giving access to the mechanism at the front shall be provided. Suitable gaskets shall be provide to make the mechanism housing water proof. Dust and vermin proof. The housing latch shall accommodate pad lock requiring a 12 mm dia hole pad lock and duplicate keys shall be furnished by the tenderer . A common marshalling box for the three poles of the breaker shall be provided along with supply of tubing

- 3.3.2 The operating mechanism shall have aluminum casting suitable for outdoor duty. Control coils and auxiliary switches shall be fixed on operating mechanism. All electrical accessories including heater other than control coils and auxiliary switch shall be mounted inside one common control cabinet (marshalling box) which shall be made of 2mm thick sheet steel. All mechanical and electrical components inside the cabinet shall be mounted on angled frame. The cabinet shall be duly painted and IP55 protected suitable for out door purpose. The cubicle shall have padlock arrangement on door.
- 3.3.3 Suitable 230 volts A.C. heaters shall be amounted in the housing to prevent condensation and shall be controlled by thermostat so that the cubicle temperature is always maintained approximately 10 deg C above the outside Air temperature. ON/OFF switch and fuses/MCB shall also be provided.
- 3.3.4 Terminal block shall be furnished in the mechanism housing. Terminals for D.C. and A.C. shall be provided separately and isolated from each other. Terminal for the control and other circuit shall be suitable for accommodating 3 core 2.5mm2 copper conductor cable leads. Spare terminals for control wiring shall be provided. All wiring in the house shall be of standard insulating material and shall be such that it shall not support combustion. Suitably rated switches for A.C. supply shall be provided in the mechanism to enable the control supply to the breaker to be cut off. A light point with a control switch shall also be provided.

4.0 TERMINAL BLOCK AND WIRING :

- 4.1 Terminal connectors in the terminal block shall be of ELMEX make and have the following features and must be provided with shorting and disconnecting links to facilitate isolation of any desired connection or circuit.
- 4.2 For the safe contact condition and lightness of screws the terminal body, bridge, pressure pad and the screws shall be of high strength brass. The outer surfaces of all metal parts shall be coated suitably for protection against atmospheric effect.

4.3 SCREW LOCKING

All the screws shall be secured by reaction principals against unintentional self loosening.

4.4 **THREADING**

The threading parts shall be such that if the screws are adequately tightened for checking purposes it shall not break or become free. For studs and screws female threads shall be provided by using flawless taps to get strong threads.

4.5 CLAMPING OF CONDUCTORS

Terminal connector shall be such that the conductor can be fixed with adequate contact pressure and without undue damage to the conductor. While tightening the screws/nuts the terminal connectors shall not move or get displaced.

For easy connections of even the thinnest conductor and providing rigid connections without any damage, the bottom of the terminal body shall be flat. The terminal connector shall also be suitable for accommodating at least 3 crores of 2.5 sq.mm., copper conductor cable without any preparation viz. lugs, clamping soldering etc. The contact pressure shall not be transferred through insulating material. Gripping of conductor shall be made effective by a pressure pad between metal surfaces only.

4.6 TERMINAL BLOCK HOUSING

These shall be made from high grade melamine, thermosetting molding powder having the highest unit tracking property. The impact strength shall be in between 0017-0019 kg-m tested in accordance with clause 0.3.2 table 1 of IS:3669 B-1966, testing method must be adopted as per clause II of IS 2221 of 1962.

4.7 **TERMINAL BLOCKS**

Terminal blocks shall be of disconnecting type.4.8 SHORTING LINKS

Circuit Isolation Link

The circuit isolation link shall be provided in each and every connector of terminal blocks.

Shorting Links

The provision of permanent (removable) shorting links in each terminal connector shall be done (whenever required), so that any two adjacent terminals can be shorted effectively (maximum) to consecutive five terminal Connectors.

4.9 **MOUNTING DEVICE**

The terminals shall be mounted by clipping action at two points on the aluminum/steel channel as per DIN 46277/1 and these shall be easily removable without affecting the mounting of adjacent terminals.

4.10 MARKING/ LABLES/FERRULES/TERMINAL NOS

The marking labels on each side of ends shall be fitted permanently with duly engraved

descriptions. The embossing shall be of permanent type scratch proof and suited to tropical climatic condition. The size shall be such that these may easily be inserted on the P.V. C. insulation 2.5mm², copper conductor cable and shall not come out itself.

4.11 MOUNTING FOR TERMINALS

The terminal connectors shall be mounted in such a fashion that connections are made on lifting up the disconnecting link.

4.12 END CLAMPS

To avoid side ward movement and to hold the terminals closely together, the end clamps shall be provided at both the ends of the terminal.

4.13 TESTING BUSH AND SCHEMATIC DIAGRAM

The testing bushes shall be provided on the top and bottom of each terminal of terminal block. A schematic diagram shown on a PVC plate with screen printing of permanent nature (non-scratch able, clearly visible) shall be riveted / affixed on the side of control cubicle door. Similarly the terminal block arrangement on separate plate shall be riveted on the control/cubicle door.

4.14 COLOUR OF TERMINAL BLOCKS

The following colours of terminal blocks shall be used:

a) For A.C. circuit terminal block : Red colour

B) FOR D.C. CIRCUIT TERMINAL BLOCK CONVENTIONAL : COLOUR

4.15 VOLTAGE AND CURRENT CARRYING CAPACITY

The rating of terminal connector shall be of 15 Amps. and 250 volts D.C for uninterrupted duty, complete with insulting barriers at both end of terminal block (if necessary).

4.16 ELECTRICAL TRENCH

Terminal connector housing shall be provided with a through and through running recess i.e. electrical trench on both sides of terminal for removing dust with blower.

5.0 A.C. CIRCUITS

5.1 HEATERS

The controlling fuse/MCB, link and switch/MCB for the heater shall be provided in its own pole cabinet. The thermostat at a preset of 50 deg C permanently shall be provided in the cubicle to control the individual heater.

5.2 **D.C. CIRCUIT**

No local fuse and links shall be provided in the circuit breakers cubicle for the D.C. circuits. Suitable rotary switch/MCB shall be provided in such cases.

5.3 AUXILIARY CIRCUIT BREAKERS CONTACTS (USED IN TRIPPING AND CLOSING CIRCUITS)

Circuit breaker's auxiliary contacts used in the tripping/closing circuit for breaking of tripping/closing currents shall be rated for not less than 10 Amps. 110 Volts D.C. The material of contacts and their arrangement shall be such that the contact resistance shall be minimum to avoid unnecessary heating and contact pressure shall not reduce before at least 10,000 operations.

5.4 **PRESSURE LOCKOUT CONTACTOR**

For the purpose of locking out, an auxiliary contactor in conjunction with air/gas pressure switch in closing/tripping circuits to be used.

The following colour shall be used in the wiring :

a)	A.C. circuit	:	Black
b)	D.C. circuit	:	Grey
c)	Earthing	:	Green

6.0 **BUSHING AND INSULATORS**

- ^{6.1} Porcelain used for bushing shall be homogenous free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.
- 6.2 Glazing of the porcelain shall be uniform and brown in colour, free from blisters, bums and other defects. Bushing shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used all bushings of identical rating shall be interchangeable.
- 6.3 Puncture strength of bushings shall be greater than flashover value. When operating at normal rated voltage, there shall be no electric discharge between the conductor and bushings which would cause corrosion or injury to conductors, insulators, or supports by

the formation of substances produced by chemical action. No radio disturbance shall be caused by the bushings when operating at the normal rated voltage.

- 6.4 All iron parts shall be given zinc chrome coating hot dip galvanized and all joints shall be airtight. Surfaces of the joints shall be airtight. Surface of the porcelain parts shall be made smooth by grinding and metal parts by machining. Bushing design shall be such as to ensure a uniform compression on the joints.
- 6.5 The basic insulation level of the bushings, insulating porcelains and the external insulator supports etc. shall be 1050KV (peak) and shall be suitable for insulation in heavily polluted atmosphere with minimum total creepage distance of 6125mm as per relevant IEC. The minimum clearance in air between phases and live parts to earth shall be as per relevant IEC.
- 6.6 The high pressure air passage in the hollow insulator should be protected by suitable insulating tube which should withstand static . Air pressure equal to twice the normal working pressure.
- 6.7 Oil filled bushing should be free from oil leakage and should be designed to prevent accumulation of explosive gases and to provide adequate oil circulation to remove internal heat. Adequate means should be provided to accommodate conductor expansion and there should not be any undue stressing of any part due to temperature changes. They should be equipped with liquid level indicators and means for sampling and draining oil from the bushings.

7.0 **CONTACTS**:

- 7.1 Main contacts shall have ample area and contact pressure for carrying the rated current and the short time rated current of the breaker without excessive temperature rise which may cause pitting or welding. Contacts shall be easily replaceable and shall have a minimum of movable parts and adjustments to accomplish these results. Main contacts shall be the first to open and the last to close so that there will be little contact burning and wearing.
- 7.2 Arcing contacts, if provided, shall be the first to close and last to open and shall be easily accessible for inspection and replacement. Tips of arcing and main contacts shall be silver plated or have a tungsten alloy tipping.

8.0 **INTERLOCKS**

- 8.1 All the three poles shall trip simultaneously on a pneumatic/electrical command. Pole discrepancy timer relay shall be supplied with each breaker to trip the breaker as well as to give a remote trip discrepancy alarm.
- 8.2 The following air / gas pressure alarm / inter lock shall be provided on the circuit breaker each with 2 contacts :
 - i. Low pressure pre-locking alarm switch
 - ii. Low pressure closing / tripping lockout interlock.
 - iii. Low pressure auto re-closing lockout interlock.

9.0 AUXILIARY SWITCHES

- ^{9.1} Each circuit breaker shall be provided with10 normally open & 10 normally closed contacts on each pole and 12 normally open and 12 normally closed contacts common for all three pole operations. All switches shall be positively driven (not by spring) in both directions.
- ^{9.2} Normal position of auxiliary switches refers to contact position when circuit breaker is open.

^{10.0} **PNEUMATIC SYSTEM**

All compressed air cabin connections specially between ceramic and metallic components shall be completely tight for pressures up to twice the rated pressure for breaker operation. The gaskets used for these joints shall have a long life under climatic conditions as already specified in this specification. Necessary arrangement for draining the condensed moisture from the lower points in the pneumatic system should be incorporated.

^{11.0} UNIT COMPRESSED AIR SYSTEM

- ^{11.1} Each SF6 Circuit Breaker should consist of two number unit compressors. Each compressor shall be capable to feed air for all operations of the circuit breaker satisfactorily. The other compressor shall be as stand by for emergency purposes although both will run simultaneously. All necessary electrical/pneumatic connections between compressors and each pole of circuit breaker shall be carried out by Contractor.
- ^{11.2} The initial filling time of the compressed air system shall not be more than 72.75 minutes (approx) with compressor running under normal operating conditions. The minimum running time of the compressor for replenishing the air system from the present starting pressure to the rated pressure shall not be more than 10 minutes. The flow capacity of all the valves shall be at least 20% greater than the total compressor capacity.
- ^{11.3} The complete details of compressor unit air receivers, the automatic control equipment and other accessories included in the plant shall also be supplied along with the breaker and compressor units. The complete system scheme and layout of automatic control equipment and air compressor equipment shall be furnished with circuit breaker/compressor plant.
- ^{11.4} A clock / counter shall be provided in the control cubicle of the compressor unit for registering the total nos. of operations / cumulative operation time of the compressor unit.
- ^{11.5} The Unit compressed air system shall meet the following requirements:-

- a) The compressed air system shall be provided with necessary piping, piping accessories, control valves, safety valves, filters, reducing valves, isolating valves, drain ports etc. Also the unit compressed air system shall be provided with suitable anti-vibration pads.
- b) The compressors shall be of air cooled type and mounted within the operating mechanism housing OR on civil foundation with canopy(cover).
- c) The air receiver shall have stored energy for 2 CO operations of the breaker at the blocking pressure for auto re closing duty without refilling. The unit compressor shall be capable of building up required pressure for another 2 CO operations within 30 minutes.

11.6 Air Compressor

^{a.} The air compressor shall be of air cooled type complete with cylinder fabrication, drive motor etc. The compressor shall be rated for the following duty :

i.	Total running time of Compressor to build up the Rated pressure from Atmospheric pressure.	Not exceeding minutes	80
ii.	Normal running air changing	Not exceeding 15 minutes	
		considering 10% leakage per day	
iii.	Air changing time after one Close-open operation from Rated pressure	Not exceeding minutes	15

- b. Compressor shall be driven by automatically controlled motors conforming to the requirements.
- c. The compressor shall be provided with automatic adjustable unloading device during starting.

^{11.7} Air Receivers

^{a.} Air receiver shall be designed in accordance with the latest edition of the ASME Code for Pressure Vessel – Section VIII of BS 5179 A corrosion allowance of 3.0 mm shall be provided for shell and dished ends.

Receivers shall be hot dip galvanized.

b. Connections for air inlet and outlet, drain and relief valves shall be flanged type or screwed type only.

- c. Accessories such as suitable sized safety valve to relieve full compressor discharge at a set pressure equal to 1.1 times the maximum operating pressure, blow off valve, auto drain tap with isolating and by-pass valve, dial type pressure gauge and drain valve and test connection shall be provided.
- d. Air receiver shall have at least 50% spare capacity, calculated on the basis of total air requirement for 2 CO operations.

^{11.8} Quality of Air

Compressed air used shall be dry and free of dust particle and fully compatible with the materials used in the pneumatic operating mechanism. Arrangement for conditioning the compressed air if required shall be provided as an integral part of air compressor system.

^{11.9} Control and Control Equipment

- ^{a.} The compressor control shall be of automatic start/stop type initiated by pressure switches.
- b. All the necessary compressor control equipment shall be housed in a totally enclosed sheet steel cabinet also conforming to requirements. Pressure gauges and other indicating devices control switches shall be mounted on the control cabinet.
- ^{c.} A glass window shall be provided for viewing the indicating instrument/ gauges.

^{11.10} Compressed Air Piping, Valves and Fittings

- ^{a.} The flow capacity of all valves shall be a least 20% greater than the total compressor capacity.
- b. The high pressure pipe and air system shall be such that after one O-0.3 sec-CO operation the breaker shall be capable of performing one CO operation within 3 minutes.
- ^{c.} All compressed air piping shall be bright annealed, seamless phosphorous Deoxidized Non-Arsenical Copper alloy as per BS : 2874 or stainless steel pipe (C-106 of BS : 2871-1957)
- ^{d.} All joints and connections in the piping system shall be brazed or flared as necessary.

- ^{e.} All compressed air piping shall be carried out in accordance with BS : 162.
- f. Compressed air piping system shall be completed with Saddle clamps to support the piping system at suitable intervals. Necessary bolts, nuts, pipe fixing clamps etc. shall be included in the Scope of Contractor.

^{11.11} Tests

In accordance with the requirement, the compressors and its accessories shall conform to type tests and routine tests as per applicable standards.

12.0 TERMINAL CONNECTORS

- ^{12.1} 6 nos. terminal connectors shall be provided with each circuit breaker. These shall be suitable for ACSR ZEBRA conductor. The terminal pad of equipment and terminal connector shall be manufactured from same materials i.e., Aluminum alloy. The temperature of the clamps shall not exceed 80 deg C Corona rings shall be provided at the breaker terminal, if required.
- ^{12.2} Two clamp type grounding terminals, each suitable for clamping the grounding conductor, shall be provided on each circuit breaker.
- ^{12.3} Terminal connector should be designed for current ratings and shall comply in all respects including temperature rise, resistance, tensile strength and short circuit current withstand capacity tests as specified in IS:5561-1970 or latest revision thereof.

^{13.0} SULPHUR HEXAFLUORIDE GAS (SF6)

- ^{a.} The SF6 gas shall comply with IEC-376, 376A and 376B and shall be suitable in all respects for use in the switchgear under the operating conditions.
- b. The high pressure cylinders in which the SF6 gas is shipped and stored at site shall comply with requirements of the following standards and regulations:

IS:4379–	Identification of the contents of industrial gas cylinders.
IS:7311–	Seamless high carbon steel cylinders for permanent and
	High pressure liquefiable gases.

^{c.} The SF6 gas shall, be tested for purity, dew point air hydrolysable fluorides and water contents as per IEC-376, 376-A and 376-B and test certificates shall be furnished to Purchaser.

^{14.0} SPECIFIC REQUIREMENT OF SF6 C.B.

- ^{14.1} Circuit breakers shall be of single pressure type with two air compressor for pneumatic operations. Circuit breakers shall be so designed that upon loss of pressure the gap between open contacts shall be suitable to withstand at least the rated voltage at zero gauge pressure of gas.
- ^{14.2} Design and construction of the circuit breaker shall be such that there shall be no possibility of gas leakage and moisture content.
- ^{14.3} In the interrupter assembly there shall be an absorbing product box to eliminate SF6 decomposition products and moisture.
- ^{14.4} When pole unit (interrupter) is removed SF6 gas shall not drain out from the pole. Facility shall be available so that a complete pole unit can readily be replaced by another pole unit without disturbing the other poles.
- ^{14.5} Material used in the construction of circuit breakers shall be such as to fully compatible with SF6.
- ^{14.6} Each pole shall form an enclosure filled with SF6 gas. The pressure of pole shall be monitored and regulated by individual pressure switches. Adequate O-ring seals with test hole for leakage test of the internal seal shall be provided on each static joint.
- ^{14.7} Sufficient SF6 gas shall be provided to fill all the breakers installed at a substation. Rate of leakage of SF6 gas shall not be more than 1% per year.
- ^{14.8} The circuit breaker shall have facilities as to reduce the gas pressure within the circuit breaker to a value not exceeding 8 mill bars within 4 hours or less. The breaker shall be capable of withstanding this degree vacuum without distortion or failure of any part.
- ^{14.9} The Circuit Breakers shall be designed for pressure withstand values, much higher than the rated operating pressures to minimize damages to operators in the event of gas or vapors escaping under pressure.
- ^{14.10} SF6 gas shall comply with IEC-376 and be suitable in all respects for use in circuit breakers under the operating conditions.

- ^{14.11} The high pressure cylinders, in which the SF6 gas is dispatched and stored at site, shall comply with the requirements of the local regulation and by-laws.
- ^{14.12} Sufficient SF6 gas shall be provided to fill all the circuit breakers installed plus an additional 20% of the quantity to compensate for losses during future operations.

15.0 MOUNTING STRUCTURE

^{15.1} The circuit breaker shall be suitable for mounting directly on plinth. Suitable steel structures, supporting column for mounting the circuit breakers shall also be supplied along with the breaker. The steel structures shall be pillar/lattice type and galvanized as per relevant IS. The drawing of the offered steel structure should be sent with each breaker along with other technical details etc.

16.0 INTERPOLE WIRING

Necessary electrical wires/air pipes required or inter pole connections shall also be in the scope of supply. All cables to be used by Contractor shall be armored and shall be as per IS-1544 (1100 volts grade) only copper conductor shall be used. Minimum size of conductor shall be 2.5 sq. mm (copper).

17.0 INSULATION REQUIREMENT OF CIRCUIT BREAKERS

The insulation phase to ground, the insulation between open contacts and the insulation between phases of the completely assembled circuit breaker shall be capable of withstanding satisfactorily dielectric test voltage corresponding to the basic insulation level of 1050KV (peak).

The minimum clearance in air between phases and live parts to earth should be as per IEC. The breaker poles should be suitable to be placed 4.5 meters apart center to center.

18.0 **FITTING AND ACCESSORIES**

Following fittings and accessories shall be provided as an integral part of the equipment.

- i. Pneumatic operating mechanism housing completes with provisions of padlocks and keys.
- ii. Space heaters with automatic thermostat control.
- iii. Two unit compressors with common air receiver for 245 KV Breaker & One unit compressor with air receiver for 145 KV Breaker
- iv. Operation counter
- v. Pressure gauges

- vi. Gas density detectors (Temperature compensated pressure switch)
- vii. Local/remote change over switch.
- viii. Manually operated tripping push button/lever (mech.), conveniently located to trip all 3 phases simultaneously
- ix. Control switch to cut off control power supply (A.C. supply only).
- x. Fuses as required
- xi. Two earthing terminals
- xii. Anti pumping relay
- xiii. Pole discrepancy relay
- xiv. Rating and diagram plate as per IEC.
- xv. Main jumper terminal connectors (6 nos.)
- xvi. Spare 20% SF6 gas with cylinder.

19.0 NAME PLATE

Each circuit breaker shall be provided with a name plate and following information shall be provided :

- i. Manufacturers name and trade mark.
- ii. Serial No.
- iii. Rated voltage
- iv. Rated insulation level
- v. Rated frequency
- vi. Rated normal current
- vii. Rated short circuit breaking current
- viii. Weight
- ix. Rated duration of short circuit.
- x. Rated supply voltage of closing and opening device.
- xi. Rated pressure of compressed gas supply for operation.
- xii. Specification No.
- xiii. Year of supply
- xiv. Name of Purchaser

20.0 TYPE TESTS

The Contractor shall furnish the certified copies of type tests already carried out on offered

245 KV SF-6 circuit breaker. They shall include but not limited to the following tests-

- a) Making capacity breaking capacity and short time current rating tests.
- b) Operation tests and mechanical endurance tests.
- c) Temperature rise tests of the main and auxiliary circuits and measurement of the resistance of the main circuit.
- d) Impulse voltage dry and wet withstand tests and one minute power frequency voltage dry and wet withstand test.
- e) Line charging breaking current test.
- f) Tests to prove the rated transient recovery voltage and RRRV of the circuit breaker.
- g) Short line fault tests.
- H) Out of phase switching tests
- I) Braking small, inductive current test.
- j) Switching impulse voltage test.
- k) Measurement of RIV level.
- 1) Partial discharge test.
- m) Corona extinction voltage tests.

ROUTINE TESTS

- 20.1 The Contractor shall completely assemble and test each SF6 circuit breaker in accordance with IEC-62271-100 amendment thereof to ensure satisfactory working of all the component parts and assembled breaker as a whole.
- 20.2 Following routine tests, whether included in the manufacturer's routine test or not, shall be carried out on each circuit breaker.
- 20.2.1 One minute power frequency voltage dry withstand test as per IEC-62271-100
 - (i) At 110% of rated voltage and maximum pressure
 - (ii) At 70% of rated voltage and minimum pressure
 - (iii) At rated voltage and rated pressure
 - (iv) Tripping at 70% of rated voltage and minimum pressure
- 20.2.2 Measurement of the resistance of the main circuits as per IEC 62271-100.
- 20.2.3 Speed curves for each circuit breaker shall be obtained with the help of suitable operation analyzer to determine breaker contact movement during opening, closing auto-re closing and trip free operation under normal as well as limiting operating conditions (control voltage) pneumatic pressure etc. The test shall show the speed of contact at various stages of operation, travel of contact opening, opening time, closing time, shortest time between separation and meeting of contact at break/make operation etc.
- 20.2.4 High voltage test on control and auxiliary circuits.
- 20.2.5 Routine test performed on breaker operating mechanism as per IEC.

- 20.2.6 Routine test reports of compressor unit associated with the circuit breaker shall be furnished.
- 20.2.7 Routine test report of terminal connectors shall be furnished in accordance to IS-5561-1970.

21.0 SITE TESTS

- 21.1 The test mentioned under clause nos.20.2.2, 20.2.3 and 20.2.4 shall be conducted on the completely assembled breaker at site
- 21.2 All vessels / accessories which operate under pressure shall be tested according to relevant standards and six copies of the test certificate incorporating the following minimum information shall be submitted for each breaker.

TS-2 B

TECHNICAL SPECIFICATIONS OF 36 KV VACUUM CIRCUIT BREAKERS

1.0 STANDARD

The 36KV Vacuum circuit breaker shall comply with the requirements of latest issue of IEC-62210 except where specified otherwise in this specification. Equipment having better quality than the standards mentioned may also be considered provided documentary evidences are furnished.

2.0 PRINCIPLE PARAMETERS

The 36KV Vacuum circuit breaker shall be suitable for outdoor operation in solidly grounded system under climatic conditions specified and should have the following ratings:-

i)	Nominal system voltage	33 KV
ii)	Highest system voltage	36 KV
iii)	Rates voltage	36 KV
iv)	Interrupting capacity	1000 KVA
v)	Rated normal current	1250 A
vi)	Rated frequency	50 c/s
vii)	Rated basic insulation level	170 KV
viii)	Rated short circuit current	25 KA
ix)	Rated short circuit making current	35 KA
x)	Rated operating sequence	0-0. 3 SecCo-3 min-Co
xi)	Total break time for any current up to the rated breaking current	5-6 c/s
xii)	Control circuit voltage	110 VDC

3.0 GENERAL

- **3.1** The 36KV Vacuum circuit breaker shall be supplied as a complete unit in all respects.
- **3.2** The Vacuum circuit breakers shall provide for rapid and smooth interruption of current under all conditions, completely suppressing all undesirable phenomenons, even under the most severe conditions or while interrupting small currents, loading or logging reactive currents. The rate of rise of restriking voltage across the circuit breaker, switching on inductive or capacitive load, should not exceed 2,5 times the normal phase to neutral voltage. The total break

time for the circuit breaker throughout the range of their operating duly shall be stated in the Bid and guaranteed particulars of the breaker.

3.3 MOUNTING

The circuit breaker shall be suitable for mounting on galvanized steel structures. The prices of necessary structures for mounting the circuit breakers shall be included in the cost of circuit breakers.

3.4 CONSTRUCTION

- **3.4.1** The circuit breaker shall consist of three identical phases used with a common operating mechanism
- **3.4.2** Circuit breaker should include the prices of necessary special tools for the erection & maintenance. List of such tools should be furnished with the Bid.

3.5 OPERATING DUTY

Operating duty of the breaker should be 0-0.4 Sec. CO-3 min-CO.

3.6 TEMPERATURE RISE

The maximum temperature attained by any part of the equipment, when in service at site under continuous full load condition and exposed to the direct rays of sun, shall not exceed the permissible limit specified in the relevant standard. When the standards specify limits of temperature rise, these shall not exceed when corrected for the difference between ambient temperature at site and the ambient temperature specified in the approved specification.

3.7 INSULATION OF CIRCUIT BREAKER

The insulation to ground between open contact and between phases of the completely assembled circuit breakers shall be capable of withstanding satisfactorily dielectric test voltage corresponding to the basic insulation level i.e. 170 KV.

3.8 OPERATING MECHANISM

3.8.1 General

- 3.8.2 The circuit breaker operating mechanism shall be highly reliable and will have sufficient energy to provide full making and latching current ability of all the poles simultaneously.
- 3.8.3 The circuit breakers shall be power operated by motorized spring mechanism. The three poles of the breaker shall operate simultaneously through a mechanical coupling.
- 3.8.4 The operating mechanism shall be strong, positive quick and removable without

disturbing other parts of the breaker. The mechanism of breaker shall be a such that the failure of spring will not prevent tripping. The mechanism shall be trip free electrically and mechanically.

- 3.8.5 All working parts in the mechanism shall be of corrosion resistant material and all bearings which require grossing shall be equipped with pressure grease fittings.
- 3.8.6 Suitable anti pumping feature shall be incorporated in the circuit breaker. There shall be no objectionable rebound and the operating mechanism shall not require any critical adjustment.
- 3.8.7 It shall be strong, rigid, positive and fast in operation, Provision shall be made for local electrical control and local/remote selection with enough contacts in the cubicle of the breaker. Manual emergency local tripping arrangement shall be provided on the breaker for use in emergency during maintenance. This emergency trip is intended for use, shall a failure of any part of D.C. control circuits including trip coil takes place preventing remote electrical tripping.

The control circuits shall be designed to operate on 110V DC

- 3.8.8 Breaker shall be provided with ON/OFF mechanical indicator in position so that a man standing on ground may easily see it, with the mechanism housing closed. The operation counter shall be provided.
- 3.8.9 Electrical tripping of the breaker shall be performed by shunt trip coil. A shunt trip coil shall operate correctly under all operating conditions of the circuit breaker and all values of supply voltage between 70% to 110% of the rated voltage. A closing release shall operate correctly at all values of voltage between 80% to 110% of the rated voltage.
- 3.8.10 Working parts of the mechanism shall be made of corrosion resisting material. Bearings which require grease shall be equipped with pressure type grease fittings. Bearing pins, bolt-nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker.
- 3.8.11 Power supply for auxiliaries will be available at 415 volts 3 phases 50 hertz, 230 volts, single phase, 50 Hertz or 110 volts D.C.

4.0 OPERATING MECHANISM HOUSING

4.1 Operating mechanism and all accessories shall be enclosed in a weather proof cabinet of high strength steel sheet construction, the thickness of which shall not be less than 2 mm. Hinged doors giving access to the mechanism at the front shall be provided. Suitable gaskets to make the mechanism housing water proof, dust proof and vermin proof. The housing latch shall accommodate padlock. A common marshalling box for the three poles of the breaker shall be provided suitable 230 volts A.C. heaters shall be mounted in the housing to prevent condensation, so that the cubicle temperature is always maintained approximately 10^{0} C above the outside air temperature.

Miniature circuit breaker shall also be provided. Terminal board shall be furnished in the mechanism housing. Terminals for D.C. shall be isolated for each other. Terminal for the control and other circuits shall be suitable for accommodating 2.5 sq.mm. stranded copper conductor cable leads. Spare terminals for control wiring in the housing shall be provided. Insulation material shall be such that it shall not support combustion, suitable rated switches for A.C. supply shall be provided in the mechanism to enable control supply of the breaker to be cut off. A 5A, 3 pin plug point with a control switch shall be provided.

5.0 **BUSHING AND INSULATORS**

- 5.1 Porcelain used for bushing shall be homogenous, free from lamination, cavities and other flaws of imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.
- 5.2 Glazing of the porcelain shall be uniform and brown in colour, free from blisters, burns and other defects. Bushing shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used. All bushing of identical rating shall be interchangeable.
- 5.3 Puncture strength of bushings shall be greater than flashover value, when operating at normal rated voltage. There shall be no electric discharge between the conductor and bushings which could cause corrosion or injury to conductors, insulators or supports by the formation of substance produced by chemical action, No radio disturbance shall be caused by the bushings when operating at the normal rated voltage.
- 5.4 All iron parts shall be given hot dip zinc/chrome coating and all joints shall be air tight. Porcelain parts shall be designed by grinding and metal parts by machining. Bushing design shall be such as to ensure a uniform compression on the joints.
- 5.5 The basic insulation level, of the breaking chamber porcelain, insulator supports etc shall be 170KV peak and shall be suitable for insulation in heavily polluted atmosphere with minimum total creepage distance as per relevant IEC.
- 5.6 The minimum clearance in air between phase and live parts to earth shall be as per IEC.
- 5.7 Necessary cable glands for the cables of the operating mechanism shall be provided along with a large common gland plate. Total requirement and size of the cable glands will be as below: -

1.	2 x 2.5	sq.mm. Cu Cable	4 nos.
2.	4 x 2.5	sq.mm. Cu Cable	5 nos.

- 3. 6 x 2.5 sq.mm. Cu Cable 3 nos.
- 4. 10 x 2.5 sq.mm. Cu Cable 1 no.

6.0 CONTACTS

Main contacts shall have ample area and contact pressure for carrying the rated current and the short time rated current of the breaker without excessive temperature rise which may cause pitting or welding.

7.0 INTERLOCKS

- 7.1 Provision shall be made to enable mechanical/electrical interlocking with opening or closing of the isolator with the circuit breaker 3 nos. castel locks with one key for each circuit breaker as well as associated isolators shall be supplied along with the circuit breaker. A switch (KS) which will be actuated by the insertion of key shall be provided
- 7.2 The following interlocks shall be provided on the vacuum circuit breaker each with 2 contacts.
- 7.2.1 Spare contact for tripping.
- 7.2.2 All the three poles of the breaker shall trip simultaneously on an electrical command.

8.0 AUXILIARY SWITCHES

- 8.1 Circuit breaker shall be provided with 6 normally open and 6 normally closed contacts. All switches shall be driven positively i.e. (not by spring) in both directions.
- 8.2 Normal position of auxiliary switches refer to contact positions when circuit breaker is open.

9.0 TERMINAL CONNECTORS

6 nos. rigid type aluminum terminal connectors each suitable for ACSR Twin Panther/ Twin Moose conductor with 90 mm, centre to centre spacing shall be provided with each circuit breaker.

The temperature at the clamp shall not exceed 80° C. Two number grounding terminals suitable for clamping the ground conductor shall be provided on breaker. The terminal connector shall conform in respect of temperature rise, tensile strength and short circuit breaking current withstanding capacity tests etc. as per IS 5561-1970 or its latest revision thereof.

10.0 TERMINAL BLOCK AND WIRING

- 10.1 Terminal connection in the terminal block shall have the following features and must be provided with shorting links.
- 10.2 For the safe contact conditions and tightness of screws, the terminals, body

bridge, pressure pad and the screws shall be of high strength brass. The outer surface of all metal parts shall be nickel plated for protection against atmospheric effects.

10.3 24 nos. terminals for current transformers as spares shall be provided in the circuit breaker cubicle on a separate terminal block. Elmex make terminals shall be provided. These terminals shall have a facility of inserting testing bushes. Four number testing bushes shall also be supplied fitted in the terminal block.

10.4 SCREW LOCKING All the screw shall be secured by reaction principle against unintentional self loosening.

10.5 THREADING

The threading parts shall be such that if the screws are adequately tightened for checking purposes shall not break or become free. For studs and screws, female threads shall be produced by using flaw less taps to get strong threads.

10.6 CLAMPING OF CONDUCTORS

Terminal connector shall be such that the conductors can be fixed with adequate contact pressure and without undue damage to the conductor, while tightening the screw or nuts, the terminals connectors shall not move or get displaced.

For the easy connections even the cheapest conductor and providing rigid connections without any damage, the bottom of the terminal body shall be flat.

The terminal connector shall also to suitable for accommodating at least 2 cores of 2.5 sq. mm. copper conductor cable without any pre-operation vis lugs, clamping, soldering etc.

10.7 TERMINAL BLOCKS

These shall be made from high grade melamine thermosetting molding power having the highest unit tracking property. The impact strength shall be between 0017-0019 tested in accordance with clause no. 3.2 table-1 of IS 3669 B-1966. Testing method must be adopted as per clause-II of IS 2221 of 1962. Terminal blocks shall be snap on type to facilitate easy removal of terminal from the channel and thus the dust may be removed from the terminal block housing.

10.8 SHORTING LINKS

The provision of permanent (removable) shorting links in each terminal connector shall be provided (where over required so that any two adjacent terminals can be shorted effectively.

10.9 MOUNTING DEVICE

The terminal shall be mounted by clipping action at two points on the aluminum/steel channel as per DIN 46277 and these shall be easily removable without affecting the mounting of adjacent terminal.

10.10 MARKING LABLES

The marking labels on each side of ends shall be fitted permanently duly engraved descriptions. The embossing shall be of permanent type scratch proof and suited to tropical climatic condition. The size shall be such that these may easily as inserted on the P.V.C. insulation of 2.5 mm, copper conductor cable and shall not come out itself.

10.11 DIMENSION OF CLEARANCES AND CREEPAGE DISTANCES

This will be such that auxiliary circuitry can withstand the routine test requirement of 2KV for 1 minute in line with IEC 62210.

10.12 MOUNTING FOR TERMINALS

The terminal connectors shall be mounted in such a fashion that connections are made on lifting up the disconnecting link.

10.13 END CLAMPS

To avoid side ward movement and to hold the terminals closely together, the end clamps shall be provided at both the ends of the terminals.

10.14 COLOUR OF TERMINAL BLOCKS

The following colours of terminal blocks shall be used.

- a) For A.C. circuit terminal block Red colour.
- b) For D.C. circuit terminal block Conventional colour.

11.0 FITTING AND ACCESSORIES :-

Following fittings and accessories shall be provided as an integral part of the equipment.

Sl.No.	Description of fitments	Quantity
1.	Vacuum interrupters	3
2.	Set of porcelain insulator housingVacuum interrupter and glass fiber drive rod	3
3.	Galvanized steel support structure with foundation bolts	1
4.	Three phase interphase assembly connected to common Operating shaft.	1
5.	Motor/manually charged independent spring closing mechanism having :-	1
	i. Mechanical ON/OFF indicator	

- ii. Spring charged indicator
- iii. Manual trip/close device (mechn.) to trip all the three phases simultaneously
- iv. Operation counter
- v. Spring charging motor
- vi. Tripping and closing coil suitable for 110V DC

6. Local contril panel comprising

- i. Local/remote selector switch 1
- ii. Control I/R/C with pistol Grip handle (spring return to neutral type)
- iii. pole MCB suitable 'or AC supply rated6 Amps for heater circuit.
- iv. 75 watt, 230 V & anticondensation heater with thermostat and switch.
- v. Antipumping contactor.
- vi. Cable gland plate.
- vii. Set of 13 Nos. control cable glands.

7.	Spring charging handle	1
8.	Set of 3 nos. castel lock with 1 key	1
9.	Spare terminals for CT	24
10.	Earthing terminals	2

12.0 NAME PLATE

- 12.1 The firm shall affix a name plate on each vacuum circuit breaker having following informations:
 - i. Manufacturer's name and trade mark.
 - ii. Sr. Number
 - iii. Rated Voltage
 - iv. Rated insulation level
 - v. Rated frequency
 - vi. Rated normal current
 - vii. Rated short circuit breaking current
 - viii. Weight

- ix. Rated supply voltage of closing and opening devices
- x. Year of supply
- 12.2 A metallic plate containing schematic diagram/wiring diagram etc, embossed over it shall be affixed in the control cubicle of the breaker.

13.0 A.C. CIRCUITS

13.1 HEATERS

The controlling M.C.B. for the heater circuit of the control cabinet shall be provided.

13.2 D.C. CIRCUITS

No local fuse and links shall be provided to the circuit breaker's cubicles in the D.C. circuits.

13.3 AUXILLIARY CIRCUIT BREAKER CONTACTS (Used in Tripping and Closing Circuits)

Circuit breaker auxiliary contacts used in trip closing circuit shall be rated for not less than Amps at 110 volts D.C.

The materials of contacts and their arrangement shall be such that the contact resistance shall be minimum to avoid unnecessary heating and contact pressure shall not reduce before at least 10,000 operations.

13.4 <u>COLOUR OF WIRING</u>

The following colours shall be used in the wiring

a.	A.C. Circuit	Black
b.	D.C. Circuit	Grey
c.	Earthing	Green

12.0 <u>MOUNTING STRUCTURES</u>

- 12.1 Suitable mounting frames for installing the circuit breaker shall be supplied alongwith the breaker. The mounting structures shall be made of steel, suitable treated and galvanized for outdoor duty as per relevant ISS. The drawing of the steel structures shall also be furnished for approval.
- 13.0 <u>TESTS</u>

13.1 <u>TYPE TEST</u>

Each circuit breaker shall comply with the type tests and test reports shall be

furnished alongwith the Bid.

13.2 <u>ROUTINE TEST :</u>

- 13.2.1 Routine tests as per IEC-66 shall be carried out in each circuit breaker in the presence of Purchaser's representative if so desired. All test reports shall be submitted and get approved from the before the dispatch of the equipment.
- 13.2.2 Following routine tests whether included in the manufacturer's routine test or not shall be carried out on each circuit breaker.
- 13.2.2.1 One minute power frequency voltage dry withstand tests as per IEC 62210
- 13.2.2.2 Routine tests of breaker operating mechanism as per IEC 62210 or its latest version.
- 13.2.2.3 Measurement of the resistance of the main circuits as per IEC 62210
- 13.2.2.4 To determine breaker contact movement during opening, closing operation under normal as well as limiting operating condition, control voltage etc. The tests shall show the speed of contacts at various stages of operation travel of contacts, closing time, shortest time between separation and meeting of contacts at break/make operation etc.
- 13.2.2.5 High voltage test on control and auxiliary circuits.

14.0 <u>SITE TESTS</u>

The tests mentioned under clause 14.2.2.2 to 14.2.2.5 shall be conducted on the completely assembled breaker at site provided that testing equipments are made available at site by the Purchaser.

15.0 <u>COMPLETENESS OF CONTRACT</u>

Any fittings, accessories or apparatus which might not have been mentioned in the specn, but which are usually necessary for the equipment of similar nature, are to be provided by the Bidder without extra cost. All apparatus must be complete in all detail whether mentioned in the specification. or not.

TECHNICAL SPECIFICATION OF

245 KV/145KV/36KV CURRENT TRANSFORMERS

1.0 STANDARDS :

1.1 Except as modified in this specification, the Current Transformers and accessories shall be in accordance with the latest editions of the following standards :-

1.	IEC Publication 185	:	Current Transformers
2.	Draft Supplement to IEC publication 185 (1966)	:	CTs for protection system for which transient performance is significant.
3.	IS:2705 (Part-I to IV) 1991 & IEC 60444-1	:	Specification for CTs.
4.	IS : 2099	:	High voltage porcelain bushing.
5.	IS : 3347	:	Dimension for porcelain T/F
6.	IEC : 60-1973	:	High voltage test techniques.
7.	IS : 335	:	Insulating oil for T/F and switchgear.
8.	IS : 3202	:	Code of practice : climate proofing of electrical equipment.
9.	IEC-270-1968	:	Partial discharge measure-ment.
10.	IEC-44(4)-1980	:	Instrument transformers measurement of partial discharge.
11	LIPPTCL prevalent practices &		

11. UPPTCL prevalent practices & operational experiences.

1.2 **TYPE & RATING :**

- 1.2.1 The CTs should be of the outdoor type, single phase, 50 c/s, oil immersed, self cooled, hermetically sealed, suitable for operation in humid atmosphere in the tropical sun with climatic conditions as indicated in Clause 4.0 of General Technical Requirements. The CTs should also be suitable for use in area subject to heavy lightning storms.
- 1.3 The CTs shall comply with requirements indicted below :-

S.No.	Particulars	245 KV CTs	145 KV CTs	36 KV CTs
1.	Nominal system voltage	220 KV (r.m.s.)	132 KV (r.m.s.)	33 KV(r.m.s.)
2.	Highest system voltage	245 KV (r.m.s.)	145 KV (r.m.s.)	36 KV(r.m.s.)
3.	Frequency	50 Hz	50 Hz	50 Hz
4.	Earthing of system	Effective	Effective	Effective
5.	Insulation level (BIL)	1050 KV (peak)	650 KV (peak)	170 KV (peak)
6.	Transformation ratio	1000/800/500/30 0/1A	800- 500/1A (For160MVA T/F) 400-200-100/1A (For 40 MVA T/F) 800-400-200/1A (For Feeders)	400-200/1A (For Feeders) Two cores. 800- 400/1A(For T/F) Three cores.
7.	No. of cores	Five	Three	Two /Three
8.	Short time current rating (Correspondin g to 6500 MVA-fault level)	40 KA for 3 sec.	31.5 KA for 3 sec.	25 KA for 3 sec.
9.	Creepage distance of bushing.	6125 mm (min.)	3625 mm (min.)	900 mm (min)
10.	Ratio selection	Primary reconnection & Secondary tapings.	Primary reconnection & secondary tapings	Primary reconnectio n & secondary tapings.
11.	Continuous primary current	120% of rated primary current.	125% of rated Primary current.	120% of rated primary current.

12.	Short time primary current.	Twice rated current.	Twice the rated current.	Twice the rated current.
13.	Continuous secondary current rating.	120%	2 Amps.	2 Amps. (min.)
14.	Rated withstand dynamic current (2.5) times of short time current rating.	100 KA (peak)	78.5 KA (peak)	62.5 KA (Peak)
15.	One minute power frequency withstand voltage (KV)	460 KV	275 KV	70 KV

1.4.0 **CONSTRUCTION :**

- 1.4.1 Current Transformers shall be ring type mounted in appropriate voltage class oil filled shaded porcelain bushings, suitable for outdoor service and upright mounting on steel structures as per drg. No.W-04611/ESDC.
- 1.4.2 Design and construction of CTs shall be sufficient to withstand the thermal and mechanical stresses resulting from the specified short circuit current. The core laminations shall be of cold rolled grain oriented silicon steel or other equivalent alloy. The exciting current shall be as low as possible and the current transformer shall be capable of maintaining its rated accuracy for burdens and saturation limits specified.
- 1.4.3 Current Transformers shall be suitable for outdoor use. Tenderers should quote, clearly specifying the type of CT design.
- 1.4.4 Current Transformers shall have high accuracy commensurate with the faster protection schemes employed in the system. The cores to be used for protection shall, therefore, besides being of low reactance type, produce undistorted secondary currents under transient condition on all the ratios.

- 1.4.5 CT secondary terminals shall be brought out in a weather proof terminal box. The terminal box shall be provided with five glands suitable for 1100 V grade, PVC insulated, PVC sheathed, 2x2.5 mm² copper conductor cables.
- 1.4.6 Polarity marks shall be indelibly marked on each current transformer and at the lead terminations in the associated terminal block. Facility shall be provided for short circuiting and grounding the CT secondary at the terminal blocks.
- 1.4.7 CT shall be provided with name plate showing the particulars and diagram of the current transformer in line with the relevant IEC.
- 1.4.8 CTs shall be hermetically sealed to eliminate breathing and prevent air and moisture from entering the tank. These shall be provided with oil level gauge and pressure relieving device capable of releasing abnormal pressure.
- 1.4.9 Continuous current rating of secondary winding of core should be as per requirement specified. The secondary terminal should be brought out in a compartment on one side of CT for easy access. The secondary terminals should be provided with short circuiting arrangement. The secondary leads should be adequately reinforced to withstand normal handling without damage. The sealing arrangement of secondary terminals should also be provided in a compartment of two sides of CT terminal box.

The secondary terminal box should be partitioned so as to house the metering terminals separately with the provision of sealing and locking of the metering terminals.

1.4.10 CT cores used for protective relaying purpose should be of accuracy class specified. Magnetization curves should be furnished for metering and protection cores.

1.5.0 **BUSHINGS :**

- 1.5.1 Bushings shall be made of homogeneous, vitreous porcelain of high mechanical and dielectric strength. Glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water.
- 1.5.2 Bushings conforming to IS-2099 & 3347 shall be hollow porcelain type hermetically sealed to prevent ingress of moisture and with suitable facility to indicate oil level.
- 1.5.3 Cast metal end caps for the bushings shall be of high strength, hot dip galvanised malleable iron. They shall have smooth surface to prevent discharge taking place between the metal parts and porcelain as a result of ionisation.

1.6.0 **TERMINAL CONNECTORS**

- 1.6.1 All instruments transformers shall be provided with terminal connectors suitable to receive ACSR ZEBRA conductor in case of 245 KV CTs, ACSR ZEBRA/Tarantula conductor in case of 145 KV CTs & ACSR Twin PANTHER/ Twin Zebra conductor in case of 36 KV CTs as per Cl 8.3 of "General Technical requirements of Specifications ".
- 1.6.2 Two grounding terminals shall be provided on the tank of each transformer on opposite sides. The grounding conductor shall be of MS flat of size 75x10 mm.

1.6.3 **MATERIAL :**

For non-current carrying parts, the bolts, nuts, washer and check nuts up to 10 mm size should be of stainless steel and 12 mm size or above should be hot dip galvanized marked with ISI certification mark. Nuts, washers, bolt for current carrying parts should be tinned copper. These should be manufactured by a reputed concern and conform to IS-1363-1967 and IS-1367-1967 or latest amendment thereof

1.6.4 **DESIGN**

The design of the connectors shall be such as to give intimate contact between the conductor and terminal and offer protection to the contact surfaces against effects of electrolytic (between two dissimilar metals) and atmospheric corrosion. The connector shall have sufficient mechanical strength and shall completely enclose the conductor and terminals. The connector shall hold the conductor and terminal very tightly so that the connector withstands the mechanical stresses set up by vibration, wind and short circuit current. The conductivity of connectors shall be high to minimize power loss. The connector should be designed with large factor of safety and should comply in all respect of temperature rise; resistance and tensile strength withstand capacity as per ISS-5561-1970 or amendment thereof.

1.7.0 **GENERAL :**

1.7.1 Instrument transformer shall be provided with suitable lifting arrangement to lift the bushings and the tank.

1.7.2 **INSULATING OIL :**

A sufficient quantity of oil for the base top and porcelain housing shall be furnished with each CT. Insulating oil shall meet requirements of IS-335 for use in electrical apparatus. The Contractor shall submit 4 sets of test reports of oil being filled in CT covering in all the tests specified in IS besides giving complete dissolved gas analysis of oil prior to filling. This test report shall be based on the basis of previous job executed by the bidder or on the prototype.
1.7.3 Instrument transformers shall be complete with accessories like terminal connectors, grounding lugs, filling and draining plugs, oil sight glass, weather proof terminal box etc.

1.8.0 **<u>TESTS :</u>**

1.8.1 Type Tests :

All the equipments offered shall be fully type tested as per the relevant standard. Reports of following type tests are to be submitted with offer.

- 1.8.1.1Short time current test: As per IS : 27051.8.1.2Temperature rise test: As per IS : 27051.8.1.3Impulse voltage withstand
test: should be for ± 15 Impulse, not less
IS : 27051.8.1.4Radio interference test: As per IS-8263-19761.8.1.5One minute power
frequency(Wet)withstand
test.: As per IS : 2705
- 1.8.1.6 All other type tests shall be in accordance with the latest rev. of IS/IEC.

1.8.2 **ROUTINE TEST :**

The following routine tests shall be carried out :-

- 1.8.2.1 Verification of terminal marking and polarity. (As per IS : 2705)
- 1.8.2.4 High voltage power frequency tests on secondary windings. (As per IS : 2705)
- 1.8.2.5 Over voltage inter turn test. (As per IS : 2705) for cores 1 and 2 i.e. on which distance protection is to be installed.
- 1.8.2.6 Partial discharge test (in accordance with IEC-44(4)-1980). The test circuit for the measurement of partial discharge shall be in accordance with Sub-Clause 4.2 of IEC-270-1968. The partial discharge test shall be carried out after all tests are completed. The partial discharge level shall not exceed 10 Pico-coulombs.
 - i) An excitation curve with voltage in volts on ordinate and magnetization current in mA on abscissa plotted up to that voltage level above knee point voltage when 10% increase in voltage causes 50% increase in magnetization current.

- ii) The CT shall be tested for leakage and strength by applying to complete CT and porcelain housing filled with oil at a pressure not less than 0.7 Kg/cm² above the maximum operating pressure for a period of 24 hrs. or not less than 1 Kg/Cm² above the maximum operating pressure for a period of 6.0 hours. If leakage occurs the CT shall be retested after all leakage has been stopped.
- iii) Tan delta measurement.
- iv) Temperature rise test at least once against the order.

1.9.0 **DRAWINGS :**

- 1.9.1 Drawings incorporating the following particulars shall be submitted with the offer for the purpose of preliminary study.
 - a) General outline drawing showing complete dimensions, net weights, shipping weights, quantity of insulating oil etc.
 - b) Connection diagram and rating plate particulars.
- 1.9.2 The drawings to be furnished by the Contractor for approval after acceptance of his tender, shall include the following particulars (all explanations legends etc. shall be given in English and dimensions marked in Metric units).
 - a) General outline drawings showing front and side elevations, top and bottom plan views, all accessories and external features, with complete detailed dimensions, net and shipping weights, size of lifting lugs, quantity of insulations oil etc.
 - b) Name plate drawings of terminal connectors showing material composition, permissible temperature rise, current carrying capacity etc.

1.10.0 **JUNCTION BOX :**

Junction Box : Type-I 1.10.1 (For 245 kV CTs)

- (a) One junction box shall be provided for each set of three nos. single phase 245 kV CTs as per drawing shown in fig. 1(a). Each junction box shall be equipped as below :
- (b) Junction box shall be equipped with at least 50 nos. ELMEX/TOSHA make terminals with shorting links. These terminals shall be suitable to receive at least 2 cores of 2.5 sq.cm. copper conductor cable. These terminals should be suitable to withstand up to 5 kV. Terminal blocks shall be provided with serial no. tags from 1 to 50

- (c) The junction box shall be of sheet steel construction not less than 3.0 mm thick sheet on all sides suitable for mounting on an auxiliary structure.
- (d) Junction box shall be provided with front hinged door and handle along with provision for locking, suitable gasket/neoprene rubber bending to be provided to make it dust proof, vermin proof and water tight. The arrangement for cable entry shall be from bottom for both incoming and outgoing 10 core 2.5 sq.mm. copper conductor PVC insulated cable of 1100 volts, for which 9 nos. water tight chromium plated brass cable glands shall be provided.
- (e) The junction box shall be hot dip galvanised or painted with two coats of zinc chromate primer both inside and outside after proper cleaning and pickling. Finally the inside shall be painted with two coats of white enameled paint and outside with two coats of grey epoxy paint. Dimensional and GA drawings of junction box shall be submitted for approval.
- (f) Four earthing terminals (M₆ Brass screws washer and base) inside and two earthing terminals (M₈ brass screws washers and base) outside of junction box shall be provided with earthing wares eyebolts, below them the BOSSES shall be bronzed and Hardware shall be electro tinned.
- (g) Two sets of CT test terminal blocks (link type) shall be provided to prevent open circuiting of CTs during testing.
- (h) The junction box shall be suitable for mounting on CT auxiliary structure as shown in fig.1(a), with doors in front with water proofing gaskets. It will be fully air tight, water proof and vermin proof as per IP 44.
- (i) Slot of suitable size should be provided in the raised bottom of the junction box and blanked with a removable gland plate. Each gland plate shall be provided with required number of double compression type brass cable glands suitable for steel wired cable.

1.10.2 Junction Box : Type-II (For 145 kV CTs)

- a) One junction box shall be provided for each set of three nos. single phase 145 kV CTs as per drawing shown in fig. 1(a). Each junction box shall be equipped as below :
- b) Junction box shall be equipped with at least 38 nos. ELMEX/TOSHA make terminals with shorting links. These terminals shall be suitable to receive at least 2 cores of 2.5 sq.cm. copper conductor cable. These terminals should be suitable to withstand up to 5 kV. Terminal blocks shall be provided with serial no. tags from 1 to 38.

All other provisions shall be the same as mentioned in para 1.10.1 c) to i)

1.10.3 Junction Box : Type-III (For 36 kV CTs)

- a) For the outgoing 33 kV feeders one junction box shall be provided for three nos. single phase 36 kV CTs as per drawing shown in fig. 1(b). Each junction box shall be equipped as below :
- b) Junction box shall be equipped with at least 20 nos. ELMEX/TOSHA make terminals with shorting links. These terminals shall be suitable to receive at least 2 cores of 2.5 sq.cm. copper conductor cable. These terminals should be suitable to withstand up to 5 kV. Terminal blocks shall be provided with serial no. tags from 1 to 20.
- c) The junction box shall be suitable for mounting in outdoor substation either on supporting structures of the CTs or on concrete pedestals. The boxes will be completely water tight, dust & vermin proof as per IP 44. It shall be provided with hinged cover on the front and removable covers to be fixed with screwed stands on three sides. The front cover shall have a glass window for inspection of fuses.
- d) Following water tight brass cable glands shall be provided on the removable gland plates at the bottom :

	Glands suitable for	Quantity
a)	2C x 2.5 mm PVC cable	3 nos.
b)	4C x 2.5 mm PVC cable	3 nos.

e) The junction box shall be of sheet steel construction not less than 3.0 mm thick sheet on all sides suitable for mounting on and shall be hot dip galvanized or painted inside and outside as mentioned in 1.10.1 e).

1.11.0 COMPLETNESS OF THE EQUIPMENT :

Any fittings, accessories or apparatus which might not have been mentioned in this technical details but which are used or necessary in the equipment of similar nature are to be provided by the Contractor without any extra cost. All apparatus must be complete in all respect whether mentioned or not.

<u>Annexure (A)</u>

245 KV C.T. REQUIREMENT

Cor e	or Application Current Output		Accuracy Class	Values at Maximum Tap			
No.		Ratio (A/A) (VA)			Min. Knee point Voltage (Volts)	Max. Exciting current (mA)	Max. CT Secondar y winding Resistanc e (Ohms)
1	2	3	4	5	6	7	8
I	Transformer Diff. I/ Distance Protection Main-I	1000- 800- 500- 300/1	-	PS	1100	80	5 Ω
II	Transformer Diff.II /Distance protection Main-II	- do -	-	PS	1100	80	5 Ω
III	Metering*	- do -	30 VA	0.2	-	-	-
IV	Bus Bar Diff. Main	- do -	-	PS	1100	80	5 Ω
V	Bus Bar Diff.	- do -	-	PS	1100	80	5 Ω

<u>Annexure (B</u>)

145 KV C.Ts REQUIREMENTS

TYPE- A (For 132 kV Feeders)

Core No.	Application	Current Ratio (A/A)	Output Burden (VA)	Accuracy Class as per IEC- 185	Minimum Knee point Voltage (Volts)	Max.Exciting current at half knee point voltage (mA)	Maximum CT secondary winding Resistanc e at 75 deg C (Ohms)
1	2	3	4	5	6	7	8
I	Distance Protection	800/1	-	PS	1100	20 at VK/2	5 Ω
		400 /1	-	PS	1100	20 at VK/2	5 Ω
		200/1	-	PS	550	40 at VK/2	2.5Ω
II	Over Current & E/F	800/1	-	PS	1100	20 at VK/2	5 Ω
	Protection	400 /1	-	PS	1100	20 at VK/2	5 Ω
		200/1	-	PS	550	40 at VK/2	2.5Ω
	Metering*	800/1	20	0.2	-	-	-
		400/1	20	0.2	-	-	-
		200/1	20	0.2	-	-	-

TYPE- B (For 132 kV side of 160 MVA 220/132 kV Transformers)

1	2	3	4	5	6	7	8
I	Differential Protection	800-500/1	-	PS	1100	20 at VK	5 Ω
II	Over Current & E/F	800-500/1	-	PS	1100	20 at VK	5 Ω
III	Metering*	800-500/1	20 VA	0.2	-	-	-

TYPE- C (For 132 kV side of 40 MVA 132/33kV kV Transformers)

1	2	3	4	5	6	7	8
I	Differential Protection	400/1	-	PS	1100	20 at VK/2	5 Ω
		200 /1	-	PS	550	40 at VK/2	2.5 Ω
		100/1	-	PS	550	40 at VK/2	2.5Ω
II	Over Current & E/F Protn.	400/1	-	PS	1100	20 VK/2	5 Ω
		200 /1	-	PS	550	40 VK/2	2.5 Ω
		100/1	-	PS	550	40 VK/2	2.5 Ω
	Metering*	400/1	20	0.2	-	-	-
		200/1	20	0.2	-	-	-
		100/1	20	0.2	-	-	-

<u>Annexure €</u>

36 KV C.T. REQUIREMENTS

TYPE- A (For 40 MVA Transformers)

1	2	3	4	5	6	7	8
I	Metering*	800/1	10	0.2	-	-	-
		400/1	10	0.2	-	-	-
II	Protection	800/1	-	PS	400	30	4 Ω
		400 /1	-	PS	400	30	4 Ω
	Protection	800/1	-	PS	400	30	4 Ω
		400 /1	-	PS	400	30	4 Ω

TYPE- B (For 33 kV Feeders)

1	2	3	4	5	6	7	8
I	Metering*	400/1	10	0.2	-	-	-
		200/1	10	0.2	-	-	-
II	Protection	400/1	20	5P10	-	-	-
		200 /1	20	5P10	-	-	-

MOUNTING DETAILS OF 245 / 145 KV CT , PT AND CVT

Drg. No. W-04611



NOTES:

1. ALL DIMENSIONS ARE IN M.M.

2. ALL MOUNTING HOLES ARE OF 22 mm Ø

3. CT, PT & CVT MAY BE FIXED EITHER ON SET

OF HOLES MARKED 'A' OR ON THE HOLES MARKED 'B'.

W-04611

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MOUNTING DETAILS OF 220 / 132 KV C.T., P.T. AND C.V.T.



JUNCTION BOX FOR 245 KV AND 145 KV CTs





JUNCTION BOX FOR 36 KV CTs AND 36 KV PTs



FRONT VIEW

NOTE:

THIS DRAWING IS ONLY FOR THE GUIDANCE OF THE BIDDER. HE WILL SUBMIT HIS OWN DRAWING WITH THE COMPLETE DETAILS FOR APPROVAL.



SIDE VIEW

STANDARDISED TERMINAL BOARD DRAWING FOR 245 KV CT JUNCTION BOX

<u>Annexure - 1</u>

			50
			49
	48		
	47 4		
			46
	F	889	45
	.O H	289	44
NO	8	LSS	43
ECT	F	889	42
ROT	НЧ	289	41
AR P	۲.	159	40
USB.	F	889	39
8	НС	289	38
	Å	LSS	37
	Ŀ	887	36
z	НЧ	257	35
TIO	8	LS†	34
TEC	Ŀ	887	33
R	H	785	32
BAR	.	157	3
BUS	R-PH CT	8S7	30
		785	29
		LS†	28
	: РН СТ	ESZ	27
z		282	26
10	•	LSZ	25
DTEC	5	ESZ	24
R	Hd	282	23
Ř	Y	LSZ	22
BAC	Ч,	ESZ	21
	Hd	252	20
	œ	LSZ	3 19
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7	H S	281	1
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INTERNAL DETAILS OF 132 KV 3 Ø CT JUNCTION BOX

		VLS		30
	-	MIN		29
		TER		28
			e se	27
		m	332	26
			3S1	25
_	<u>u</u>		ese	24
CORE- III	ERIN	≻	332	23
	MET		3S1	22
			e se	21
		œ	3S2	20
			3S1	19
	O/C & E / F PROTECTION	1	283 2	18
		<u></u>	282	17
			2S1	16
_			283	15
Ë I		7	252	4
CO CO			281	13
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		~	282	7
			281	9
			1S3	6
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TECHNICAL SPECIFICATION OF 245 KV CAPACITOR VOLTAGE TRANSFORMERS

1.0 **STANDARDS:**

Unless otherwise specified elsewhere in this specification, the rating as well as performance and testing of the 245 KV Capacitor Voltage Transformers along with associated accessories shall conform but not limited to the latest issues/amendments of standards available at the time of placement of order of all the relevant standards as listed hereunder.

Sl.No.	Standard No.	Title
1.	IS: 3156 (part IV)	Capacitor Voltage Transformers
2.	IS: 2099	High voltage porcelain Bushings
3.	IS: 2071	Method of High voltage testing
4.	IS: 335	Insulating oil for transformers and switching
5.	IS: 2165	Insulation Co-ordination for equipment of 100 kV and above.
6.	IEC-186	Voltage Transformers:Chapter-III Capacitor Voltage Transformers: Chapter-IV
7.	IEC-186A	First supplement to IEC Publication:186
8.	IEC-270	Partial Discharge Measurement.
9.	IEC-171	Insulation co-ordination
10.	IEC-358	Coupling capacitor divider.
11.	IEC-60	High Voltage Testing Techniques.
12.	IS: 9348	Coupling capacitors and capacitor dividers.

1.0 **PRINCIPAL TECHNICAL PARAMETERS**

1.1 The Voltage Transformers shall conform to the following specific parameters:

SI. No	Parameters	Specification		
1	2	3		
1.	Type of installation	Single Phase, Oil filled		
		hermetically sealed and		
		outdoor types		
2.	Type of mounting	Pedestal type		
3.	Suitable for system frequency	50 Hz ± 5%		
4.	Highest system Voltage	245 Kv		
5.	Transformation ratio on all windings	<u>220,000 / 110</u>		
		√3 √3		
6.	Method of earthing	Effectively earthed		
7.	1.2/50 micro second lightning impulse withstand voltage kV (peak)	1050		
8.	1 minute dry power frequency withstand voltage kV (rms)	460		
9.	Min. Creepage Distance mm.	6125		
10.	Radio interference Voltage at 266 kV	Not exceeding 500 micro volts		

- 1.1 Voltage ratios and other requirements of the Voltage Transformers shall comply with the requirement indicated in Annexure-I
- 1.2 Maximum permissible temperature rise of windings of voltage transformers shall be 50° C over an ambient of 50°C.
- 1.3 245 kV CVTs shall be suitable for carrier coupling purposes.

The CVTs must not enter into Sub-harmonic resonance. Transient oscillations during energisation must be damped out sufficiently rapidly so that secondary peak voltage after 0.20 seconds from the time of energising should not differ by 10% from its final steady state value.

They must have sufficiently low short circuit impedance as seen from secondary. The short circuit impedance as seen from secondary should not exceed 0.25 ohm.

CVTs shall be suitable for fast single/three pole reclosing of the lines. Reclosing time may be as low as 0.3 seconds.

CVT must transmit accurately sudden drops of primary voltage following a short circuit between primary terminal and earth. The secondary output voltage shall decay within one cycle of rated frequency to a value less than 10% of peak value before short circuit.

GENERAL TECHNICAL REQUIREMENTS:

Construction:

245kV voltage transformers shall be capacitance voltage divider type with wound type intermediate transformer, mounted in 245 kV class shaded oil filled porcelain bushing, suitable for outdoor service and upright mounting on steel structures.

- 3.1.2 The Potential Transformers shall be wound electromagnetic type mounted in oil filled shaded porcelain bushings, suitable for outdoor service and upright mounting on steel structures.
- 3.1.3 Design and construction of VTs shall be sufficient to withstand thermal and mechanical stresses resulting from the specified short circuit currents.
- 3.14 VT secondary terminals shall be brought out in a weather proof terminal box. The terminal box shall be provided with five brass glands suitable for 1100 V grade, steel wire unarmoured, PVC insulated, PVC sheathed, 2.5 sq.mm. stranded copper conductor cables.
- 3.15 Polarity marks shall be indelibly marked on each current transformer and at the lead terminations at the associated terminal block.
- 3.16 VT shall be provided with name plate showing the particulars and diagram of the voltage transformers in line with the Indian Standard-3156.

4.0 Bushings:

- 4.1 Bushings shall be made of homogenous, vitreous porcelain of high mechanical and dielectric strength. Glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water.
- 4.2 Bushings shall be oil filled type, hermetically sealed to prevent ingress of moisture and with suitable facility to indicate oil level.
- 4.3 Cast metal end caps for the bushings shall be of high strength, hot dip galvanized malleable iron. They shall have smooth surface to prevent discharge taking place between the metal parts and porcelain as a result of ionisation.

5.0 <u>Terminal Connectors:</u>

All instrument transformers shall be provided with terminal connectors suitable to receive following types of conductors. Exact size of the connector will be furnished to the successful supplier. 5.1 Two grounding terminals shall be provided on the tank of each transformer, on opposite sides. The grounding conductor shall be MS flat of size 75 x 10 mm.

6.0 **General:**

- 6.1 Instrument transformer shall be provided with suitable lifting arrangement to lift the bushings and the tank.
- 6.2 Instrument transformers shall be supplied complete with insulating oil required for first filling. Power factor of transformer oil shall be of the order of .005.
- 6.3 Instrument transformers shall be complete with accessories like terminal connectors, grounding lugs, filling and draining plugs, oil sight glass, weather proof terminal box etc.

7.0 **JUNCTION BOXES:**

The junction boxes shall be adequately designed and dimensioned to accommodate the fuse links, miniature circuit breaker and various terminal connectors providing sufficient earth clearance and should also have convenient space to house various cable glands.

- 7.1 The junction boxes should be of cast iron or fabricated construction. In the case this gauge. The junction boxes should be painted with one coat of zinc CHROMATE of fabricated construction the gauge used should at least be 16 SWG and not less than primer and two coats of light grey enamel paint or any other approved paint both inside and outside after proper cleaning and phosphatising. These should be dust and vermin proof, water tight and suitable for mounting in outdoor substations either on supporting structure of the equipment or on concrete pedestals. Each junction box shall have slanting top and shall be provided with hinged cover on the front and removable covers to be fixed with screwed studs on three sides flanges together with suitable water tight cable glands as specified under item and sketch. The cover and the flanges shall be provided with suitable packings and gaskets so as to make these junction boxes completely water tight. Blanking washers should be provided in the cable glands.
- 7.2 The terminal blocks provided with these junction boxes shall be rated for 15 Amps. and will be suitable for uninterrupted duty. The terminal blocks shall be 400 volt grade complete with insulated barriers, terminal studs, washers, nuts and identification strips and shall have also disconnecting and shorting links. These should be suitable to receive at least 2 cores of 2.5 mm sq. copper

conductors cables. The terminal blocks should preferably be made of Kirloskar-Asea type OTEA-46, Essan, Elmax make terminals or equivalent. The fuse links employed should be of high rupturing capacity non-deteriorating, English Electric make mounted in such a fashion that these can be easily taken out and replaced without removing any wiring. The NS type fuse link should be provided with fuse carrier and base assembly such that visual indication of blown fuses may be possible from the inspection window without removing the cover of fuse fittings. Necessary internal connections between the terminal block and other apparatuses such as fuses, miniature circuit breakers etc. are shown as in sketches enclosed.

- 7.3 The junction boxes should be as for as possible in accordance with sketches enclosed with the specification, however, it is at the discretion of the tenderer to alter the dimension slightly to suit his designs. The wiring should be provided as shown in the sketch.
- 7.4 The miniature circuit breakers should be single pole 5 Amps. 110 volts A.C. continuous rating having thermal over load protection LVPAS or MORARJI DORMAN or equivalent make and with one normally closed and one normally open set of auxiliary contacts and should conform with the relevant ISS.

8.0 **Detailed Specifications**:

8.1 Junction Box:

- 8.1.1 One junction box shall be provided for each set of 3 nos. single phase 245 kV CVTs as per drawing shown in fig. 1(a). Each junction box shall be equipped as below:
- 8.1.2 Terminal blocks with 65 nos. OTEA -46 terminal or Easun make terminals and associated accessories as specified above.
- 8.1.3 9 nos. HRC-ND- cartridge fuses link type NS-10 (2.0A) with carrier and base assembly (English Electric make), 3 nos. neutral links and 2 nos. miniature circuit breakers each with one NO and one NC auxiliary contact duly mounted and wired.
- 8.1.4 Water tight brass cable glands suitable for 4 core, 10 mm. sq. PVC copper cable 14 nos.
- 8.1.5 Water tight brass cable glands suitable for 2 core, 2.5 mm. sq. PVC copper cable 2 nos.
- 8.1.6 Each junction box shall be provided with glass window on the front cover for inspecting the fuse periodically from outside.

9.0 <u>TESTS:</u>

9.1 **<u>TYPE TESTS</u>**:

All the equipment offered shall be fully type tested as detailed below and as per the relevant standards:

- 1. Temperature rise test
- 2. Lightning Impulse voltage withstand test.
- 3. Test for accuracy
- 4. Ferro Resonance test (For 245 kV and 145 kV CVTs only)
- 5. Transient response test (For 245 kV and 145 kV CVTs only
- 6. Power Frequency withstand voltage.

9.2 ROUTINE AND ACCEPTANCE TESTS:

Following tests will be carried out.

- 9.2.1 Verification of terminal markings and polarity: As per IS: 3156
- 9.2.2 Power frequency test on secondary winding: As per IS: 3156
- 9.2.3 Power frequency test on primary winding: As per IS: 3156
- 9.2.4 Determination of error according to the requirement of the appropriate accuracy class: As per IS: 3156
- 9.2.5 Capacitance and loss angle measurement before and after voltage test: As per IS: 9348
- 9.2.6 Partial discharge test on capacitor divider: As per IEC-44(4) for 245 KV CVTs.
- 9.2.7 Oil leakage test: As per IS: 9348.

10.0 DRAWINGS AND DATA:

The Contractor shall furnish following drawings to the Purchaser-

- General outline and assembly drawings of the equipment.
- Graphs showing the performance of equipment in regard to magnetization characteristics.
- Sectional views showing:
- General Constructions Features.
- Materials/Gaskets/Sealing used.
- The insulation of the winding arrangements, method of connection of the primary/secondary winding to the primary/secondary terminals etc.

- Porcelain used and its dimensions along with the mechanical and electrical characteristics.
- Arrangement of terminals and details of connection studs provided.
- Dimensional and general arrangement drawing of the junction box.

11.0 <u>SURFACE FINISH</u>:

11.1 Interior and exteriors:

All interiors and exteriors of control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, creases or other adhering foreign matter. All steel surfaces in contract with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surface exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical hear and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade no.IS-5.

11.2 Galvanizing:

All ferrous parts including all sizes of nuts, bolts, plain and spring washers etc. shall be hot dip galvanized conforming to latest version of IS:2629 or any other equivalent authoritative standard.

12.0 SPARE PARTS AND MAINTENANCE EQUIPMENTS:

The Contractor shall indicate in his proposal optional spare parts and maintenance equipments, if any, for five years of operation. The prices of spares shall be quoted separately.

REQUIREMENT OF 245 KV CVT

S.No.	DETAILS		PARTICULA	RS			
1.	Transformation ratio on all windings	220,000 / <u>110</u> √3 √3 (No. of second	$\frac{220,000 / 110}{\sqrt{3}}$ (No, of secondary windings 3)				
2.	Supply frequency	50 Hz.					
2		Capacitor valt	and two				
5.	Туре		age type.				
4.	Rated voltage factor	1.2 continuou 1.5 for 30	is seconds.				
5.	Application	Winding I Protection	Winding II Protection	Winding III Metering/Synchro.			
6.	Accuracy	3P	3P	0.2			
7.	Phase angle error	As per IS					
8.	Output burden	150 VA	150 VA	50 VA			
9.	Rated capacitance	4400 + 10% - 5%					
10.	Rated total thermal burden	750 VA		I			
11.	Standard reference range	97% to 103%	for protection	&			
	of frequency for which the accuracies are valid.	99% to 101%	for measurem	ent.			
12. a)	One minute power frequency test on secondary winding.	3 KV (r.m.s.)					
b)	Withstand voltage between low voltage terminal and earth terminal	4 KV (r.m.s.)					
(Note : This test voltage shall be 10 KV (r.m.s.) in the low voltage terminal exposed to weather).							

c)	Radio interference voltage of 266 KV (r.m.s.)	Not exceeding 500 microvolts.
13.	Corona extinction voltage.	320 KV (r.m.s.)
15.	Partial discharge level at rated voltage for capacitor divider.	Less than 10 pico coulombs

MOUNTING DETAILS OF 245 / 145 KV CT , PT AND CVT

Drg. No. W-04611



NOTES:

1. ALL DIMENSIONS ARE IN M.M.

2. ALL MOUNTING HOLES ARE OF 22 mm Ø

3. CT, PT & CVT MAY BE FIXED EITHER ON SET

OF HOLES MARKED 'A' OR ON THE HOLES MARKED 'B'.

W-04611

UP POWER CORPORATION LTD ELECTRICITY SUBSTATION DESIGN CIRCLE LUCKNOW

MOUNTING DETAILS OF 220 / 132 KV C.T., P.T. AND C.V.T.





TECHNICAL SPECIFICATION OF 145 KV POTENTIAL TRANSFORMERS

1.0 STANDARDS :

Unless otherwise specified elsewhere in this specification, the rating as well as performance and testing of the 145 KV Potential Transformers along with associated accessories shall conform but not limited to the latest issues/ amendments of standards available at the time of placement of order of all the relevant standards as listed hereunder.

Standard No.	Title
IS:3156:1992) Transformers	Specification for Voltage (Part I to III) & IEC 186: 1987
IS:2099	Specification for High Voltage porcelain bushing
IS:335	Specification for Insulating oil for T/F & Switchgear
IS:3202	Code of practice: climate proofing of Electrical equipment
IS:4146: 1983	Application Guide for Voltage Transformers.
IS: 2629	Recommended practice for hot dip galvanizing of iron & steel.

2.0 PRINCIPAL TECHNICAL PARAMETERS

The Potential Transformers shall conform to the following specific parameters:

SI. No	Parameters	Specification 145 kV
1.	2	3
1.	Type of installation	Single phase, Oil immersed, self cooled, Hermetically sealed, Outdoor type.
2.	Type of mounting	Mounting on steel structures
3.	Suitable for system frequency	$50 \text{ Hz} \pm 5\%$
4.	Highest system voltage	145 kV
5.	Transformation ratio on all windings	$\frac{132,000}{\sqrt{3}}$ / $\frac{110}{\sqrt{3}}$
6.	Method of earthing	Solidly Grounded
7.	1.2/50 micro second lightning impulse withstand voltage kV (peak)	650
8.	1 minute dry power frequency withstand voltage kV (rms)	275
9.	One minute power frequency withstand voltage on secondary	3 kV
10.	Min. Creepage Distance mm.	3625

Voltage ratios and other requirements of the Voltage Transformers shall comply with the requirement indicated in Annexure-I (B) for 145kV PTs respectively.

Maximum permissible temperature rise of windings of voltage transformers shall be 45 °C over an ambient of 50°C.

3.0 BASIC DESIGN AND TECHNICAL REQUIREMENT FOR 145KV POTENTIAL TRANSFORMERS :

3.1 **GENERAL :**

- (a) The PTs shall be single phase, oil immersed and self cooled type suitable for outdoor direct in Sun service, complete in all respects confirming to the modern practice of design and manufacture.
- (b) The core of PTs should be of high grade, non-aging, electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over voltage.
- (c) The potential transformers shall be hermetically sealed to eliminate breathing and prevent air and moisture from entering into the tank. If necessary these shall be provided with oil level gauge and shall be provided with pressure relieving device capable of releasing abnormal internal pressures. The details of hermetic sealing should be given in the tender.
- (d) The potential transformers will consist of a top tank to accommodate primary terminal assembly, oil level gauge, pressure relief device etc. and a bottom tank to accommodate secondary cores, terminal boxes etc.
- (e) All potential transformers shall be paper insulated oil filled type. The potential transformers unit after providing paper insulation shall be housed in the tank containing oil. Please note that epoxy casting in primary & secondary core is not acceptable.
- (f) The insulation as per the latest version of IS: 4800 or equivalent International Standard of the potential transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectric values of external & internal insulations shall be clearly brought out in the guaranteed technical particulars. The dielectric withstand values specified in this specification are meant for fully assembled potential transformers.

3.2 **PORCELAIN HOUSING:**

The equipment should be designed using single porcelain housing. No joints shall be provided in the porcelain. The housing shall be made of homogeneous, vitreous porcelain of high mechanical and electric strength. Glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water or condensed water particles (fog). The profile of porcelain shall be aerodynamic type as per the latest version of IEC: 815.

3.3 MAIN TANK (METAL TANK):

Special precaution will have to be taken towards selection of material for the main tank and the following will have to be ensured:

- (a) Material for main tank which should be minimum 3 mm thick mild steel / stainless steel / aluminium alloy.
- (b) The practice of providing inserts of non-magnetic material in the body of the tank with suitable welding to reduce eddy current shall not be acceptable. This problem should be avoided by selection of tank of suitable material.
- (c) Welded joints have to be minimized to avoid possibility of oil leakage. In any case welding in horizontal plane shall be avoided. The material selected for the tank shall be justified with suitable explanation.
- (d) The slot / hole cutting in the bottom tank should be done smoothly to avoid any sharp edges within the tank. All welded surfaces need to be smoothening and shall be covered with pressboard or other insulating material of good mechanical properties.
- (e) The bottom tank should not have any dents and pitting to ensure proper tightening of gasket and to avoid any oil leakage. Fabrication of bottom tank shall be done by utilizing fresh sheet steel only.
- (f) The top & bottom tanks should be painted with two coats of zinc chromate primer both inside and outside after proper cleaning and pickling. Finally the inside of tanks should be painted with two coats of white enameled paint or any other paint which is non-reactive to oil.

4.0 <u>WINDINGS</u>:

4.1 **PRIMARY WINDING:**

All primaries of PTs shall be connected in phase to neutral with the neutral solidly earthed. The neutral of the system is also solidly earthed.

4.2 SECONDARY WINDINGS:

All PTs shall be provided with 3 separate secondary windings each rated for110 / $\sqrt{3}$ volts for connection in star and delta separately. The star winding to be used for metering, relaying (distance relays) and synchronizing should be of accuracy class specified. The rated burden of all 3 windings shall not be less than the specified VA burden. The secondary of the PTs should be capable of simultaneous loading at their individual rated capacities.

The secondary terminal box should be partitioned so as to house the metering terminals separately with locking and sealing arrangement of metering terminals. "METERING" & "PROTECTION" should be clearly indicated on each compartment door respectively by engraving or by providing the metallic plate.

5.0 **INSULATION:**

The equipment shall withstand satisfactorily dielectric voltage corresponding to basic insulation level of 650 KV.

6.0 **<u>TEMPERATURE RISE:</u>**

The PTs shall be designed to limit the temperature of windings and other parts as specified in the Indian Standard but owing the maximum ambient temperature being 50°C instead of 40°C. The corresponding temperature rise should be reduced by 10°C as specified in 7.2.1.2 of IS: 3156 (Part-I) 1992.

The maximum attainable temperature of the windings cores etc. therefore, shall not exceed 90°C while the maximum temperature of oil at the top should be limited to 85°C. The temperature rise at 1.2 times rated primary voltage when applied continuously at rated frequency and simultaneous rated burden on both the secondaries shall not exceed the above specified limits and the temperature rise at 1.5 times rated voltage when applied for 30 seconds starting from previous stable operating condition at rated frequency and simultaneous rated burden on both secondaries should not exceed the above temperature limits by more than 10°C.

7.0 **INSULATING OIL:**

The quantity of insulating oil in each transformer and complete specifications of the oil shall be stated in the tender. The oil shall confirm to the requirements of IS: 335. The PTs shall be supplied completely filled with oil. The supplier shall submit the test reports of oil being filled in PTs covering in all the tests specified in IS besides giving complete dissolved gas analysis of oil prior to filling.

8.0 <u>TYPE OF MOUNTING:</u>

The PTs shall be suitable for mounting on steel structures as per drawing enclosed with specification. Foundation details of the equipment must invariably match the provisions as shown in the above drawing. The necessary flanges, bolts etc. for the base of the PTs shall be supplied and these shall be hot-dip galvanized.

9.0 **TERMINAL CONNECTORS:**

Bi-metallic terminal connectors for connecting "ACSR Panther" conductor to the PT terminals must be supplied along with the PT.

9.1 MATERIAL:

All the steel bolts, nuts, washers and chec knuts shall be hot dip galvanized marked with ISI certification mark. All steel bolts and nuts shall confirm to IS: 1363-1967 and IS: 1367-1961 or amendment thereof. Bolts and nuts should be manufactured by a reputed concern.

9.2 **DESIGN:**

The design of the connectors shall be such as to give firm and full contact between

connector, the conductor and terminal and offer protection to the design of the connectors shall be such as to give firm and full contact surface against effects of electrolytic (between two dissimilar metals) and atmospheric corrosion. The connector shall have sufficient mechanical strength and shall completely enclose the conductor and terminal. The connector shall hold the conductor and terminal very tightly so that the connector withstands mechanical stresses setup by vibration, wind and short circuit current. The conductivity of connectors shall be high enough to minimize power loss.

The connectors shall be designed with large factor of safety and shall comply in all respects of temperature rise resistance and tensile strength withstand capacity as per IS: 5561-1970 or amendment thereof, as mentioned below:-

(a) **<u>TEMPERATURE RISE TEST:</u>**

The temperature rise of terminal connectors above a reference ambient temperature of 40^{0} C when carrying rated current shall not exceed 45^{0} C. If the ambient temperature exceeds 40^{0} C the permissible temperature rise shall be reduced by an amount equal to the excess ambient temperature. So with the ambient of 50^{0} C in our climatic conditions, the allowable maximum temperature rise is 35^{0} C only.

(b) **<u>RESISTANCE TEST:</u>**

The resistance of 1.25 m of a conductor including one terminal connector such as splices or elbows shall not exceed the resistance of 1.25 m of the identical conductor without connector, by more than 10%.

(c) <u>TENSILE TEST:</u>

The test will be carried out in tensile testing machine and test load will be applied in direction of the conductor as below:

- (i) A tensile load of about 5% of the breaking load of the conductor shall be applied and the conductor shall be marked in such a way that movement relative to the conductor can easily be detected without any subsequent adjustment of terminal connector. The load shall be steadily increased to 10% of the breaking load. This load shall be maintained for 1 minute. There will be no movement of the conductor relative to the terminal connector due to slip during this1minute period and no failure of the connector will take place.
- (ii) Connector shall have at least 4 nos. of bolts and these should be located as close to the conductor as possible and should be opposite to each other. Bolt diameter should be such as to give desired clamping and contact pressure.
- (iii) A check nut shall be provided on each bolt nut to avoid loosening nuts due to vibration.
- (iv) The contact surface shall be ground finished to the required diameter of the conductor. The edges of the connectors shall be adequately round so as to minimize the corona effect.

- (v) All casting shall be free from blowholes, cracks & other casting defects.
- (vi) All current carrying parts shall be designed and manufactured to have minimum contact resistance.

10.0 IDENTIFICATION PLATES:

- 10.1 The Supplier is required to affix a plate on the PT inscribed with the following information:-
 - 1. Specification No.
 - 2. Year of Order
 - 3. Property of UPPTCL

11.0 **RATING & DIAGRAM PLATE:**

A non-corroding metal name plate shall be attached to each instrument transformer and located in a conspicuous position clearly readable to a person standing on the ground. The name plate marking shall comply with IS and shall includes connection diagram.

The PT sealed at the factory, shall have this fact indicated on the name plate or label if it is undesirable that oil samples be withdrawn periodically for test purposes. The fact that the instrument transformers should not be titled more than 30 degrees from the vertical or normal position during transportation or while in storage should be indicated on the name plate or label. Also appropriate instructions for handling and precautions to be exercised shall be indicated.

12.0 <u>PT JUNCTION BOX:</u>

- 12.1 Junction boxes shall be adequately designed and dimensioned to accommodate the fuse links, miniature circuit breaker and various terminal connectors providing sufficient earth clearance, and should also have convenient space to house various cable glands.
- 12.2 The junction boxes should be of cast iron or fabricated construction. In the case of fabricated construction the gauge used should at least be 16 SWG and not less than this gauge. The junction boxes should be painted with one coat of Zinc Chromate primer and two coats of light Grey Enamel paint or any other approved paint both inside and outside after proper cleaning and phosphatising. These should be dust and vermin proof, water tight and suitable for mounting in outdoor substations either on supporting structures of the equipment or on concrete pedestals. Each junction box shall have slanting top and shall be provided with front hinged covers and with suitable water tight cable glands as per approved drawings. The cover and the flanges shall be provided with suitable packing and gaskets so as to make these junction boxes completely water tight. Blanking washers should be provided in the cable glands.
- 12.3 The terminal blocks provided with these junction boxes shall be rated for 15 Amps. and will be suitable for uninterrupted duty. The terminal blocks shall be400 volt grade complete with insulated barriers, terminal studs, washers, nuts and identification strips and shall have also disconnecting and shorting links. These

should be suitable to receive at least 2 cores of 2.5 mm sq. copper conductor cables. The terminal blocks should preferably be made of Kirloskar-Asea type OTFA-46, Essan, Elmax make terminals or equivalent. The fuse links employed should be of high rupturing capacity non deteriorating, International Standard make mounted in such a fashion that these can be easily taken out and replaced without removing any wiring. The NS type fuse links should be provided with fuse carrier and base assembly such that visual indication of blown fuses may be possible from the inspection window without removing the cover of fuse fittings. Necessary internal connections between the terminal block and other apparatus such as fuses, miniature circuit breakers etc. are shown as in sketches enclosed.

- 12.4 The junction boxes should be as far as possible in accordance with sketches enclosed with the specification, however, it is at the discretion of the tenderer to alter the dimensions slightly to suit his designs. If any major alteration is required after approval of the drawings at the manufacturing stage, the same may be got approved by this office with specific reason thereof. The wiring should be provided as shown in the sketch.
- 12.5 The miniature Circuit Breakers should be single pole 5 Amps., 110 V A.C. continuous rating having thermal over load protection LVPAS or MORARJI DORMAN or equivalent make and with one normally closed and one normally open set of auxiliary contacts and should confirm with the relevant ISS.
- 12.6 The junction Box should be partitioned in two compartments comprising two doors hinged in the middle so as to house the metering & protection terminals separately with locking & sealing arrangement. "METERING" & "PROTECTION" should be clearly indicated on each compartment door respectively by engraving or by providing the metallic plate.

12.7 DETAILED SPECIFICATIONS:

132 KV 3-PHASE PT JUNCTION BOXES (MULTI CIRCUIT)

Terminal blocks with 65 nos. OTFA-46 terminal or equivalent to International accessories as specified above. Standard make terminals and associated

33 nos. HRC-ND-cartridge fuse link type NS-10 with carrier and base assembly (International Standard make).

Watertight brass cable glands suitable for 4 core, 10 mm sq. PVC copper cable – 14 nos.

Watertight brass cable glands suitable for 2 core, 2.5 mm sq. PVC copper cable -2 nos.

Each junction box shall be provided with glass windows on the front cover for inspecting the fuses periodically from outside.

13.0 TESTING OF PTs:

13.1 <u>TYPE TESTS:</u>

The Tenderer must have got the following type tests carried out on their offered PTs as per latest edition of IS: 3156:

- (a) Temperature rise test.
- (b) Lightening impulse test for voltage transformers for service in electrically exposed installation.
- (c) High voltage power frequency wet withstand voltage test on outdoor voltage transformers.
- (d) Determination of errors or other characteristics of 0.2 accuracy class.
- (e) All other type tests shall be in accordance with the latest revision of IS: 3156.

13.2 **ROUTINE TESTS:**

The following tests shall be performed on each PT unless otherwise specified:

- (i) Verification of terminal marking and polarity.
- (ii) Power frequency dry withstand tests on primary & secondary windings.
- (iii) Induced over voltage withstand test.
- (iv) Partial discharge tests.
- (v) Determination of errors or other characteristics of 0.2 accuracy class.
- (vi) The PT shall be tested for leakage and strength by applying to complete PT and Porcelain housing filled with oil at a pressure not less than 0.7 Kg. /cm2 above the maximum operating pressure for a period of 24 hours or not less than 1 Kg/cm2 for a period of 6.0 hours. If leakage occurs the PT shall be re-tested after all leakage has been stopped.
- (vii) Temperature rise test with terminal connector at least once against the order.

14.0 **<u>DESIGN DATA:</u>** The following information for PT shall be submitted:

- 14.1 Manufacturer's type designation.
- 14.2 General description of equipment offered. Its principal design features, arrangement of parts and class of insulation used.
- 14.3 Outline dimensions of assembled PT (drawing and dimensions sheet may be submitted).

- (a) Full cross-section of assembled PT showing primary winding, cores and secondary windings, clamping secondary leads and terminals, hermetic sealing arrangements, oil gauge, drain & sampling valves, grounding of cores etc.
- 14.4 Quantity of oil in litres.
- 14.5 Net weight in Kg.
 - (a) PT with oil.
 - (b) Core, coils, cover and porcelain housing.
 - (c) Tank & fittings.
 - (d) Oil.
- 14.6 Total shipping weight and size of package.
- 14.7 Porcelain housing, make, type, rating and weight.
- 14.8 Type of insulation and impregnation used in primary and secondary (Photographs may be submitted) and details of processing.

ANNEXURE-I (B)

REQUIREMENT OF 145 KV PT

S.No.	DETAILS	PARTICULARS				
1.	Transformation ratio on all windings	$\frac{132,000}{\sqrt{3}} / \frac{110}{\sqrt{3}}$				
		(No. of secondary windings 3)				
2.	Supply frequency	50 Hz.				
3.	Туре	Single phase, Oil immersed, self cooled, Hermetically sealed, Outdoor type.				
4.	Rated voltage factor	1.2 continuous and 1.5 for 30 seconds.				
5.	Application	Winding I Protection	Winding II Protection	<u>Winding III</u> Metering		
6.	Accuracy	3P	3P	0.2 Note : Acc. of 0.2 to be maintained up to and including a total simultaneous burden of 100 VA on all the windings.		
7.	Phase angle error	As per relevant IS				
8.	Output burden	50 VA	50 VA	50 VA		
9.	Creepage distance of bushing	3625 mm (minimum).				
10.	Total simultaneous burden	100 VA				
11.	One minute power frequency withstand voltage on secondary.	3 KV (r.m.s.)				
12.	Rated Power Factor	0.8				
13.	Class of insulation in windings	A				



NOTES:

- 1. ALL DIMENSIONS ARE IN M.M.
- 2. ALL MOUNTING HOLES ARE OF 22 mm Ø 3. CT, PT & CVT MAY BE FIXED EITHER ON SET
 - OF HOLES MARKED 'A' OR ON THE HOLES MARKED 'B' .

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MOUNTING DETAILS OF 220 / 132 KV C.T. , P.T. AND C.V.T.



FIG. 1(b)


INTERNAL DETAILS OF 145 KV 3 Ø PT JUNCTION BOX

TECHNICAL SPECIFICATION OF 36KV POTENTIAL TRANSFORMERS

1.0 SCOPE :

This Specification covers the design, manufacture, assembling, testing at manufacturers' works, supply and delivery of single phase Potential Transformers with terminal connectors and junction boxes for service in 33 KV, three phase system.

Type & Rating :

1.1 The potential transformers shall be outdoor type, single phase, oil immersed, self cooled, suitable for operation on three phase, 50 c/s, 33 KV Solidly Grounded system where the short circuit level of the system is of the order of 1000 MVA under the tropical climate conditions specified under General Requirement of Specification.

The potential transformers should have the following ratings:-

1. Rated Voltage	33 KV
2. Nominal System Voltage	33 KV
3. Highest System Voltage	36 KV
4. Type of Supply	3- Phase A.C.
5. Frequency	50 Cycles/sec.
6. Earthing	Solidly Grounded
7. No. of Secondary Windings	Two
8. Transformation Ratio:	Winding – I & II 33 KV/ $\sqrt{3}$ / 110
	Volt/ $\sqrt{3}$
9. Rated Burden:	
Winding – I	50 VA each
Winding –II	50 VA each
10. Accuracy Class:	
Winding – I	0.2 for metering
Winding – II	3P for protection
11. Basic Insulation Level (Impulse)	170 KV (Peak)
12. Creepage distance	900 mm (minimum)
13. Rated Voltage Factor:	
	(a) Continuous 1.1
	(b) 30 seconds 1.5
14. Service Conditions	Outdoor, direct in Sun service.

1.2 STANDARDS:

The potential transformers should confirm in all respects to latest edition of ISS: 3156/1965 except wherein specified otherwise.

1.3 GENERAL:

(a) The PTs shall be single phase, oil immersed, self cooled type suitable for outdoor direct

in Sun service complete in all respects confirming to the modern practice of design and manufacture.

- (b) hysteresis loss and high permeability to ensure high accuracy at both normal and over voltages.
- I The potential transformers should preferably be hermetically sealed to eliminate breathing and prevent air and moisture from entering into the tank. If necessary these should be provided with oil level gauge and pressure relieving device capable of releasing abnormal internal pressures. The details of hermetic sealing should be given in the Bid.

1.4 WINDINGS:

(a) PRIMARY WINDING:

All primaries of PTs should be connected in phase to neutral with the neutral point solidly earthed. The neutral of the system is also solidly earthed.

(b) SECONDARY WINDINGS:

All PTs shall be provided with two separate secondary windings each rated for $110 / \sqrt{3}$ volts for connection in star and delta separately. The star connection is to be used for metering and shall be of accuracy class specified. The rated burden of this winding shall not be less than the values specified. The delta connection is to be used for protection relaying (directional relays) should be of accuracy class specified. The two secondary of the PTs should be capable of simultaneous loading at their individual rated capacities.

The secondary terminal box should be partitioned so as to house the metering terminals separately with the provision of sealing & locking of the metering terminals. "METERING" & "PROTECTION" should be clearly indicated on each compartment cover respectively by engraving or by providing the metallic plate.

1.5 INSULATION:

The potential transformers should withstand satisfactorily dielectric test voltage corresponding to basic insulation level of 170 KV for 36 KV PTs.

1.6 TEMPERATURE RISE:

The PTs should be designed to limit the temperature of windings and other parts as specified in the Indian Standard but owing to maximum ambient temperature being 50° C, instead of 40° C specified in Note 1 of Table-3 of IS: 3156(Part-I) 1965 the corresponding temperature rise should be reduced by 10° C.

The maximum attainable temperature of the windings, cores etc. thereof should not exceed $95_{\circ}C$ while the maximum temperature of oil at the top should be limited to $85^{\circ}C$.

The temperature rise at 1.1 times rated primary voltage when applied continuously at rated frequency and simultaneous rated burden on both the secondaries shall not exceed the above specified limits and the temperature rise at 1.5 times rated voltage when applied for 30 seconds starting from previous stable operating condition at rated frequency and simultaneous rated burden on both secondaries should not exceed the

above temperature limits by more than 10°C.

1.7 INSULATING OIL:

The quantity of insulating oil in each transformer and complete specifications of the oil should be stated in the Bid. The oil should confirm to the requirements of IS -335. The PTs shall be supplied completely filled with oil.

1.8 TYPE OF MOUNTING:

The PTs shall be suitable for mounting on steel structures. The necessary flanges, bolts etc. for the base of the PTs should be supplied and these should be hot-dip uthorized. 4 nos. mounting holes (15 mm) are required at rectangular spacing of 370x250 mm.

1.9 TERMINAL CONNECTORS:

Bi-metallic terminal connectors suitable for connecting ACSR "Panther" conductor to the PT terminals should be supplied.

1.9.1 MATERIAL:

All the steel bolts and nuts, washers, checknuts should be hot dip uthorized marked with ISI certification mark. Steel bolts and nuts shall confirm to IS: 1363-1967 and IS: 1367-1961 or amendment thereof. Bolts and nuts should be manufactured by a reputed concern.

1.9.2 DESIGN:

The design of the connectors shall be such as to give intimate contact between connector, the conductor and terminal and offer protection to the contact surface against effects of electrolytic (between two dissimilar metals) and atmospheric corrosion. The connector shall have sufficient mechanical strength and shall completely enclose the conductor and terminal. The connector shall hold the conductor and terminal very tightly so that the connector withstands mechanical stresses setup by vibration, wind and short circuit current. The conductivity of connectors shall be high enough to minimize power loss.

The connectors should be designed with large factor of safety and should comply in all respects of temperature rise, resistance and tensile strength withstand capacity as per ISS: 5556-1970 or amendment thereof.

The Bidder is required to fill up Annexure-I and should also furnish copy of routine and type tests of the terminal connectors carried in. Drawing of the connector shall also be submitted with the Bid.

Suitable terminal earth connector for earthing connections shall also be supplied.

1.10 BUSHING / INSULATORS:

The basic impulse level of the bushings and insulators should be as specified and they should be suitable for installation in heavily polluted atmosphere. The minimum total creepage distance of the bushing / insulator shall be as per clause 7.0 of latest edition of IS: 13134-1992 i.e. its minimum value shall be 36x25xKD where KD is the correction factor for average diameter of insulator. The porcelain used should be homogenous and free from cavities or other flaws. Bushing should be designed to have ample insulation mechanical strength and rigidity for satisfactory operation under the conditions

specified. The puncture strength of bushing should be greater than the flashover value. The bushing shall be entirely free from external and internal corona.

1.11 JUNCTION BOX:

1.11.1 Junction boxes shall be adequately designed and dimensioned to accommodate the fuse links, miniature circuit breaker and various terminal connectors providing sufficient earth clearance, and should also have convenient space to house various cable glands.

The junction Box should be partitioned in two compartments comprising two doors hinged in the middle so as to house the metering & protection terminals separately with locking & sealing arrangement. "METERING" & "PROTECTION" should be clearly indicated on each compartment door respectively by engraving or by providing the metallic plate.

- 1.11.2 The junction boxes should be of cast iron or fabricated construction. In the case of fabricated construction the gauge used should at least be 16 SWG and not less thanthis gauge. The junction boxes should be painted with one coat of Zinc Chromateprimer and two coats of light Grey Enamel/ epoxy paint or any other approved paint both inside and outside after proper cleaning and phosphatising. These should be dust and vermin proof, water tight and suitable for mounting in outdoor substations either on supporting structures of the equipment or on concrete pedestals. Each junction box shall have slanting and protruding outward top on all the four sides and shall be provided with hinged covers on the front and removable covers to be fixed with screwed studs on 3 sides flanged together with suitable water tight 6 nos. cable glands as specified under item and sketch. The cover and the flanges shall be provided with suitable packing and gaskets so as to make these junction boxes completely water tight. Blanking washers should be provided in the cable glands.
- 1.11.3 The terminal blocks provided with these junction boxes shall be rated for 15 Amps. And will be suitable for uninterrupted duty. The terminal blocks shall be of 400 volt grade complete with insulated barriers, terminal studs, washers, nuts and identification strips and shall also have disconnecting and shorting links. These should be suitable to receive at least 2 cores of 2.5 mm sq. copper conductors cables. The terminal blocks should preferably be made of Kirloskar-Asea type OTEA-46, Elmax make terminals or equivalent. The fuse links employed should be of high rupturing capacity nondeteriorating, International Standard make mounted in such a fashion that these can be easily taken out and replaced without removing any wiring. The NS type fuse links should be provided with fuse carrier and base assembly such that visual indication of blown fuses may be possible from the inspection window without removing the cover and fuse fittings. Necessary internal connections between the terminal block and other apparatus such as fuses, miniature circuit breakers etc. are shown as in sketches enclosed.
- 1.11.4 The junction boxes should be as far as possible in accordance with sketches enclosed with the specification, however, it is at the discretion of the Bidder to improve and alter the dimensions slightly to suit his designs subject to approval of the Engineer of the contract. The wiring should be provided as shown in the sketch.
- 1.11.5 36 KV PT junction boxes (Three Phase) shall be equipped as follows:
 - 1. Terminal blocks with 12 nos. OTEA-46 Essan or Elmax or Tosha make terminals or equivalent and associated accessories as specified.
 - 2. 3 nos. HRC-ND-cartridge fuse link type NS-10 with carrier and base assembly(International Standard Make).

- 3. Watertight brass cable glands suitable for 4 core, 2.5 mm sq. PVC copper cable- 2 nos.
- 4. Watertight brass cable glands suitable for 2 core, 2.5 mm sq. PVC copper cable- 4 nos.

Each junction box shall be provided with glass window on the front cover for inspecting the fuses periodically from outside.

The Bidder is required to fill up the schedule of technical and guaranteed particulars for junction boxes enclosed at Schedule-R and also furnish the copies of type and routine tests reports carried out by them or their sub-Bidders in the past as per relevant ISS. The test reports shall be submitted in the Proforma enclosed at Schedule-R. The drawings of the Junction Box shall also be submitted with the Bid.

1.12 TESTS:

Reports of all type tests as stipulated in ISS: 3156 should be supplied.

Each PT should be subjected to routine tests as specified in IS: 3156 in the presence of Purchaser's representative, if so, desired by the purchaser. All test reports should be submitted and got approved by the purchaser before authorize of the equipment.

1.13 GUARANTEED TECHNICAL PARTICULARS:

Guaranteed Technical Particulars as called for in the schedule of Technical and Guaranteed particulars, which are subject to guarantee should be clearly marked in enclosed Schedule - R.

1.14 SPARE PARTS:

A list of spare parts recommended for five years operation for each PT along with itemized prices should be furnished with the Bid. The Purchaser will decide the actual quantities of spare parts to be ordered on the basis of the list and the itemized prices of spare parts.

1.15 SCHEDULE OF REQUIREMENT & PRICES:

The schedule of Requirements and Prices should be indicated as per Schedule-Q.

1.16 IDENTIFICATION PLATES:

The Bidder is required to affix a plate on the PT inscribed with the following information:-

- 1. Specification number
- 2. Year of order
- 3. U.P. Power Transmission Corporation Ltd.

1.17 MODE OF DESPATCH:

1.18.1 PTs shall be despatched by Road Transport only. In this case the date of receipt of equipment at site shall be deemed as the date of delivery.

1.18.2 In the event of despatches made by Rails, date of RR (Railway Receipt) shall be deemed as the date of delivery. This will be applicable only when the Firm is specifically authorized by the purchaser to deliver the PTs by Rail instead by Road.

ANNEXURE-II

REQUIREMENTOF 36KV PT

S.No.	DETAILS	PARTIC	ULARS
1.	Transformation ratio on all windings	<u>33,000</u> / <u>110</u> √3 √3	
		(No. of secondary windir	ngs 2)
2.	Supply frequency	50 Hz.	
3.	Туре	Single Phase wound ele	ectromagnetic type PT
4.	Rated voltage factor	1.1 continuou	
		1.5 for 30 seconds.	
5.	Application	Winding I Metering	<u>Winding II</u> Protection
6.	Accuracy	0.20 Note : Acc of 0.2 to be maintained up to and including a total simultaneous burden of 75 VA on all the three windings.	3P
7.	Phase angle error	As per rel	evant IS
8.	Output burden	50 VA	50 VA
9.	Total simultaneous burden	75 VA	I
10.	One minute power frequency withstand voltage on secondary.	3 KV (r.m.s.)	
11.	Rated Power Factor	0.8	
12.	Class of insulation in windings	A	
13.	Method connection which will be adopted		
	-Primary winding	Star/earthed	
	-Secondary winding I	Star/earthed	
	-Secondary winding II	Open delta	



FRONT VIEW OF JUNCTION BOX



SIDE VIEW OF JUNCTION BOX



INTERNAL DETAILS OF 33 KV PT. JN. BOX 3 PHASE

NOTES:

- 1. ALL DIMENSIONS ARE IN M.M.
- 2. DRAWING IS NOT TO SCALE.
- 3. WATER TIGHT CABLE GLANDS CAN BE MOUNTED ACCORDING TO THE REQUIREMENT IN THE BACK OF THE POSITIONS SHOWN IN THE SKETCH. DISTANCE BETWEEN TWO ROW SHOULD NOT BE LESS THAN 80 M. M.
- 4. THIS DRAWING IS ONLY MEANT FOR THE PURPOSE OF THE SPECIFICATION.

REFERENCE TABLE:

- 1. GLASS WINDOW
- 2. GLAND PLATE
- 3. DOORCOVER
- 4. FUSES
- 5. LOCKING DEVICE
- 6. WATER TIGHT CABLE GLANDS
- 7. TIGHTENING STUD

<u>TS-5A</u>

TECHNICAL SPECIFICATION FOR 245 AND 145 KV MOTOR OPERATED ISOLATORS

1.0 STANDARDS

1.1 The Isolators shall conform to the latest revisions with amendments available of relevant standards, rules and codes, some of which are listed herein for ready reference.

Sl.No.	Standard	Title
1.	IEC-168	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 100
2.	IEC-129	Alternating Current disconnectors and earthing switches.
3.	IS-1818	Specification for alternating current isolators (disconnectors) and earthing switches.
4.	IS-9921	Specification for outdoor air break isolators and earthing switches for voltages up to 220 kV.
5.	IS-5561	Electrical power connectors
6.	IS-325	Specification for three phase induction motors.
7.	IS-3202	Code of practice for climate proofing of electrical equipment
8.	IS-2544	Specification for porcelain post insulators (3.3 kV and above)

2.0 TYPE OF ISOLATORS

This specification covers following type of isolators-

- Bus isolators
- Line isolators
- Tandem isolators

3.0 PRINCIPAL PARAMETERS

Principal parameters for 245 and 145 kV isolators are enclosed separately at Annexure-I.

4.0 AUXILIARY DC SUPPLY

The auxiliary DC supply shall be 110 V.

TECHNICAL SPECIFICATIONS FOR 36 kV ISOLATORS

1.0 STANDARDS

For standards please refer the specifications for 245kV and 145 kV isolators.

2.0 TYPE OF ISOLATORS

- a) Three phase, 1250 A, 36 kV manually operated, Standard isolators without earth switch.
- b) Three phase, 1250 A, 36 kV manually operated, Standard isolators with one earth switch.

3.0 PRINCIPAL PARAMETERS

<u>Sl. No.</u>	DETAILS	<u>36 kV Isolator</u>
1	Rated Voltage	36 kV
2	System frequency	50 Hz
3	System Earthing	Effectively earthed
4	Type of Isolator	Outdoor, Horizontal air break suitable for upright mounting
5	Continuous current rating	1250 A
6	Operating mechanism	Manual
7	Phase to phase spacing	1500 mm
8	Rated short time withstand current	25 kA (rms)
9	Rated peak short circuit current	62.5 kA (peak)
10	Temperature rise	As per IEC-129 derated for an ambient of 50^{0} C
11	Seismic co-efficient	0.3 g.
12.	1.2/50 microsecond full wave positive and negative impulse withstand voltage to earth	70 kV (peak)
13.	One minute power frequency withstand voltage dry & wet to earth	70 kV (rms)
14.	Auxiliary Contacts	4 normally open and 4 normally closed.
15	Insulation level of insulators	
	i) Impulse voltage withstand test (1.2/50 micro second full wave)	170 kV (peak)

	ii) Power frequency withstand voltage to earth (dry & wet)	70 kV (rms)
16	Creepage distance of insulators :	
	i) Total	900 mm
	ii) Protected	450 mm
17	Minimum strength :	Suitable to withstand wind, short
	i) Torsional	circuit and operating forces
	ii) Cantilever	
18	Interlocks with circuit breaker	1 set of electrical and castel type interlocks.
19	Type of contacts	Hard drawn electrolytic copper with silver plating
20	Conductor take off	Horizontal/vertical according to actual requirement.
21.	Phase-to phase clearance	1500 mm

4.0 TERMINAL CONNECTORS

4.1 Each Isolator shall be provided with appropriate number of suitable for twin ACSR Zebra/Panther conductors as specified in 'General Technical Requirements' and approved drawings.

5.0 INTERLOCKS

It is proposed to electrically interlock the Isolators with the associated 33kV circuit breakers in accordance with switchyard safety interlocking scheme such that the Isolators can not be manually operated if the 33 kV breaker is on. The bidder will furnish details of the electrical interlocking scheme proposed by him. Any and all accessories required on the isolator side for satisfactory operation of the scheme shall be deemed to be in the scope of the supply. Interlocking arrangement shall be of failsafe type.

6.0 OPERATING MECHANISM AND CONTROL:

A lever shall be provided for manual operation of the isolator. Arrangement shall be provided to padlock lever when not in use.

7.0 CONSTRUCTION FEATURES:

As per 245 kV isolators.

8.0 ACCESSORIES:

As per 245 kV isolators

9.0 NAME PLATES:

Isolators shall be provided with the name plates. The name plates shall be weatherproof and corrosion proof. It shall be mounted in such a position that it shall be visible in the position of normal service and installation. It shall carry the following informations:

- (a) Name of the manufacturer
- (b) Designation type
- (c) Serial number
- (d) Rated voltage
- (e) Impulse withstand voltage to earth
- (f) Rated current
- (g) Rate short time current
- (h) Rated maximum duration of short time current

10.0 INSULATORS

The Bus post insulators will have a top housing pitch circle Dia. of 127 mm. The insulators will confirm to IEC-168.

11.0 TESTS

For details of test certificates, routine and type tests to be performed, as mentioned in the 245 kV isolators.

12.0 DRAWING AND DATA

As per 245 kV isolators

13.0 SUPPORTING STRUCTURES

The isolators shall be suitable to be mounted on auxiliary structures as per general technical requirements.

TECHNICAL SPECIFICATION FOR 245/145/36KV SOLID CORE POST INSULATORS

1.0 **STANDARDS**

Insulators should conform to the latest publications of IS 2544 & IEC in all respects except BIL which should be 1050Kvpfor 245 kV, and 650 kVp for 145 kV withstand. Equipment meeting any other authoritative standards which ensures equal or better quality than the IS mentioned above, is also acceptable.

2.0 **REQUIREMENT FOR INSULATORS**

2.1 FOR 245 AND 145 KV POST INSULATORS

	(1)	Nominal voltage	:	245 KV	145 kV
	(2)	Highest system voltage	:	245 KV	145 kV
	(3)	Sytem frequency	:	50Hz.	50 Hz.
	(4)	Number of phases	:	3 (Three)	3 (Three)
	(5)	Neutral	:	Effectively	Effectively
				earthed	earmed
	(6)	Short circuit current	:	40.0 KA	31.5 KA
	(7)	Phase to phase spacing	:	4.5 meters	3.0 meters
	(8)	Height of the insulator support structure.	:	2750 mm.	2750 mm
	(9)	PCD of Top Flange	:	127 mm.	127 mm
	(10)	PCD of Bottom Flange	:	184 <u>+</u> .2 mm.	184 <u>+</u> .2 mm
	(11)	BIL	:	1050 KV	650 mm
	(12)	Height of insulator	:	2300.00mm	1500 mm
2	.2	FOR 36 KV POSTINSULATORS	5		
	(1)	Nominal voltage	:	36 KV	
	(2)	Highest system voltage	:	36 KV	
	(3)	Sytem frequency	:	50Hz.	
	(4)	Number of phases	:	3 (Three)	

(5)	Neutral	:	Effectively earthed.
(6)	Short circuit current	:	25.0 KA
(7)	Phase to phase spacing	:	1.5 meters
(8)	Height of the insulator support structure.	:	2750 mm.
(9)	PCD of Top Flange	:	127 mm.
(10)	BIL	:	250 KV
(11)	Height of insulator	:	508.00 mm

3.0 **DESIGN & TYPE :**

The porcelain used for the manufacture of the insulators should be homogenous, free from laminations and other flaws or imperfections which might affect the mechanical or dielectric quality. These should be thoroughly verified, tough imperative to non-impress of moisture. The glazing of the porcelain should be of uniform brown colour, free from bilaters, burns and similar other defects.

The total fittings for the insulated material made from reliable cast iron or grey iron and galvanised thereafter. Cementing between metal to porcelain should be carried out by high grade port land cement with special filler to check the expansion and contraction problem.

The metal cement porcelain joints should be painted with suitable paints to offer protection against different thermal expansions.

The insulator units shall be such that the length of shortest breakdown path through valid insulating material is at least equal to half the length of the short break down path through air outside the insulator.

4.0 Metallic Flange

4.1 **Top Flange Co-ordination**-

Top metallic flange holes are to be co-ordination with respective UPPTCL drawings.

4.2 Bottom Flange Co-ordination –

Bottom metallic flange are to be co-coordinated with respective UPPTCL drawings.

5.0 **MECHANICAL STRENGTH**

i)	Banding strength	420 Kg. F
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ii) Torsion strength 450 Kg. M

6.0 **CREEPAGE DISTANCE**

The minimum nominal specific creep age distance should not be less than 6125 mm as applicable for heavily polluted atmosphere as per latest edition of IS-2544/IEC 815 as per provisions made in IEO-815, in order to apply the specific creep age distance concept certain dimensional parameters characterizing the insulator should be taken into account, which relates to the shed/shape to the profile of the insulator. The tenderer should therefore give full detail of shed/shape/profile of the insulator (for vertically used insulators) to safeguard the requirement of projected profile/protected creep age distance. As per above provisions the insulator may be type tested for heavy polluted atmosphere conditions and the type test report may be submitted with the offer. This requirement is very vital, and equipments not meeting the minimum requirements shall not be acceptable.

7.0 **DESIGN, MATERIAL AND WORKMANSHIP :**

The successful tenderer should assume full responsibility for co-ordination with insulator manufacturer and adequate design. All materials used in the construction of the equipment shall be of appropriate class, well finished and of approved design and make. All similar parts should be accurately finished and interchangeable. All ferrous parts should be heavily hot dip galvanized as per relevant ISS Bolts, nuts, pins and washers etc. used should also be galvanized. Special attention should be paid to give tropical treatment to all the equipment as it will be subjected during service to extremely severe exposure to atmospheric moisture and long period of high ambient temperature.

8.0 **GALVANISING**:

All metal parts of insulators shall be made of forged steel and shall be hot dip galvanized after all machining work in accordance with the latest edition of IS 2639-1964 and shall satisfy the test mentioned in IS 2633 :1964. The galvanized material shall be guaranteed to withstand at least six dips under the standard test galvanizing. The zinc operating shall be adherent, smooth, reasonably bright continuous and free from such imperfections such as flux, ash, rust, strains, bulky, white deposit and blisters etc. All surface of the metal parts shall be relatively smooth with no projecting points or irregularities. Insulators units after assembly shall be concentric and coaxial within limits as may be permissible by the relevant 1SS/IEC.

9.0 BOLTS AND NUTS FOR FIXING TOP AND BOTTOM :

Tenderer shall quota their price including the prices of nuts and bolts but will give technical specification of the recommended size of bolts and nuts for fixing top and bottom and any intermediate point if any in schedule item-27.

10.0 **TEST & TEST CERTIFICATES :**

10.1 **<u>TYPE TEST :</u>**

The test for the offered insulators shall be performed in accordance with mentioned standards or any other relevant IS or IEC and test certificates shall be furnished along with the proposal standards to which these tests will conform.

- a) Power frequency withstand/ Flashover test, Impulse withstand/ flashover test, mechanical & electrical type tests and results test as per IEC 168-1984 and/or ISS 2544-1973.
- b) Visible discharge test as per IS 2544-1973
- c) Radio interference test as per IEC 437-1975.
- d) Switching surge test as per IEC 506-1975.
- e) Certified pollution test as per IEC 507-1975.
- 10.2 The type test shall include at least the following tests :
 - a) Visual discharge test.
 - b) Impulse voltage withstand test.
 - c) Dry and wet 1 minute power frequency withstand test.
 - d) Switching surge test.
 - e) RIV test.
 - f) Puncture test.
 - g) Porosity test.
 - h) Temperature cycle test.
 - i) Test for mechanical strength.
 - k) Galvanizing test.
 - I) Artificial pollution test.

10.3 SAMPLE OF ACCEPTANCE TEST

The following sample tests as per IEC 168-1964/IS 2544-1973 shall be conducted by the

- (a) Verification of dimensions.
- (b) Temperature cycle test.
- (c) Test for mechanical strength.

- (d) Puncture test.
- (e) Galvanizing test.
- (f) In addition to above sample test the total creep age measurement test shall also be conducted by the controller.

i) TOTAL CREEPAGE MEASUREMENT TEST

The creepage distance of each unit shall be measured by applying a thin inextensible cord along with shortest distance from the upper metal fitting to the lowest metal fitting, the cord to be in contact with the external surface of the unit. The total creepage distance shall be obtained by adding the values obtained above for the relative units and shall be not less than the value nominated under minimum 'Total creepage Distance' in clause above.

10.4 **ROUTINE TESTS**

The following routine tests as contained in IEC-168-1 and IE-2544-1973 shall be performed by the Contractor on each insulator.

- a) Visual examination test.
- b) Electrical routine test.
- c) Mechanical routine test.
- d) In addition to above routine, the Flaw detection test and High frequency voltage dry flashover test shall also be conducted as follows :-

i) FLAW DETECTION TEST

Every porcelain body of the insulator to be supplied, shall be tested before assembly with Ultrasonic wave or by other approved means to detect any possible voids, crack, porosity or similar defects. The tenderer submitting a quotation shall describe in detail the proposed method of carrying out this test. As longitudinal ultrasonic testing is possible only on unassembled insulators, it is the responsibility of the Contractor to ensure that, if using the ultrasonic method this test be conducted before cementing the metal fittings on the porcelain and be directed from both ends of the porcelain.

ii) HIGH FREQUENCY VOLTAGE DRY FLASHOVER TEST

Every porcelain part of the insulator shall be set up between suitable terminals and subjected to a high frequency (200 or more KHz) voltage sufficient to cause vigorous flashover. The flashover shall be maintained for period of not less than three seconds without puncturing the porcelain.

11.0 GUARANTEED TECHNICAL PARTICULARS

Technical and guaranteed particulars as required in the Schedule-'R' should be furnished with the tender, failing which the tender is likely to be rejected.

TECHNICAL SPECIFICATIONS OF 198 KV/120 KV/30 KV 10KA METAL OXIDE GAPLESS SURGE ARRESTERS

1.0 **STANDARDS**

The Lightning Arrester shall conform to the latest revision with amendments available of the relevant standards, rules and codes some of which are listed herein for ready reference:

<u>Sl.No.</u>	<u>Standard</u>	<u>Title</u>
1.	IEC 99 – 4	Specification Part – 4 for Lightning Arrester without gap for AC system
2.	IS: 3070	Specification for lightning Arrester for alternating current system Part
3.	IS: 2629	Recommended Practice for hot dip galvanizing of iron and steel
4.	IS: 2633	Method for testing uniformity of coating on Zinc coated articles
5.	IS: 5621	Specification for large hollow porcelain for use in electrical installation
6.	IS: 2174	Degree of protection provided by enclosure for low voltage switch-gear and control
7.	IEC: 71	Electrical Clearances
8.	IS: 12063	Classification of degree of protection provided by enclosure of electrical equipment.

1.1 **PRINCIPAL PARAMETERS**

a)	Rated system voltage	245 KV	145 KV	36 KV
b)	System neutral earthing	Effectively earthed		
c)	Installation		Outdoor	
d)	Rated arrester voltage	198 KV	120 KV	30 KV
e)	Max. continuous operating voltage (MCOV) at 50 ⁰ C	168 KV	102 KV	24 KV
f)	Nominal discharge current	10 KA (8/20 microwave)		
g)	Rated frequency		50 Hz	

h)	Minimum line discharge capacity		2 KJ / KV	
i)	Power frequency reference voltage	Not less than MCOV		
j)	Max. Residual voltage at nominal discharge current of 10 KA and 8/20 Micro Sec.	550 KV _P	400 KV _P	100 KV _P
k)	Peak & value of high current (4/10 Microwave)	100 KA		
I)	Creepage distance	25 mm/KV		
m)	Partial discharge test on 1.05 MCOV	Net more than 50 Pico coulombs		
n)	One minute power frequency voltage of arrester housing	460 KV	275 KV	70 KV
0)	Impulse withstand voltage of arrester housing with 1.2/50 micro second wave.	1050 KV _P	650 KV _P	170 KV _P
p)	Minimum prospective fault current.	40 KA		
q)	Radio interference voltage	Not more	than 500 mi	cro volts.
r)	Pressure relief class	Class-A		
s)	Current for pressure relief.	40 KA		
t)	Seismic acceleration	0.3 g.		
u)	Long duration discharge class	Clas	s 3 (as per l	EC)

1.2 SERVICE REQUIREMENT

1.2.1 The duty cycle of the circuit breakers installed in the 220 KV/132KV/33 KV system of UPPTCL is 0-0.3 sec-CO-3 min-CO. The surge arresters shall be suitable for this circuit breaker duty in system.

The Contractor shall verify and establish by preliminary study, the parameters of the arresters indicated in this specification and confirm their suitability for the system and duty requirements as specified herein.

1.3 **ARRESTER DUTY**

- 1.3.1 The surge arrester shall be single pole, self supporting heavy duty station class zinc oxide gapless type without any series or shunt spark gaps. The nonlinear resisters shall be connected in series or in parallel.
- 1.3.2 The surge arresters shall be capable of discharging energy equivalent to class-3 of IEC as required by the UPPTCL'S 220 KV/132 KV/33 KV system on two successive operations.

- 1.3.3 The reference current of the arrestors shall be of the order of 5mA. High enough to eliminate the influence of grading stray capacitance on the measured reference voltage.
- 1.3.4 The details of the equipments to be protected by these surge arresters are as under :-

Equipment		Basic Insulation level				
		220 KV	132 KV	33 KV		
i)	Transformer 220 KV side	950 KV _P	550 KV _P	170 KV _P		
ii)	Switchgears, CTs and CVTs	1050 KV _P	650 KV _P	170 KV _P		

1.4 **CONSTRUCTIONAL FEATURES**

- 1.4.1 The non-linear blocks shall be sintered metal oxide material. These shall be so arranged in the final assembly as to provide excellent mechanical and electrical properties, even after repeated operations.
- 1.4.2 The surge arresters shall be fitted with pressure relief devices and diverting posts, suitable for preventing violent shuttering of porcelain housing and providing path for the flow of rated fault currents in the event of arrester failure.
- 1.4.3 Arresters shall incorporate adequate creepage distance (25mm/KV) in order to prevent arrester failure due to uneven voltage gradient across the stacks in the event of contamination of the arrester porcelain.
- 1.4.4 The arresters shall be fully stabilized thermally to give a life expectancy of 20 years under site conditions, and shall take care of the effect of solar radiation etc.
- 1.4.5 Seals shall be provided in such a way that these are always effectively maintained, even when discharging the maximum lightning current.
- 1.4.6 Arresters shall be suitable for hot line washing.

1.5.0 **MATERIAL**

- 1.5.1 All material used in the manufacture of surge arrester shall be new, unused and of finest quality. All materials should comply with the applicable provisions of the tests of this specification, ISI, Indian Electricity Rules, Indian Electricity Act, and other applicable statutory provisions rules and regulations. All the materials used in the manufacture of surge arresters and its accessories should be of reputed manufacturer
- 1.5.2 The Purchaser reserves the right to ask for documentary proof of the purchases of various materials to be used for the manufacture of surge arresters and its accessories and to check that the Contractor is complying with quality controls as per this specification

1.6.0 **PORCELAIN**

- 1.6.1 The porcelain used in the surge arrester housing shall be from the best available materials. The porcelain housing shall be so coordinated that external flashover will not occur due to application of impulse or switching surge voltage up to the design value of the arrester. The porcelain used shall be homogenous free from laminations, cavities and other flaws or imperfections which might affect the quality and shall be thoroughly vitrified tough and impervious to moisture. Glazing of porcelain shall be free from blisters, burrs and other defects. It shall have ample insulation mechanical strength and rigidity for the conditions of use. When operating at normal rated voltage there shall be no electrical discharge which might cause corrosion or injury to insulator, conductor on supports. The following tests shall be required for porcelain components :
 - i) Temperature cycle.
 - ii) Porosity.
 - iii) Visual examination

1.7 METAL PARTS

- 1.7.1 All iron parts shall be hot dip, galvanised. Joints shall be made air tight surfaces of joints shall be turned up porcelain parts by grinding and metal parts by machining to ensure a uniform compressive pressure.
- 1.7.2 Steel bolts, nuts, washers and check nuts should be hot dip galvanised conforming to IS :1363-1967, IS :1367-1961 and latest amendment thereof. This should be of reputed manufacturer and should bear ISI mark.

1.8 FITTING AND ACCESSORIES

1.8.1 **INSULATION BASE**

Insulating base offered for the surge arrester, shall be manufactured from the best available porcelain. One number insulating base shall be supplied by the Contractor with each surge arrester.

1.8.2 **SURGE COUNTER**

Self containing discharge counter, enclosed suitably for outdoor use & requiring no auxiliary or battery supply for operation, shall be provided for each single pole unit. The surge counters on cyclometric dial shall be robust and of adequate size. These shall be so located that incoming and outgoing connections are made with minimum possible blend and incoming & outgoing connections shall be provided with at least 2 nos. bolts each. The discharge counters shall be suitably mounted on the support structure of the surge arresters so that the counter shall be visible through an inspection window and should be readable from ground level. The internal connections of surge counters shall be provided to carry large surge currents as per surge arrester specifications.

The cubicle housing the surge counters shall be made of 12 SWG sheet and it should be water tight and vermin proof.

1.8.3 MILLI AMMETERS

Suitable milli ammeters (without push buttons) on each pole of the arrester, with appropriate connections, shall be supplied to measure the leakage currents. The milli ammeter shall be suitably mounted on the support structure of the arrester, suitable means to differentiate between the internal grading currents and external leakage currents shall be indicated.

1.8.4 **GRADING CORONA RING**

Suitable grading corona ring shall be provided on each complete arrester unit as required for proper stress distribution.

1.9 **TERMINAL CONNECTORS**

- 1.9.1 The arresters shall be provided with line side terminal connectors made out of hot dip galvanised suitable for specified ACSR conductors for vertical as well as horizontal entry.
- 1.9.2 Two ground terminals diagonally opposite suitable for connecting 50x6mm GI earth strip shall be provided each with two holes of size M- 10 horizontally and suitable for the above strip.
- 1.9.3 The design of connectors shall be such as to give firm contact between connectors. They should offer protection to contact surface against effects of leakage between dissimilar metals and atmospheric corrosion. The connectors shall have sufficient mechanical strength and shall completely enclose the conductor and terminal. It shall hold the conductor and terminal so that the connector with stand mechanical stresses set up by vibration, wind and short circuit currents. The conductivity of the connectors should be high so that the power loss is minimum.
- 1.9.4 It should be designed with high factor of safety and conform in respect of temperature rise, resistance and tensile strength to ISI 5561-1970 and latest amendment thereof.
- 1.9.5 The terminal connectors should be suitable to carry large surge currents for duration of microseconds and short duration short circuit power frequency currents.
- 1.9.6 The connectors shall have at least 4 nos. of 12mm dia bolts and nuts with washers and check nuts and should be located as close to the conductor as possible.
- 1.9.7 The contact surface should be neat, clean, smooth and should be such that the corona effect is minimum as far as possible.
- 1.9.8 All castings shall be free from blow holes, tracks sharp edges and other casting defects.

- 1.9.9 All current carrying parts shall be designed and manufactured for the minimum contact resistance.
- 1.9.10 The Contractor shall submit the detail drawing of the terminal connectors and their test certificates.

1.10 **TYPE OF MOUNTING**

The surge arresters together with insulating case and surge monitors should be suitable for upright mounting on auxiliary steel structure as per UPPTCL standard drawing. Electro galvanized steel bolts, nuts, washers and check nuts for mounting the lightning arresters shall be supplied by the Contractor along with arresters. The PCD and no. of holes in the base mounting flange shall be in accordance with the Purchaser's requirement to suit the auxiliary structure.

1.11 **TESTS**

The surge arresters shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with IEC 99.4 (1991) and other relevant standards.

1.11.1 **<u>TYPE TESTS</u>**

The type test reports as per IEC 99-4 its latest amendment or any other relevant IEC/ISS along with the tender. The reports shall be duly authenticated by the laboratory/agency by whom these tests have been performed and shall include full identification detail of the equipments as well as of the manufacturer :

1.12 **ROUTINE AND ACCEPTANCE TESTS**

1.12.1 ROUTINE TESTS AS PER B-8 IEC-99-4 (CLAUSE-8.1)

- 1. The specified residual voltage tests on complete arrester or arrester unit or a sample comprising resistor elements.
- 2. Measurement of reference voltage on complete arrestor unit.
- 3. Partial discharge test on each arrester unit.
- 4. Sealing leakage test on each unit.

1.12.2 ACCEPTANCE TESTS AS PER IEC-99-4 (CLAUSE 8.2.1)

Following tests shall be carried out on the nearest lower whole number to the cube root of the number of arresters to be supplied-

- 1. Measurement of power frequency reference voltage on complete arrester at the reference current.
- 2. Lightning impulse residual voltage on complete arrester or arrester unit at nominal discharge current of 250 A.
- 3. Partial discharge test on complete arrester or arrester unit.

1.12.3 TESTS ON SURGE MONITORS

- 1. Tests for correctness of surge counter corresponding to discharge.
- 2. Tests for correctness of leakage current indicating meter before and after the discharge.
- 3. Visual examination test.

1.13 NAME PLATE AND MARKING

The surge arresters shall be provided with legible name plate marked with date as per IEC with at least following date :-

- i) Rated voltage.
- ii) Rated frequency.
- iii) Nominal discharge current.
- iv) Continuous operating voltage (MCOV)
- v) Long duration discharge class.
- vi) Pressure relief class.
- vii) Year of manufacture.
- viii) Manufacturer's name, trade mark, type & other identification.
- ix) Specification No.
- x) No. of order of assembly units.
- xi) Total weight of the arrester.

1.14 COMPLETENESS OF THE EQUIPMENT

Any fitting, accessories or apparatus which might not have been mentioned in the contract but are usual or necessary in the equipment, are to be provided by the Contractor without any extra cost. The apparatus must be complete in all respects whether mentioned in the specification or not.

CONTROL AND RELAY PANELS GENERAL

1.0 TYPE OF PANELS:

1.1 Simplex Panels:

Control and Relay Panels shall consist of separate vertical stationary front panels with equipment mounted thereon and having wiring access from the rear. Each cubicle assembly shall be provided with doors on the rear having handles with built in locking facility. It shall have double leaf doors with lift off hinges at the back for panels of width more than 800 mm.

These panels shall be of the following approximate dimensions: -Height: 2250mm + 15mm ant vibration pad + 50 mm (base) Depth: 800mm to 1000mm Width: 800 mm to 1000 mm

2.0 CONSTRUCTIONAL FEATURES:

- 2.1 The Control and Relay panels shall be simplex type at upcoming 220KV substation specified in UPPTCL. It is the responsibility of the bidder to ensure that the equipment specified and such unspecified complementary, equipment required for completeness of the Protection/Control Schemes be 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.
- **2.2** The panels shall be completely metal enclosed to ensure a dust, moisture and vermin proof atmosphere. The enclosure shall provide a degree of protection not less than IP 31 in accordance with IS-2147.
- 2.3 Panels shall be rigid free standing and floor mounting type and comprise of structural frames enclosed completely with specially selected texture 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 not less than 2.0 mm for sides, door top and bottom portions. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transportation and installation.
- 2.4 All joints shall be made flush and all edges shall be bent at right angles and rounded. All structural members shall be bolted or welded together. Necessary arrangement shall be provided for bolting together the adjacent panels as well as for fastening them to the floor. The opening required for mounting the equipment shall be punched or cut and filed smooth.
- 2.5 All doors, removable covers and panels shall be gasketed all around with synthetic rubber gaskets Neoprene/EPDM generally conforming to provision of IS 11149. However, XLPE gaskets can also be used for fixing protective toughened 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** Metal sills in the form of metal channels properly drilled shall be furnished by the Bidder along with anchor bolts and necessary hardware for mounting the panels.

These shall be dispatched six months in advance of the despatch of the respective panels, so that they may be installed and levelled when concrete foundations are poured or roof ceilings are laid. Panels shall have additional rolled channel plinth at the bottom with smooth bearing surface. The panels shall be fixed on the embedded foundation channels with intervening layers of ant vibration strips made of shock absorbing materials which shall be supplied by the Bidder

- 2.7 All control cables shall be laid in a cable gallery or trench under the control room / PRR. Cable entries to the panels shall be from the bottom. The bottom plates of the panels shall be fitted with removable gland plates for fixing the cable glands, the size of which shall suit the purchaser's external cables to the panels. Cable gland plates shall be fitted without glands. Cable gland plate fitted in the bottom of the panel shall be connected to the earthing of panel/station through a flexible braided copper conductor rigidly. Entry holes in concrete floor shall be provided by the purchaser. Necessary foundation drawings showing cables entry positions and foundation belt locations shall be supplied by the Bidder. All necessary arrangements shall be made inside the control panel to hold the cables so that no load comes on terminals due to the weight of hanging cable. Purchaser's external cable connections will be terminated on the terminal blocks to be provided by the Bidder.
- **2.8** Design, material selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside with all exterior surfaces tune and smooth.

2.9 The dimensions of the panels shall be as mentioned in Clause-1.1 of this section.

2.10 Relay panels of modern, modular construction of standard 19" 483 mm) width in accordance with IEC 297 shall also be acceptable.

3.0 PAINTING:

- 3.1 Prior to painting the Bidder has to ensure that all sheet steel work shall be pre treated by as per the following seven tank cleaning procedure. Immerse the components in the Degreasing solution tank. The immersion time shall be 20-30 minutes. Rinse the components while taking out. Transfer the components to the next water-rinsing tank. Rinse thoroughly and ensure that the surface is clean without any oil, dirt, grease contamination. Immerse the components in De-rusting solution tank, the immersion time shall be 15-20 minutes. The immersion time shall be extended depends on the extent of rust/scale contaminant. But once rust/scale removed the components should not be over pickled. Transfer the components to the next water-rinsing tank (running water). Rinse thoroughly and the surface should be clean without any contaminant. Then immerse the components in the Hot Phosphate solution tank. The immersion time shall be 4-5minutes. After Phosphating the components shall be rinsed in water (running) tank thoroughly. Immerse the Phosphated and rinsed components (wet condition) in Passivation tank. The immersion time shall be 30-40 seconds.
 - II Subsequent to pre treatment, the components shall be further processed as follows.

Transfer the components into hot air drier to eliminate water contents, air drier temperature shall be max. of 60-80 deg.C.

The heat remains in the parts from the hot Passivation bath will facilitate the drying. So the drying shall be completed as soon as components are free from moisture & the drying time should not be clasped.

After hot air drying ensure that the component should not have any water content, corrosive points or cracks. If water content is still available (corners, crevices) air-dry the components to eliminate the remaining water content. The appearance of Phosphase-Passivated components shall be in uniform light grey colour (shade 631 of IS: 5)

3.2 Power coating shall be done with light grey (shade-631) colour. 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.

Note: The Phosphate coating shall be 'Class-C', as specified in IS: 6005. Welding shall not be done after Phosphating the Phosphated surfaces shall be rinsed and passivated prior to application of stoved red oxide primer coating. After primer application, two coats of power coating with light grey (shade 631 of IS: 5 shall be applied, unless required otherwise by the owner).

4.0 MOUNTING:

- **4.1** All equipment on and in panels shall be mounted and completely wired to the terminals blocks ready for external connection. The equipment on front of panel shall be mounted flush.
- **4.2** 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 shall be clearly visible.
- **4.3** The Bidder shall carry out cut-out, mounting and wiring of the Purchaser's issue items supplied by others which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cutouts if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.
- **4.4** The Centre lines of switches, push buttons and indicating lamps shall be not less than 750 mm from the bottom of the panel. The Centre lines of relays, meters and recorders shall be not less than 450 mm from the bottom of the panel.
- **4.5** The Centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise the top lines of all meters, relays and recorders etc. shall be matched.
- **4.6** No equipment shall be mounted on the doors.
- **4.7** All the equipment connections and cabling shall be designed and arranged to minimise the risk of fire and damage which may be caused by fire.

5.0 PANEL INTERNAL WIRING AND OTHER ACCESSORY EQUIPMENT:

- 5.1 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. These adjacent inter panel wiring shall be clearly indicated in the drawing furnished by the Bidder.
- 5.2 All wiring shall be carried out with 650V grade, single core, stranded copper conductor wires with PVC insulation and shall be low smoke flame retardant grade and vermin and rodent proof, which shall have oxygen index not less than 29 and temperature index not less than 250 deg. C. The minimum size of the stranded copper conductor used for internal wiring shall be as follows
 - a) All circuits except current transformer circuits and voltage transformer circuits meant for energy metering one of 1.5 mm sq. Copper.
 - b) Current transformer circuits one 2.5 Sqmm copper.
 - c) Voltage transformer circuits (for energy metering): Two of 2.5 mm sq. per lead . The minimum No. of strands per conductor shall be three.
- 5.3 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.
- 5.4 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. These buses shall have a nominal cross section equivalent to a copper diameter of 6 mm and shall be suitably insulated all along their run. D.C. buses shall be divided into two sections to permit two independent supply points.
- 5.5 Wire termination shall be made with solder less crimping type and tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided on 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. Numbers 6 and 9 shall not be included for ferrule purposes. The wire numbers shown in the wiring diagram shall be as per IS 305.

- 5.6 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. Arrangements shall permit easy inter-connections to adjacent panels at site and wires for this purposes provided by Bidder shall be looped and bunched properly inside the panel.
- 5.7 Bidder shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

6.0 TERMINAL BLOCKS:

- 6.1 All internal wiring to be connected to the external equipment shall terminate on terminal blocks, preferably vertically mounted on the side of each panel. Terminal blocks shall be 650 V grade and have 10 amps continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Terminal block design shall include a white fibre markings strip with clear plastic, slipon/clipon terminal covers. Markings on the terminal strips shall correspond to wire number and terminal numbers on the wiring diagrams.
- 6.2 Not more than 2 wires shall be connected to any terminal. Suitable supports shall be provided for the incoming cables. The terminal blocks shall be arranged to provide maximum accessibility to all conductor terminations. The terminal blocks shall be fully enclosed with easily removable covers and made of moulded, non inflammable plastic material with bases and barriers moulded integrally.
- 6.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.
- 6.4 At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.
- 6.5 In case of duplex panels separate set of terminal blocks shall be provided with separate internal cable entries for the front and rear sections. Wiring gutters, troughs shall be provided at the top for interconnecting wiring between front and rear section of duplex panels.
- 6.6 Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductor's of purchaser's cables:
 - i) All circuits expect CT and voltage circuits one 2.5 Sqmm. copper
 - ii) All CT and PT circuits' minimum of two of 2.5 mm sq. copper.
 - iii) AC/DC power supply circuits one of 6 mm sq. aluminum.
- 6.7 There shall be a minimum clearance of 250 mm between the first row of terminal blocks and the associated cable gland plate or panel side wall as per the terminal block mounting arrangement adopted. Also, the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
- 6.8 Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run parallel and in 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 purchaser's external cable connection. An adjacent terminal block shall also share this field wiring corridor. A steel strip shall be connected between adjacent terminal block rows at 450 mm intervals for support of incoming cables. 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 to terminals.
- 6.9 All number and sizes of the purchaser's multicore incoming cable will be furnished to the Bidder after placement of the order. All necessary cable terminating accessories such as gland plates, packing glands, crimp type tinned copper lugs supporting clamps and brackets, wiring troughs and gutters etc. for purchaser's cable shall be included in the Bidder's scope of supply

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 name plates shall be provided for circuit/feeder designation. These circuit labels shall be larger than the other name plates.
- 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. The name plates shall be mounted directly by the side of the respective equipment and shall not be hidden by the equipment wiring.
- 7.3 Name plates shall be made of non-rusting metal or 3 ply lamicoid. Name plates shall be black with white engraving lettering. The name plate inscription and size of name plates and letters shall be submitted to the Purchaser for approval.
- 7.4 Each instrument and meter shall be prominently marked with the quantity measured (e.g. kV, A, MW etc.). All relays and other devices shall be clearly marked with manufacturer's name and type, serial numbers and electrical rating data.
- 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 otherwise 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 relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

8.0 SUPPORTING STEEL:

All necessary embedded levelling steel, sills, anchor bolts, channels and other parts for supporting and fastenings the panels and vibration damper shall be supplied by the Bidder. Embedded parts with detailed instructions shall be delivered in time to meet the schedule for insertion in the building structure.

9.0 MISCELLANEOUS ACCESSORIES:

- 9.1 Plug Point: 240 Volts, Single Phase, 50 Hz AC socket with switch suitable to accept 5 amps and 15 amps pin round standard plug, shall be provided in the interior of each cubicle with ON-OFF switch for connection of hand lamps.
- 9.2 Interior Lighting: Each panel shall be provided with a energy saving fluorescent lighting fixture rated for 240 Volts, single phase, 50Hz supply for the interior illumination of the panel during maintenance. The fittings shall be complete with switch fuse unit and switching of the lighting shall be controlled by the respective panel door switch.
- 9.3 Switches and Fuses: Each panel shall be provided with necessary arrangements for receiving, distributing isolating, of DC and AC supplies for various control, signalling, 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 ratings shall be such as to ensure selective clearance of sub circuit faults. MCBs shall confirm to IS : 13947. Each MCB shall be provided with one potential free contact and the same shall be wired for

annunciation purpose. However voltage transformer circuits for relaying and metering shall be protected by fuses. All fuses shall be HRC cartridge type conforming to IS: 13703 mounted on plug in type fuse bases. Fuse carrier base as well as MCBs shall have imprints of fuse rating and voltage.

- 9.4 Space Heater: Tubular space heaters of adequate capacity and suitable for connection to single phase, 240V, 50Hz supply shall be provided inside each panel to prevent condensation of moisture on the wiring and panel mounted equipment when the panel is not in operation. These shall not be mounted close to the wiring or any panel mounted equipment. Heaters shall be complete with isolating switches, HRC fuse on phase and link on the neutral of the heater supply and its switching shall be controlled by a thermostat.
- 9.5 Test Blocks: Switchboard type, back connected semi flush mounting type test blocks with contacts suitably rated shall be provided with links or other devices to enable insertion of a series device into the circuit without causing open circuit in the CT. secondary or to enable short circuiting of the CT. Secondary Test block covers shall be removable from the front of the panels and shall be provided with suitable sealing arrangement to prevent unauthorized access to the test studs. If any test plugs are to be used with the test studs, 6 Nos. of each type of such test plugs shall be supplied free with the main equipments.
- 9.6 Other Accessories: Test link, special terminal boards and other accessories normally required for testing operation and maintenance of all relays and meters shall be furnished by the Bidder.

10.0 EARTHING:

- 10.1 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 50 x 6 mm GI flat or equivalent copper unless specified otherwise. 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 Bidder. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.
- 10.2 Provision shall be made on each earth bus bars of the end panels for connecting Owner's earthing grid. Necessary terminal clamps and connectors for the purpose shall be included in the scope of supply of Bidder. The size of Owner's earthing grid connections will be furnished later to the Bidder. The earth wire or screens should be clearly bonded and earthed at the gland plate. The earthing scheme shall be got approved.
- 10.3 All metallic cases of relays, instruments and other panel mounted equipment shall be connected to the earth bus by independent 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.
- 10.4 Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided.
- 10.5 VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.
- 10.6 The detailed earthing scheme shall be submitted for approval.

11.0 INSTRUMENTS, METERS, RECORDERS & TRANSDUCERS:

11.1 All instruments, meters recorders and transducers shall be enclosed in dust proof, moisture resistant, black finished cases and shall be suitable for tropical use. All indicating instruments and recorders shall be provided with separate individual transducers conforming to Annexure-XI and they shall be calibrated along with transducers to read directly the primary quantities. They shall be accurately adjusted and calibrated at works and shall have means of calibration check and adjustment at site. The bidder shall confirm that the instruments, recorders along with transducers and energy meters offered by them are suitable for connecting to the instrument transformers having the technical particulars given in the associated schedule of details of instrument transformers. All accessories including the test switches and test plugs, where applicable shall be furnished. Their elements shall be shock resistant and shielded from external magnetic fields.

11.2 Indicating Instruments:

- a) Unless otherwise specified all electrical indicating instruments shall have circular 240 deg. scale and with a dial of 96 mm x 96 mm. They shall be suitable for flush mounting with only flanges projecting on vertical panel and back connected.
- b) Instruments dial shall be with white circular scale and black pointer and with black numerals & lettering and knife edge pointers. The dial shall be free from warping, fading, and dis-colouring. The dial shall also be free from parallax error. Spring controlled instruments shall be provided with front of board zero adjuster, capable of being safely handled while the instrument is in service.
- c) Instruments shall conform to IS:1248 and shall have accuracy class of 1.5 or better. The design of the scales shall be such that it can read to a resolution corresponding to 50% of the accuracy class index.
- d) Instrument covers shall be of shadow proof design, utilising all available light. The indicating instruments shall have red marks on the dial corresponding to rated values of the associated primary equipment.
- e) Ammeters and current coils of watt meters and varmeters shall continuously withstand 120% of rated current and 10 times the rated current for 0.5 sec. without loss of accuracy. Voltmeters and potential coils of watt meters and varmeters shall withstand 120% of rated voltage for 0.5 seconds without loss of accuracy.
- f) DC ammeters shall be provided with external shunt wherever the current exceeds 5 amps. The rated voltage drop for the shunts shall be 75 mV.
- g) Synchronising Instruments shall also meet the requirements of Clause 10.5 of this section.
- h) Digital bus voltage and frequency meter shall be of class 0.5 and shall have digital display of five (5) and four (4) digits respectively with display size not less than 25 mm (height).

11.3 Metering Instruments:

11.3.1 Energy Meters:

1.0 SCOPE

This specification covers design, engineering, manufacture, assembly, inspection, testing at manufacturers works before dispatch, supply and delivery at different destination stores located in the state of Uttar Pradesh, 0.2s accuracy class bi-directional, static, suitable for outdoor type mounting also, microprocessor based, 3 phase–4 wire, HT, CT & VT operated, capable of full four quadrant measurement, single circuit, tri-vector energy meters. These

meters shall be suitable for measurement of energy and power, demand requirement in an A.C. balanced / unbalanced system over a power factor range of zero- lag to unity to zero-lead. These meters should have communication ports for future interface to Automatic Meter Reading (AMR) system, using low power radio/GSM/GPRS frequencies.

Meters shall also have standard communication feature for down loading of metering data through hand held data collection device (MRI). A related PC compatible base computer software (BCS) for analysis and reporting as per the details given here in, shall also be supplied.

All associated software – for MRI, as well as for PC, including time correction utility, and those required as part of the metering system, whether specifically laid out in this specification or not, shall be deemed to be included in the scope of supply under this contract.

However, features of the offered equipments, better, or superior than the annexed specifications, may be acceptable, for which bidders may submit convincing stipulations to the satisfaction of the purchaser; the sole intention being, acquiring the best possible product.

The 'Guaranteed Technical Particulars' as annexed herein, for the offered equipments shall be essentially filled.

2.0 SERVICE CONDITIONS

The meters shall be suitable for satisfactory continuous operation under the following tropical conditions:-

a)	Maximum ambient temperature:	50 °C
b)	Minimum ambient temperature in shade:	0 °C
c)	Relative Humidity:	100% max
d)	Maximum annual rainfall:	1450 mm
e)	Maximum wind pressure:	195 Kg/sq.m
f)	Maximum altitude above mean seal level:	2000 meters
g)	Iso-ceraunic level:	50 days/year
h)	Seismic level:	0.3g
i)	Hot and humid tropical climate conducive	to dust, rust and fungal growth.

3.0 CHARACTER OF SERVICE

V.T. and C.T. operated, three phase, four wire 1A, 110V ph-ph/63.5Vph-n, 0.2s accuracy class non ABT type energy meter for measurement/recording of various parameters of energy being transferred through a three phase single circuit network. The energy meters shall be suitable for measurement of energy parameters for bidirectional flow of power as power flow through the purchaser's three phase network could be in either direction. The load being fed by the three phase network may be balanced or unbalanced.

The design shall allow outdoor cubicle mounting (cubicles are not in the scope of supply) in the switch yard of 132/220/400kV grid substations, primarily, but not limited to, metering of independent feeders, as well as indoor mounting in control panels.

4.0 APPLICABLE STANDARDS

The CT PT operated HT energy meter shall be of accuracy Class 0.2s and conform to following standards-

▶ IS 14697: 1999

Specification for A.C Static Transformer operated Watt Hour &
CBIP Technical Report No. 88 (Revised July 1996 and Amendments & Errata issued in April - 1999 and September'99) Specification for A.C. Static Electrical Energy Meters.

- > IEC 687 Alternating current static watt-hour meters for measurement of active energy, class 0.2.
- ▶ IS-3202 Climatic proofing of electrical equipment.
- \triangleright CBIP technical report 111 where ever applicable.

5.0 PRINCIPAL PARAMETERS

The energy meters shall be indoor/ out door type connected with the secondary side of out door current and voltage transformers.

Sl.No.	Item	Specification
i.	Type of Installation	Indoor(non AC) /Outdoor
ii.	CT secondary	1 A
iii.	VT secondary	110 V/ $\sqrt{3}$ Volts
iv.	Auxiliary AC Supply	230 V+ 10 % to -15%
v.	Auxiliary DC Supply	110 V/220V/ <u>+</u> 10%
vi.	System frequency	50HZ <u>+</u> 5%
vii.	Earthing System	Solidly Grounded

6.0 GENERAL TECHNICAL REQUIREMENT

i) Application:	3 phase 4 wire, -/01A			
ii) Rated Secondary Voltage:	-/110V AC, 63.5 Volts (Phase to Neutral)			
iii) Rated secondary Current (I Basic):	1 Amp balanced & unbalanced load			
iv) Maximum Current :	2 Amps.			
v) Rated Frequency:	50 Hz.			
vi) Accuracy class:	0.2s			
vii) Power Factor:	Unity to Zero (all power factor lag to lead).			
viii) Power Consumption:	Not more than 1.5Watt per phase(Active)			
	10 VA (Apparent)			
	Apparent power consumption in each			
current circuit at basic current and				

reference frequency shall not exceed

1.0 VA

ix) Phase Sequence Immunity: Shall be unaffected to phase sequence.

x) Data Transfer Speed from meter to MRI and from MRI to BCS: at least 19200 kbps.

- xi) Communication Port: Optical port for MRI and communication port for remote data transfer.
- xii) Degree of protection of encapsulation : shall be at IP 51/IP 54 or better.
- xiii) Minimum Starting Current 0.1% of I basic.

7.0 MEASURING / RECORDING AND DISPLAYING OF VARIOUS PARAMETERS AND INFORMATION

- 7.1 The energy meters should be able to measure/record and display the following parameters and information -
 - (i) Active energy in KWH for forward or positive direction.
 - (ii) Reactive energy in KVARH for forward or positive direction.
 - (iii) Apparent energy in KVAH for forward or positive direction.
 - (iv) Maximum apparent power demand in KVA for forward or positive direction over the set demand integration period. The demand integration period shall be 15 mins.
 - (v) Cumulative energies shall be logged at a predefine time (any 15 minute boundary) of every day. These will be maintained for at least last 35 days. This capture data shall be available to BCS. By default the capture time shall be mid-night (00:00:00 hrs).

The parameters to be captured are as belowkWh (Import) kWh (Export) kVArhI WI (Import when Active Import) kVArhE WI (Export when Active Import) kVAh WI (Active Import) kVAh WE (Active Export)

The cumulative active energy of 08:00AM of present day shall be available on the display till 08:00AM of the subsequent day after which the same shall be overwritten with cumulative active energy at 08:00AM of that day. The same shall also be recorded in the memory.

- (vi) Active energy in kWh for reverse or negative direction.
- (vii) Reactive energy in kVArh for reverse or negative direction.
- (viii) Apparent energy in kVAh reverse or negative direction.
- (ix) Maximum apparent power demand in kVA for reverse or negative direction over the set demand integration period.
- (x) Capture data as per (v) above shall be available for both forward and reverse direction of power flow.
- (xi) Date.
- (xii) Time.
- (xiii) Maximum demand reset count.
- (xiv) Date of last maximum demand reset.
- (xv) Time of last maximum demand reset.
- (xvi) Cumulative value of maximum demand for forward or positive direction.
- (xvii) Cumulative value of maximum demand for reversed or negative direction.
- (xviii) Instantaneous power factor of the system with lag/lead sign.
- (xix) Voltage between all the three phase to neutral of the V.T. secondary supply.
- (xx) Secondary currents of all the three C.Ts.
- (xxi) Angles between the phasors. The threshold values of voltage and current for the meter to be able to display the above angles are as follows-
- **a-** Voltage 70% of the standard reference voltage or more.
- **b-** Current 1% of the standard basic current or more.

Alternatively, Instantaneous phase wise power factor may be provided. (xxii) Information related to events of tampering with V.T./C.T. circuits.

- 7.2 All the parameters and information mentioned in para 7.1 should be displayed on manual scrolling with scroll hold facility. In addition to this the parameters and information mentioned in para 7.1-i to xii should also be displayed on auto scrolling preferably in the same sequence.
- 7.3 On Auto scrolling the display time of each parameter/information should be between 10 seconds to 12 seconds (both values inclusive).
 Following additional parameters shall be available on display in addition to above by pressing of push button-
 - Present Status of Abnormality.
 - Latest Occurrence of Abnormality with date & time.
 - Latest Restoration of Abnormality with date & time.
 - Connection check.

8.0 CONSTRUCTION AND DESIRED TECHNICAL FEATURES

- **8.1** The meter shall be manufactured using one of the World's latest design and manufacturing technology and best quality material so as to ensure high reliability and long trouble free service.
- **8.2** The meter shall be of projection type designed and constructed in such a way so as to ensure the following:
 - i) No danger is introduced in personal safety under normal use.
 - ii) Protection against spread of fire.
 - iii) Protection against penetration of dust, vermin, moth, water and moisture.
- **8.3** The meter case shall be tough and weather resistant, so as to ensure that any enclosure deformation does not adversely affect the functioning of the meter. The energy meter cover shall be made of high-grade engineering plastic. The window shall be of transparent material, ultrasonically, seamless type, welded with the meter cover such that it cannot be removed unless the meter is damaged and its cover seals broken.
- **8.4** The meter design shall not allow its internal parts to be accessible by unauthorized users. The cover should be screwed to the base with the help of sealable captive screws. A complete tamper proof arrangement is desirable.
- **8.5** The moulded terminal block housing the terminals for connecting the voltage and current circuits of the meter to the external circuits should be designed and as per the relevant standards. This terminal block should be located at the bottom of the meters and rigidly fixed to the base.
- **8.6** The material of the terminal block should be capable of passing the flammability test as given in relevant Indian standard.
- **8.7** All parts of each terminals should be such that the risk of corrosion resulting from contact with any other metal part is minimized.

8.8 The base of the meter shall have a terminal block at the bottom made out of high grade engineering plastic so as to facilitate bottom connection and houses nickel plated brass terminals for near loss free contacts..

The material of the terminal block shall be capable of passing the tests given in IS 14697: 1999/ CBIP technical report -88.

The terminal holes in the insulating material shall be of sufficient size to accommodate the insulation of the conductors. The terminal hole diameter for current terminals shall not be less than 5.0 mm & shall be of adequate length in order to have proper grip of conductors / crimping pins.

The terminal block shall satisfy all the conditions such as clearance & creepage distance between terminals & surrounding part of the meter as specified in relevant clause of IS 14697: 1999/ CBIP technical report - 88.

- **8.9** All parts that are likely to develop corrosion under normal working conditions shall be effectively treated and protected by appropriate methods. Any protective coating shall not be liable to damage by ordinary handling of or due to exposure to air, under normal working conditions.
- **8.10** All insulating material used in the construction of the meter shall be substantially non-hygroscopic, non-ageing and of proven quality.
- **8.11** The meter should be provided with a protective earth terminal if it's housing is wholly or partially made of conducting material For completely insulated body no ground terminal is required. The protective earth terminal, if any should
 - **a-** be of 4mm size.
 - **b** be electrically bonded to the access able metal parts.
 - **c-** be if possible, form part of the meter base.
 - **d-** preferably be located adjacent to it's terminal block.
 - e- be clearly identified by the grounding symbol.

9.0 MAXIMUM DEMAND ADDRESSING AND RESETTING

The meter shall continuously monitor and calculate the average demand in active & apparent mode during the defined integration period, and the maximum, out of these, shall be stored along with date and time when it occurred in the meter memory. The maximum registered value shall also be made available on meter-display.

The rising demand under the current integration period should be displayed along with the elapsed time.

The integration period shall be set as 15, 30,60 minutes, (default being 15 mins.) on real- time basis. At the end of every demand integration period the new calculated MD shall be compared with the previous MD and meter shall store whichever value is higher.

Demand Reset shall be initiated by-

- a) Auto reset at midnight hours (00:00:00 hrs) on the last day of each month.
- **b**) Through meter reading instrument (M.R.I.) with pass word authentication.

10.0 TARIFF PARAMETERS TO BE LOGGED

The energy meters should be capable of logging the following parameters and information for the twelve preceding months of billing periods:-

- i) Maximum apparent power demand for the forward or positive direction.
- ii) Maximum apparent power demand for the reverse or negative direction.
- iii) Date of resetting of maximum demand.
- iv) Time of resetting of maximum demand.
- v) Active energy recorded (in cumulative manner) for forward or positive direction up to the end of month or billing period.
- vi) Active energy recorded (in cumulative manner) for reverse or negative direction up to the end of month or billing period.

TOD Timings: There shall be a provision of eight Time of Day Zones for Energy (Active import, Reactive Lag while active import & apparent import) and Demand (Apparent demand) registers. Number and timing of these TOD Zones shall be programmable. TOD timings shall be informed later on to the successful vendor.

11.0 MAIN TECHNICAL FEATURES

11.1 POWER SUPPLY FOR METER'S INTERNAL ELECTRONIC CIRCUITS

The energy meter shall be self powered type i.e. power for working of the electronics should be drawn from the supply to it's voltage circuits via VT supply only, as no separate power supply will be available for powering up the meter. Further, the power supply scheme shall be such that meter will work as long as supply to any two of the three voltage circuits is available to the meter. When supply to all the three voltage circuits is available, the meter shall impose a fairly balanced load on the VT.

11.2 DISPLAY DEVICE

The energy meters should have L.E.D./L.C.D. high contrast display device, minimum character height being 10.0 cm, for display of various parameters and information. There should be at least 6/7 digits for displaying the values parameters preferably with floating decimal point format for high resolution display. For example values less than 10 should be displayed with three decimal points and values less than 1000 should be displayed with one decimal point. In addition to these digits the display device should have additional digit which is far to be used for easy identification of the parameter being displayed. Identification should preferably be with the help of display of meaningful short name of the parameters along with their values. Energy parameters and maximum demand should preferably be displayed along with their units. The electronic registers should have non-volatile memory having a retention time of at least five years without battery backup.

11.3 OPERATION INDICATION MECHANISM

The energy meter shall have an operation indication mechanism to indicate the recording of energy for power flow in either direction or separate registers for recording import and export parameters. Two operation indicators for the two directions of power flow is also acceptable. The arrangement shall be convenient to read and visible from the front.

11.4 COMMUNICATION FACILITY

i) <u>COMMUNICATION CAPABILITY:</u>

The meter shall have facilities for data transfer locally through CMRI and remotely by GSM and GPRS modems/devices with proper security via an optically isolated communication port using serial communication. It should be possible to configure meter for TOD tariff demand integration period, billing date, real time clock and date etc. through CMRI locally without any extra cost to **UPPTCL**. The meters shall have a galvanic ally isolated optical communication ports as per IEC 1107 so that it can be easily reading instrument for data transfer. The meter shall have additional RJ11 port along with optical port for reading data through CMRI and AMR modem. Communication ports shall not be affected by any type of infection/unauthenticated signals. The baud rate should not be less than **19200 bps** and higher baud rate shall be preferred for down loading the data.

The bidder shall supply software required for local (CMRI) & remote (AMR) connectivity including required training to use the software free of cost. Separate communication cords for optical port and RJ11 port have to be supplied with each meter free of cost.

ii) One end of this cord will have adapter suitable for the type of communication port of the meter and the other end should have a RS 232C, 9 pin D type male connector of good quality. Connections to the various pins should be as per the diagram mentioned in appendix-A of the C.B.I.P. technical report no. 111 of May'97 read with amendments. The cable should be made of flexible material, shall be shielded and the two ends should be stressed relieved. The length of the cable should be 500±10 mm. The optical leads shall have a universal optical heads. Alternatively, a universal coupling adapter shall be supplied along with every data cable.

11.5 TEST OUTPUT DEVICE

The energy meter should have some output device located at the front and capable of being read with suitable testing equipment for purpose of testing the meter within a short time. The output device may be a pulse output device or the communication port itself through which high resolution display (having at least three digits after decimal point) can be obtained. The meter shall have preferably a common pulse out put LED for kWh, kVArh and kVAh.

11.6 Self Diagnostic Features

The energy meter shall preferably have the facility of continuous online automatic monitoring, using suitable self diagnostic routines as per CBIP recommendations to check and indicate the healthiness of its various electronic devices and circuits and, in case of malfunctioning of any of the devices and circuits, the energy meter should indicate the same either by giving some visual indication at the front or by suitable display arrangement.

11.7 IMMUNITY TO ELECTROMAGNETIC DISTURBANCE

- i) The energy meter should be designed in such a way that conducted or radiated electromagnetic disturbance as well as electrostatic discharge do not damage or influence meter's performance.
- ii) The energy meter shall not be affected by high frequency super imposed signals on the power line which do not exceed 3% of regular line voltage at 0.2%Khz and 15 kHz. The disturbances include –
- (a) Harmonics
- (b) Voltage dips and short interruptions
- (c) Conducted transients

- (d) D.C. and A.C. magnetic fields
- Electromagnetic fields (e)
- Electrostatic discharges **(f)**

RADIO INTERFERENCE AND NOISE SUPRESSION 11.8

The energy meter shall not generate conducted or radiated noise/interference which could interfere with other electronic devices.

12.0 **PROTECTION AGAINST TAMPER**

- Meter cover open tamper Feature is to be provided. i)
- ii) The energy meter should have the following features for protection against tampering with/failure of V.T./C.T. circuits :

TAMPERING WITH/FAILURE OF V.T. CIRCUITS A)

In case of failure of supply to any one of the two voltage circuits of the meter in case of three wire type meter and any one or two of the three voltage circuits of the meter in case of four wire type meter due to tampered condition of the V.T. circuit(s) the energy meter should record the energy parameters normally. Dropping of VT supply voltage in one or two affected voltage circuit(s) (as the case may be) to 40% or below of the standard reference voltage should be treated by the meter as failure of VT supply and the meter shall log this event as V.T. circuit failure/tampered, provided the following conditions co exist-

_

- Duration of failure of VT supply 1-
- Current(s) in the associated 2-
- _ 300 seconds approximately of the order of 1% of the
- current circuit(s)
- standard basic current

TAMPERING WITH/FAILURE OF C.T. CIRCUITS B)

Whenever the direction of flow of current, through the two current circuits of the meter in case of three wire type meter and through the three current circuits of the meter in case of four wire type meters, are not equal due to reversal of connection(s) of current transformer(s), the energy meter should record energy parameters what it should record normally, and shall log this event as C.T. circuit reversed/tampered; provided that the magnitudes of current, flowing through the two current circuits in case of three wire type meter and at least through any two of the three current circuits of the meter in case of four wire type meter, are equal to nearly 1% of the standard basic current and such condition persists for an order of 300 seconds approximately.

C) **DISPLAY OF SHORT INFORMATION ABOUT TAMPERING EVENTS**

The energy meter should be able to display the following information about tampering events that have occurred since last demand reset :

- 1-Date of first occurrence of tampering.
- Time of first occurrence of tampering. 2-
- 3-Date of last restoration to normal condition.
- 4-Time of last restoration to normal condition.
- 5-Number of occurrences of tampering events.

RECORDING OF INFORMATION ABOUT TAMPERING EVENTS D)

The energy meter should be able to record in its memory the following data relating to events of failure of instrument transformer circuits /tampering that occur since first

powering up the meter after installation, for as many number of events as possible on F.I.F.O. first - in - first - out basis)

- 1- V.T. circuit wise date and time of each occurrence of tampering and subsequent restoration to normal condition.
- 2- Date and time of each occurrence of tampering with C.T. circuit(s) and subsequent restoration to normal condition. Occurrence of tampering with a V.T. circuit or with C.T. circuit(s) shall be treated as one event and its subsequent restoration to normal condition shall be treated as another event.
- 3- Date & time of Meter cover open tamper Feature.
- 4- Following tamper features shall be available on the display units.
 - i) Missing potential (R,Y,B)
 - ii) C.T. Reversal (R,Y,B)
 - iii) C.T. open
 - iv) C.T. shorting
 - v) Neutral disturbance
 - vi) Load imbalance

13.0 BILLING HISTORY & LOAD SURVEY Billing History

Billing History The meter shall have suffi

The meter shall have sufficient non-volatile memory(without requiring battery back up) for recording history of energy parameters for minimum last twelve billing cycles (programmable) (Bill date shall be 00:00 hrs of the 1st date of the calendar month by default). The meter shall support minimum 12 billing histories.

Billing Parameters

Following Billing parameters should be available in the meters.

- i) Energy (cumulative values) & consumption (month wise) of KWH-Imp/Exp, KVAH-Imp/Exp, KVARH Lag-Imp/Exp, KVARH Lead-Imp/Exp.
- ii) Month wise values of maximum demand KW-Imp/Exp, KVA-Imp/Exp with date & time of occurrence of that particular month for all specified Time Zones.
- iii) Average Power Factor.
- iv) Power on/off Duration month wise.
- v) Voltage & current values (secondary side).

Load Survey

The meter shall be capable of recording following parameters-

- kWH Import
- kWH Export
- kVAH Import
- kVAH Export
- kW Import
- kW Export
- kVA Import
- kVA Export

- Phase voltage (V1, V2, V3)
- Current (I1, I2, I3)
- Power Factor

These load survey and history data can be retrieved with the help of Meter Reading Instrument on local interrogation or remotely using the remote communication interface as and when desired. Load profiles can be viewed graphically / analytically with the help of meter application software. The offered meter application software shall be capable of exporting these data for analysis to other user software in spreadsheet format.

11.4 Disturbance Recorder:

A. For Line

- 11.4.1 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 relay, Transformer, and Bus bar Protection is acceptable and shall be activated in Both Numerical Protections.
- 11.4.2 The Disturbance recorder shall consist of individual acquisition units, or as a part of Bay Protection Units and an Evaluation unit which is common for the entire Sub-Station. 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 of 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 Sub-Station(s), one set of Evaluation unit shall be supplied for each substation where ever disturbance recorders are specified.
- 11.4.3 Disturbance recorder shall have minimum 8 analog and 40 digital channels for each Feeder for distance protection.
- 11.4.4 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.
- 11.4.5 The acquisition unit shall be suitable for inputs from Current Transformers with 1A rated secondary Current and Capacitive/Electromagnetic 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 it waveform.
- 11.4.6 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.
- 11.4.7 The Evaluation unit shall consist of a desktop personal computer (including VGA colour monitor, mouse and key board) and printer. The desktop PC shall have Pentium-IV processor or better and having a clock speed 2GHz or better. The hard disk capacity of PC shall not be less than 320 GB and RAM capacity shall not be less than 2.0 GB.
- 11.4.8 Evaluation software shall be provided for the analysis and evaluation of the recorded data made available in the PC under WINDOWS environment. The Software features shall include repositioning of 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 recorder shall have a facility to Transfer the Analog values during pre fault, during fault and post fault and time taken for each digital values activated after fault occurred. It shall have a facility to calculate the fault locator and Transfer the data. The disturbance records shall also be available in COMTRADE format (IEEE standard – Common Format for Transient data Exchange for Power System).

- 11.4.9 The Evaluation unit shall be connected to the printer to obtain the graphic form of disturbances whenever desired by the operator.
- 11.4.10 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 230V, single phase AC supply. In case of failure of AC supply, Evaluation unit and printer shall be switched automatically to the station DC through Inverter of adequate capacity which shall form a part of Disturbance recorder system.
- 11.4.11 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 open delta voltage and neutral current shall be derived either through software or externally by providing necessary auxiliary transformers.
 - c) The acquisition unit shall be typically used to record the following digital channels:

In Case of Line

- 1. HVMAINCB OPEN for 220KV C.B.
- All the three pole indications should be recorded.
- 2. HV TIE TIE CB OPEN
- 3. 21 MAIN1 RELAY OPERATED
- 4. 21 MAIN2 RELAY OPERATED
- 5. 87 BUSBAR RELAY OPERATED
- 6. MAIN CB A/R OPERATED
- 7. TIE CB A/R OPERATED
- 8. PSB OPERATED
- 9. SOTF OPERATED
- 10. POLE DISCREPANCY OPERATED
- 11. 27 O/V STG-1 OPERATED
- 12. 27 O/V STG-2 OPERATED
- 13. 51 STUB-1/2 OPERATED
- 14. 87HZ / LZ TEED-1/2 OPERATED
- 15. MAIN CB LBB OPERATED
- 16. TIE CB LBB OPERATED
- 17. DIRECT TRIP CH-1/2 RECEIVEDTRIP
- 18. 21M1 CARRIER RECEIVE
- 19. 21M2 CARRIER RECEIVE
- 20. 86 GR-A/B RELAY OPERATED

21. 67N DEF/TEF RLY OPERATED 22. DF/DT RELAY OPERATED

In Case of Transformer

1. HV MAIN CB OPEN 2. HV TIE TIE CB OPEN 3. LV CB OPEN 4A.. 87 T2 HZ DIFF RLY OPERATED 4B. 87 T1 LZ DIFF RLY OPERATED 4C. POLE DISCREPANCY OPERATED **5. REF OPERATED** 6. HV 67 ABCN OPERATED 7. LV 67 ABCN OPERATED 8. 51 O/L RLY OPERATED 9. NDR RLY OPERATED 10. HV 86 GR-A/B RELAY OPTD 11. LV 86 GR-A/B RELAY OPTD 12. OIL TEMP HIGH TRIP 13. WNDG TEMP HV/IV/LV TRIP 14. BUCHHOLZ MAIN/OLTC TRIP 15. PRD 1/2 TRIP 16. AT/F NEUTRAL CURRENT TRIP

- d) If offered as inbuilt feature of Line Distance Relays, it should be quoted for both Main and backup (for 100% redundancy). Similarly for Transformer 87 T1 and 87 T2,
- e) In case the disturbance recorder is in-built part of Bay protection Unit, above digital channels may be interfaced either externally or internally.
- f) 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.
- 11.4.12 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 analog and digital signals of all the channels. Ten packets of Z-fold paper (500 sheets in each packet) suitable for printer shall be supplied.
- 11.4.13 Each disturbance recorder shall have its own time generator. The clock of the time generator shall be such that the drift is limited to +/- 0.5 seconds/day, if allowed to run with out synchronisation. Further, Disturbance recorder shall have facility to synchronise its time generator from Time Synchronisation Equipment having output of following types.

Voltage signal :

Potential free contact

The recorder shall give annunciation in case of absence of synchronising pulse within a specified time. In case DR is inbuilt function of Bay Protection units (BPU) and the SAS is implementing in IEC 61850 Time Synchronization achieved through SNTP network protocol.

- 11.4.14 Sub-Stations where Time Synchronisation Equipment is not available, time generator of any one of the disturbance recorders can be taken as master and time generators of other disturbance recorders and Event loggers in that station shall be synchronized to follow the master.
- 11.4.15 The disturbance recorder shall be capable of being triggered by the following user specified quantities :
 - (a) overvoltage and undervoltage
 - (b) overcurrent
 - (c) negative sequence voltage
 - (d) zero sequence voltage
 - (e) over frequency or under frequency
 - (f) power swing

11.4.16 The transformer relay panel shall have a disturbance recording feature to record graphic form of instantaneous values of current in all three windings in 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.

- 1. 87 T2 protection operated
- 2. HV breaker status (Main)
- 3. LV breaker status ((Main)
- 4. Bucholz /OLTC Bucholz alarm / trip
- 5. WTI/OTI/PRD alarm/trip of transformer

11.4.17 Necessary hardware and software for down loading the data captured by disturbance recorder to the personal computer available in the substation shall be included in the scope.

11.5 Fault Locator:

- i) Electronic or microprocessor based type.
- ii) 'On-line' type
- iii) Built-in display unit
- iv) The display shall be directly in percent of line length or kilo-meters without requiring any further calculations.
- v) Accuracy for all types for faults and fault levels.
- vi) The above accuracy should not be impaired under the following conditions:
 - a) Presence of remote end in feed
 - b) Predominant D.C. component in fault current
 - c) High fault ARC resistance
 - d) Severe PT transients
 - e) Magnitude of line loading before occurrence of faults.
- vii) Facility for remote data transmission.
- viii) Shall meet IEC-255 or any other equivalent internationally recognized standards.
- ix) shall have mutual zero sequence compensation unit if fault locator is to be used on double circuit line .
- x) Have built in supervision and testing facility.
- xi) Built in feature of line distance relay is acceptable/provided the requirements of above clauses are met.

12.0 RELAYS:

- 12.1 All relays shall conform to the requirements of IS: 3231 or other applicable approved standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear. Relays shall be rectangular in shape and shall have dust tight, dull black or egg shell black enamel painted cases with transparent cover removable from the front.
- 12.2 All protective relays shall be in draw out or plug-in type / modular cases with proper testing facilities. The testing facilities provided on the relays available at Manufacturer/Supplier works shall be specifically stated in the bid. Necessary test plugs shall be supplied loose and shall be included in Bidder's scope of supply. Test block and switches shall be located immediately below each relay for testing. As an alternative to test block and test plug arrangements the Bidder shall also quote alternative testing facility of protective relays by providing push button which when pressed connects the testing equipment to the relay coils and injects current in the coil and automatically disconnects the trip circuits and on operation of relay gives a signal that the equipment and the circuits are healthy. The above tests shall be carried out without short circuiting the CT secondary connections. The Owner reserves the right for accepting any one of the above two testing facilities. Unless otherwise specified all auxiliary relays and timers shall be supplied in non-draw out cases/plug in type modular cases.
- 12.3 All A.C. relays shall be suitable for operation at 50 Hz. A.C. Voltage operated relays shall be suitable for 110 Volts or 110//3 VT secondaries and current operated relays for 1 Amp CT secondaries as specified in this specification. DC auxiliary relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.
- 12.4 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 to suit contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. and 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 cases 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 so chosen as not to introduce any limitations on the use of available contacts on the relay due to in-adequacy of terminals. Paralleling of contacts, if any shall be done at the terminals on the casing of the relay.
- 12.5 All protective relays, auxiliary relays and timers except the lock out relays and interlocking relays specified shall be provided with self-reset type contacts. All protective relays and timers shall be provided with externally hand reset positive action operation indicators, provided with inscription, subject to Owner's approval. All protective relays which do not have built-in-hand reset operation indicators shall have additional auxiliary relays with operating indicators for this purpose. Similar separate operating indicator (auxiliary relays) shall also be provided in the trip circuits of protections located outside the board such as bucholz relays, temperature protection, fire protection etc.
- 12.6 Timers shall be of the electromagnetic or solid state type. Pneumatic timers are not acceptable. Short time delays in terms of milli seconds may be obtained by using copper slugs on auxiliary relays. In such case it shall be ensured that the continuous rating of the relay is not affected. Time delay in terms of milli seconds obtained by the external capacitor resistor combination is not acceptable.

- 12.7 No control relay which shall trip the power circuits breaker when the relay is de-energised shall be employed in the circuits. All relays shall be self reset type unless otherwise specified.
- 12.8 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.
- 12.9 All relays shall withstand a test voltage of 2.5 KV, 50 Hz, rms voltage for one second. In case of static relays the Clause 13.12 shall be applicable.
- 12.10 Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured:
 - a) The operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.
 - b) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously. 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.
- 12.11 All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for Owner's use.
- 12.12 Wherever solid state relays are used the following requirements shall be met with:
 - a) The printed circuit cards shall be of fiber glass type and the contact shall be gold plated. All connections with the connector pegs shall be through wire wrapping. All solder joints on the printed circuit boards shall be encapsulated or covered with varnish.
 - b) The components shall be "adequately rated to carry twice the normal expected loads". The resistors shall be of carbon composition or metal oxide type and the capacitors shall be plastic film or tantalum type. Stringent measures including shielding of long internal wiring should be taken to make relays immune to voltage spikes. The relays must withstand the requirements of IEC 255-4 appendix-E Class III regarding H.F. disturbance tests, IEC 255-4 regarding impulse test at 5 KV and fast transient test as per IEC 801-4. Insulation barriers shall be provided to ensure that transients present, in CT & VT connections due to extraneous sources do not cause damage to static circuits.
 - c) All relays shall be designed for satisfactory performance under tropical and humid conditions specified under Volume-II Annexure C. Special mention shall be made in the technical deviations schedule of the bid for those relays, if any, that Bidder proposes to use which differ from specified requirements.
 - d) All devices required for correct operation of each relay shall be provided by Bidder without any extra cost.
 - e) The Bidder shall ensure that the terminals of the contacts of the relays are readily brought out for connections as required in the final approved scheme. The type of relay case size offered shall not create any restrictions on the availability of the contact terminals for wiring connections. All relay contacts used for remote annunciation shall be making type i.e. contacts should close to initiate annunciations.
 - f) DC/DC converter shall be provided in the solid state protective relay wherever necessary in order to provide a stable auxiliary supply for relay operation. Provision of DC cells in the protective relays as reliable standby power supply will however not be acceptable.

- g) The solid state relays shall be stable and suitably protected against transient/induced over voltages and noise signals. The Bidder shall state clearly in his bid, special requirements, if any, for DC input arrangement or cabling considered necessary for satisfactory operation of solid state relays quoted by him.
- h) All equipment shall be of modular construction and the modules as a subunits shall be of plug in type for easy replacement. Equipment shall use solid state components and integrated circuits of latest design/techniques. The design shall permit rapid and positive recognition of defects and facilitate easy repair. Appropriate indications shall be available to enable speedy internal fault location. All components shall be readily accessible for easy disassembly and replacement.
- i) All components shall be clearly and unambiguously marked and complete wiring shall be column coded and tagged wires only in flat ribbon cable will be exempt from tagging.
- j) Readily accessible and clearly marked test prints shall be provided at all important points in the circuit.
- k) Screw clamp terminals shall be provided for interconnection with relaying equipment. It shall be possible to test the protection channels with the equipment fully operational without rendering the equipment ineffective for genuine signals. Safety equipment such as protection cover and interlocks shall be provided. Ground terminals with isolating links shall be provided where required.
- 1) The Bidder shall include in the bid a list of installations where the relays quoted have been in satisfactory operation.
- 12.13
- i) All Relays are Numerical relays, unless other wise when ever specified that alternatively solid state relays accepted. The following information / confirmation shall also be furnished in the bid.

All Protection Relays shall be numerical Relays.

All Numerical Relays should have following minimum features.

Shall be communicable on IEC61850 protocol without any protocol converter. KEMA certificate confirming interoperability, Goose messaging. as per IEC61850 standard shall be submitted along with the Bid.

Shall have one no. front RJ45 or Rs 232 or USB port for Local Relay setting/Parameterization and One no. rear FO port for connectivity to SAS over IEC61850 protocol.

Should have sufficient configurable LEDs for main Relays and for Annunciation of backup Relays.

Should have sufficient binary input and binary outputs for 220KV and 132KV system. I/Os shall be configurable

Shall have front minimum 4 lines LCD display with Alpha numeric key pad

- ii) Numerical relays are provided with built in Event / Disturbance / Fault Recorder features.
- iii) The bidder shall bring out in the bid that the Numerical relays providing different protection features / application in a single unit if any one of the application/feature goes out of service the other feature/application (s) will remain un-effected.

12.14 All relays shall have 10% spare BIs and BOs.

13.0 AUXILIARY MONITORING RELAYS

13.1.1 Self reset auxiliary/monitoring voltages relays for specified D.C. Voltage shall be provided for use in the interlocking schemes for multiplication of contacts, and for monitoring of control supplied and circuit. Monitoring relays for lockout relay circuit shall be connected in

series with lockout relay coils. The Bidder shall be responsible to ensure that the monitoring relay ratings are such that they shall positively pick-up through the breaker coils/lockout relay coils monitored, but the breakers/lockout relays shall not operate with such a connection.

13.1.2 The supply and circuit monitoring relay shall be connected to initiate an alarm upon failure of respective supply circuit. They shall preferably have reverse flags, which drop when the relay is de-energized. Otherwise, an indicating lamp shall be provided with each monitoring relay for indication of its operation.

13.2 TRIP CIRCUIT SUPERVISION RELAYS

The trip circuit shall be supervised by means of relays. The scheme shall continuously monitor the trip circuit both before closing and after closing of the breaker. The scheme shall detect (i) Failure of trip supply to trip coil of each phase (ii) Open circuit of trip circuit wiring and (iii) Failure of mechanism to complete the tripping operation. The relays shall have necessary contacts to be connected to either the alarm bell or to the annunciator available in the control panel for visual and audible indication of the failure of trip circuit and for connection to event logger. 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. Trip circuit supervision relay shall be provided for each pole of breaker for each DC source. Also 2 Nos. Indicating lamps to act in conjunction with trip circuit supervision relays for healthy trip indication of 2 sets of trip coils shall be supplied wherever called for. Necessary external resistors for trip circuit supervision relays shall be supplied.

13.3 D.C. Supply Supervision Relay:

The relay shall be capable of monitoring the failure of d.c. supply to which it is connected. It shall have adequate potential free contacts to meet the scheme requirement. The relay shall have a 'time delay on drop-off' of not less than 100 milliseconds and be provided with operation indicator/flag.

13.4 High Speed Tripping Relay

- i) be instantaneous (operating time not to exceed 10 milli seconds).
- ii) have adequate hand resetting type contacts, preferably operated by push-button where used in bus bar protection. The re-setting time shall be within 20 milli seconds for self-resetting relays.
- iii) have necessary supervisory relays
- iv) be D.C. operated
- v) Be provided with operation indicators for each element/coil.

13.5 FLAG REALAYS:

They shall have

- a) Hand reset flag indication
- b) Two elements
- c) Have necessary NO/NC contacts for each element/coil to meet scheme requirements and other functions like event logger, disturbance recorders etc.

13.6 DETAILED DESCRIPTION OF PROTECTIONS:

The protection, auxiliary relay and timers that are required to be provided and included in the list of equipment and the detailed description of each protection and the associated equipment are described below:

The setting ranges of the equipment offered, if different from the ones specified shall also be acceptable if they meet the functional requirements. The Bidder shall quote the protection equipment meeting the following requirements.

The Bidder may also quote any alternative/additional protections or relays considered necessary by him for providing complete effective and reliable protection. These equipment shall be quoted separately as an alternative/addition to the main offer stating the price separately. The acceptance of this alternative/additional equipment shall lie with the Owner.

14.0 TRANSMISSION LINE PROTECTION:

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 primary & back up protection having equal performance requirement specially in respect of time as provided by Main protection called Main and Backup Protection.

The maximum fault current could be high as 40 KA near power station but the minimum fault current could be as low as 20% of rated current.

The starting & measuring relays characteristics should work satisfactorily under these extremely varying conditions.

The Protective Relays shall be suitable for use with capacitor voltage transformers having non-electronic damping and transient response as per IEC. It should be ensured that there is no additional delay in relay operating time created intentionally to have stable operation. The power supply unit if provided as an integral part of relay scheme shall be fully rated with liberal design in capacity.

The DC supply for solid state relay shall be from DC/DC converters and these shall be amply & fully rated for all operating conditions in service.

Insulation barriers shall be provided to ensure that transients present in CT & VT connections due to extraneous sources do not cause damage to static circuits. The circuits must comply with IEC recommendation for impulse withstand values. Adequate measures shall be taken to ensure that equipment is protected against voltage spikes occurring in Aux. DC supply.

Disturbance recorder, event recorder, and distance to fault locator relay function as an integral part of line protection relay and meeting the specification requirements as per relevant clauses of these equipment shall also be acceptable.

The following protections shall be provided for each of the 132 KV Transmission Lines.

14.1 Line protection for 220/132 KV Lines.

General requirements for Numeric Type Protection Relays:-

- i) All protection relays main-I& Main-II shall essentially be Numerical Type and shall follow IEC 61850 Protocol with latest amendments. All the software required for respective protocol communication shall be included in the scope.
- ii) Equipped with Event Recorder. Events storage shall be sufficient for the application .
- iii) Equipped with Disturbance Recorder. Trigger criteria and record length for disturbance recording should be user configurable. Disturbance record storage shall be sufficient for the application.
- iv) Equipped with Fault Locator. Trigger criteria and record length for fault recording should be user configurable. Fault record storage shall be sufficient for the application.
- v) Equipped with Ethernet ports for bay level interface.
- vi) There should be IRIG- B port for GPS time synchronisation.

- vii) Equipped with communication port (USB or RS-232 or Ethernet port) for relay configuration, data and record retrieval. It shall be possible to carry out software updates of the numeric relay through internet connectivity free of cost.
- viii) Equipped with self monitoring and diagnostic feature. A relay fail alarm should be available. A relay healthy indication shall be provided. The numeric relay shall be provided with diagnostic tools with which it shall be possible to identify and display all the defective modules of the relay.
- ix) All Necessary software for complete configuration of the protective relay, record retrieval, data retrieval shall be included in the scope & Software CD with each panel shall be provided during supply.
- x) Suitable to operate with Auxiliary DC supply voltage available in the substation (Nominal aux supply voltage is 110V DC or 220V DC as per substation DC supply voltage.)
- xi) Provision for display of alarms with LED/LCD/graphic display. The LED shall be programmable to any of the alarms and inputs.
- xii)Support multiple relay settings for protection. The numeric relay should be provided with a facility for settings file comparison.
- xiii) All configuration files of protection relay shall be stored in a non volatile memory and shall not be lost on absence of dc supply.
- xiv) The relay should be suitable for testing with universally acceptable testing Kit.
- xv) The relay should be equipped with field configurable opto isolated digital inputs and potential free digital outputs as required for the specific application. Numeric relay with non programmable inputs and non-programmable outputs are not acceptable.

(I) <u>220 KV&132KV Line Protection:</u> <u>MAIN-I AND MAIN-II DISTANCE PROTECTION</u>

The numeric distance protection relay shall comply with the following requirements

- 1. The numeric distance protection relay shall comply with the specification for the general requirement for numerical protection relay as furnished above.
- 2. The numeric relays shall be equipped with sufficient digital output contacts for trip outputs , alarms, spare and for the protection scheme implementation.

A. <u>Main-1 and Main-2 Distance Protection Relay Should be Different</u> <u>Make i.e Manufacturer.</u>

Equipped with the following built in protection functions:

21 Distance protection

- 1) The Numerical Distance Relay Offered by tenderer should have 6 un-switched independent measuring systems and be suitable for single as well three phase tripping.
- 2) The measuring systems shall have quadrilateral characteristics when plotted on R-X plane.
- 3) The Numerical Distance Protection relay/scheme shall have minimum 04 nos. measuring zones, all independently programmable in forward or reverse direction. In all the measuring zones, the zone impedance reaches or Resistive and Reactive reaches should be able to set independently.
- 4) The Distance Protection Panel scheme shall have the possibility for setting resistive reach for two phase faults and single phase to ground faults separately.
- 5) The distance protection scheme shall have zero sequence compensation factor settable for all zone. On different setting groups with the possibility to change over from one setting group to the other, to cater to different network conditions.

- 6- The Distance Protection should also not pose any problem of Load Encroachment for line lengths upto 200Km (for 220KV as well as 132KV lines).
- 7. To provide protection to the voltage transformers, fuses are provided on VT/PT/CVT junction boxes. The Numerical Distance relay should supervise these fuses and provide interlocked DC supply to block immediately the Distance Protection.
- 8. The Distance Protection Line Scheme shall be suitable for:-
- a- High speed clearance of switch on to fault (50/27)
- b- (i) High speed operation in Zone-1. The typical operating time of the relay should not exceed 30ms for zs/zl=3 and fault being at 50% of the set Zone-I reach and also not more than 55 ms. For Zs/Zl=20 at fault being at 80% of the set zone-I.
 - (ii) For Zone- 2, Zone 3 and Zone- 4, there should be continuously adjustable definite time delay.
 - (iii)Zone-2 0.1 to 1.00 sec.
 - (iv)Zone 3 0.3 to 3.00 sec
 - (v) Zone-4 1.0 to 3.00 sec.
- c- Tripping of breaker by starter.
- d- The correct operation for fault current down upto 30% of the full load current.
- e- The scheme shall be provided with:-
- i) Arc fault compensation.
- ii) Earth fault compensation.
- Mutual compensation.
 The tripping relay contacts should be suitable to make and break current of the circuit breaker (5.5 Ampere).
- 9. In the static relays insulations barriers shall be provided to ensure that transients present in CT and VT connections due to extraneous source shall cause no damage to static circuits.
- 10. The scheme shall not mal-operate on account of de-energisation of unloaded line when the VTs are provided on line side.
- 11. Zone-II and III reach setting shall be upto a maximum of 10 times of Zone-I to enable Zone setting for short line followed by long line section.
- 12. In distance relay, facilities shall be provided for functional testing of the relay quickly and easily under simulated fault conditions.
- 13. The distance relay scheme shall be essentially employed at substations/ power stations, where double main and Transfer, double main and main and transfer Bus arrangement has been adopted. The tripping contacts are thus to be provided accordingly.
- 14. The following remote indications be provided on all panels.

Distance Start I &II Distance Trip I &II Back-up Trip. VT fuse fail. D.C.Source – I fail. D.C.Source- II fail Carrier out of Service. Carrier receive.

- 15. Protective relays shall be required to be routine tested at site while in service. There shall be separate test blocks for main- I & main- II protections and it shall be possible to test one of them at a time. Leaving the other protection in service to take care of any fault occurring in the line during the testing time.
- 16. In relays insulations barriers shall be provided to ensure that the transients present in CT and PT connections due to extraneous sources shall cause no damage to static circuit. The circuits must conform with IEU recommendations for impulse with-stand values. Adequate measures shall be taken to ensure that the equipment is protected against voltage spikes in DC supplies.

- 17. Have built in fault locator with following features.-
- a) Shall display the fault location either in percentage of line length or in actual distance in kilometer based on reactance setting.
- b) Shall have an accuracy of +/-3% or better and watch dog output.
- 18. The relay should have provision for parallel line compensation for proper calculation of fault distance.
- **98**: Fuse failure detection for single, two and three phases The scheme shall incorporate necessary precaution in measurement to block the distance protection However, during blocking period the relay shall have over current protection facility for fault detection.
- 25: Synchro check function
- **50BF**: LBB Function
 - 79: Built in auto reclose function with single shot, single phase reclose with adjustable dead time setting, and with adjustable reclaim time setting. The auto reclose shall be through separate contactor instead of directly through contact of Distance relay. There should be a selector switch available for selecting A/R through Main-I & Main-II. In case of A/R on Main-I, block, start & acceptance shall be through Main-II and vice versa.
- 27/59: Under voltage/ over voltage protection should be provided & The protection element should have two independent stages.
- **50N/51N:** IDMT directional earth fault relay with adjustable setting range of 10-80% with characteristic curve for normal inverse, very inverse and extremely inverse of both IEC and IEEE curves.
- **DR:** Disturbance recorder with sufficient inputs and memory capacity to store disturbance records Shall have features to adjust pre fault and post fault time.
- ER: Event recorder. The resolution of event recorder shall be at least 1 ms.

68: Power swing blocking protection

The power swing shall be detected by rate of change of impedance with characteristics. The blocking shall have continuously adjustable time delay with setting range of not less than 2sec or shall have feature to block the tripping as long as it exists. The relay shall have feature to unblock during fault. It shall be explained how blocking is effected during power swing for phase to earth fault, phase to phase faults and three phase faults. In each case the relay shall have feature to unblock during fault and facility to block each distance zone independently.

- 85: Communication aided schemes PUTT, Blocking, weak infeed and current reversal logic.
- **46BC** : Broken conductor detection

15.0 POWER TRANSFORMER PROTECTION:

Transformer details

Transformer Capacity: 160 MVA 220/132/11KV

15.1 Numerical Transformer Differential protection (87 T1)

- i) be triple pole high speed percentage biased differential type.
- ii) have an operating time not greater than 30 milli seconds at 5 times setting.
- iii) have three instantaneous high set over current units.
- iv) have an adjustable bias setting range of 20-50%.
- v) be suitable for rated current of 1 Ampere.
- vi) have second harmonic restraint feature and fifth harmonic by-pass/restraint feature and also 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.

- vii) In case of 132 KV Transformers it shall be suitable for three phase two winding transformer (have Two bias windings per phase).
- viii) have an operating current setting of 15% or less.
- ix) the relay must be stable on heavy through faults.
- x) Include necessary separate interposing CTs for angle and ratio correction or have internal features in the relay to take care of angle and ratio correction. In case of Numerical relays this shall be taken care i.e. interposing CTs, angle and ratio correction.
- xi) be immune to magnetising in-rush current.
- xii) have features to provide stability under over excited conditions.
- xiii) shall be numerical and using conventional CTs.
- xiv) shall have disturbance recording feature to record graphic for instantaneous values of current in all three ways.

15.2 Numerical Back up Directional over current and Earth Fault Protection Relay with high set feature:

I. 67 T HV (P+N)

- i) Shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s).
- ii) Shall have necessary VT fuse fail relay for alarm purpose.
- 3 Nos. Directional O/C relays for HV side and 3 Nos. Directional O/C relays for IV side shall be provided.
- iv) Directional over current relay shall --

be triple pole type

have IDMT characteristic with a definite minimum time of 3 sec. at10 times setting. have a variable setting range of 50-200% of rated current with adjustable time multiplier settings.

have a characteristic angle of 45 deg., with lead feature a directional controlled, low transient over reach, high set instantaneous unit of continuously variable setting range500-2000% of rated current. Both the inverse and high set relays shall be directional.

include hand reset flag indicators or LEDs per phase. Shall be numerical type.

- v) Directional Earth Fault relay shall -
 - a) One No. Directional E/F relay for H.V. side & one no. Directional E/F relay for I.V. side shall be provided.
 - b) have IDMT characteristic with a definite minimum time of 3 seconds at 10times setting
 - c) have an adjustable setting range of 20-80% of rated current with adjustable time multiplier settings
 - have a characteristic angle of 45/60 deg., lag a directional controlled, low transient over reach, high set instantaneous unit of continuously variable setting range 200-800% of rated current. Both the inverse and high set relays shall be directional
 - e) include hand reset flag indicators or LEDs.
 - f) Shall be numerical type.

15.3 Transformer over load Protection Relay on 220/132 KV side

- i) be single pole type.
- ii) be of definite time over current type and built in feature with differential relay(87T1) or 67HV shall also be acceptable (alarm only).
- iii) have a continuously adjustable setting range of 50-200%
- iv) have a drop off/pick up ratio greater than 95%
- v) have separately adjustable time delay relays for alarm having a setting range of 1 to 10 seconds continuously.
- vi) Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation. DAS and optional trip facility to be connected by purchaser where needed.
- vii) be acceptable HV T/F Over Load Alarm is inbuilt feature of 87 T1.

15.4 Master trip relay for transformer:

Transformer relay panel shall be provided with two sets of master trip relays to trip the circuit breakers through the two separate D.C. sources. Operating time of master trip relay shall be less than 10 ms. The master trip relay shall be wired up to inter-trip both the H.V. and L.V. circuit breakers.

The relay shall have adequate number of contacts as will be required for the scheme.

16.0 TIME SYNCHRONISATION

- i) 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.
- ii) Time synchronisation equipment shall include antenna, all special cables and processing equipment etc.
- iii) 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.
- iv) Equipment shall operate up to the ambient temperature of 50 degree centigrade and 100% humidity.
- v) 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). including communication time for satellite link to achieve real time signal.
- vi) Equipment shall meet the requirement of IEC 60255 for storage & operation.
- vii) The equipment shall have a periodic time correction facility of one second periodicity.
- viii) Time synchronisation equipment shall be suitable to operate from 110V DC supply available at the sub-station with voltage variation of + 10% and -15%.
- 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.
- x) The cable connecting Antenna and Time Synchronising unit should be run through HDPE pipe or GI pipe from the location of Antenna fixing to Time Synchronising panel with suitable fixtures and no provision to enter rain water and should not be affected by atmospheric conditions.
- xi) The equipment shall also have real time display in hour, minute, second, mili seconds.
 (24 hours mode) and shall have a separate time display unit to be mounted on the top of control panels having display size of approximately 144 mm height. The equipment shall have periodic time correction facility of one second periodicity.

17.0 RELAY TEST KIT:

The equipment shall be supplied from reputed manufacturer. It should be got approved before inspection. It shall have provision for energy meter testing capability.

- a) Relay tools kits. 3 sets.
- b) Test Plugs 3 Nos
- c) Special Type Test Plugs for using with modular Type cases (if applicable).
- d) 1 No. Relay test kit microprocessor based fully automatic. It shall have the following features:
- i) To test all types of Distance, Over Current, Transformer, Reactor and Bus Bar protection of major manufacturers in Automatic / Semi Automatic as well as manual mode. And have necessary conversion software for testing of relays to suit to Test kit soft wares like RIO or any other type.
- ii) It shall include all the accessories required for making the complete test set up.
- iii) It shall have three phase current output range 0-50 Amps. (rms) and three phase voltage range 0-230 voltage (Ph-N).
- iv) It shall work on single phase 240V, 50 Hz \pm 10% variation.
- v) Shall include necessary software and hardware
 - a) to accept transient fault data recorder by disturbance recorder/Numerical relay from pen drive and replay these on the relay under test.
 - b) to draw the relay characteristics.
- vi) It shall be able to carry out the testing at power frequencies between 40-60 Hz.
- vii) The accuracy of relay test kit shall be as follows:
 1% on voltage and current output and resolution of time measurement of 1 ms or better.
- viii) The Kit also Suitable to test Energy Meter. Necessary Clamp On CTs (1A or 5A) & PT Plugs and interfacing item, & software is to be provided. Interfacing item should catch LCD, LED or Disc of Energy Meter.

18.0 TESTING INSTRUMENTS:

A list of all instruments and equipments recommended for testing and of the meters and those required for commissioning of C&R Panels specified other than those specified *in Clause No.21.2* of this Section shall be submitted along with the Bid. The prices of individual items shall be given. The details of each equipment and instrument shall also be furnished. This will not be considered for evaluation. However purchaser reserves the right to order for the items and quantities at his discretion at the rates quoted in the bid.

19.0 LIST OF EQUIPMENTS:

The detailed Bill of Materials to be provided in the various Control, Relay & Protection panels is listed in Annexures. The detailed Bill of Materials for Mandatory spares are also given. The Bidder shall give a complete list of equipment provided in each panel as called for in Schedule-G, Schedule of Bill of Materials. Unit price of all equipment as listed in separate *Annexure* shall also be furnished along with the bid. The Bidder shall clearly state any additional equipment found necessary to give a complete and comprehensive offer. He shall however substantiate his reasons for such additional equipment in his bid proposal.

20.0 QUALITY ASSURANCE, INSPECTION AND TESTING:

i) The Bidder shall finalise with UPPTCL the quality plan for manufacturing activities in UPPTCL format within 60days of Letter of Award, along with the total list of numeric, static and electromagnetic relays covered by the QP.

- ii) One control copy of quality manual will be submitted within one month of Letter of Award.
- iii) Bidder shall submit the Quality Plan for Bought Out items/imported items etc. in UPPTCL format.
- iv) UPPTCL reserves the right to carry out Quality Audit on quality management & manufacturing systems & procedures etc.
- v) Bidder shall furnish the QA document package in duplicate as per general terms & condition which shall include but not be limited to following:
 - a) Details of Inspection/Tests/Checks carried out as per agreed QP for main equipment.
 - b) Routine test & type test on all associated equipment including disturbance recorder & event recorders, meters, indicating instruments & cables etc. as per relevant Indian Standards/IEC Standard.

21.0 TESTS:

The equipment offered shall be fully type tested as per the relevant standards. Type testing of the relays shall be carried out based on general guide lines specified in CIGRE committee 34 report on simulator/Network Analyser /PTL for all relays offered including disturbance recorder, fault locator and event logger shall meet fast transmit level-III as per IEC-255-22-4 & IEC-1000.

The control and relay panels shall be completely assembled and subjected to the various type and routine and acceptance tests as per the relevant standards and respective equipment sections in the presence of the purchaser's representative if desired by the purchaser. The Bidder shall, in his proposal, specifically state the details of testing facilities available at his own at his principals works.

- 1 Control & Relay Panel shall also be subjected to following tests:
 - i) Mechanical operation Test.
 - ii) Verification of degree of protection as per IS:2147.
 - iii) High voltage test/Insulator Resistance Test.
 - iv) Electrical control, interlock & sequential operation test.
 - v) Verification of wiring as per approved schematic.
- 2 Bidder shall carry out H.F. Disturbance test, Impulse test and fast transient test (as per IEC 801-4) on principal numerical/static relays (of each type). Bidder shall carry out type tests on all principal relays fault locators, Disturbance recorder & event logger etc. as per relevant standards besides others as specified elsewhere in this specification.
- 3 Bidder shall carry out Burn out test at the variable voltages to prove the performance of Event logger/Disturbance recorder.
- 4 Six (6) certified copies of tests reports of the type and routine tests on the Relay panels as per the relevant standards shall be submitted by the Bidder along with the Bid.

22.0 FIRE PROTECTION:

All equipment connections and cabling should be designed and arranged to minimise the risk of fire and damage which may be caused by fire.

23.0 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, varmin and other harmful effects due to tropical environment.

24.0 TYPE TESTS

- 24.1 The reports for following type tests shall be submitted by the bidder for the Protective relays, Fault locator, Disturbance recorder and Event Logger.
 - a) Insulation tests as per IEC 60255-5
 - b) High frequency disturbance test as per IEC 60255-4 (Appendix –E) –Class III (not applicable for electromechanical relays)
 - c) Fast transient test as per IEC 1000-4, Level III(not applicable for electromechanical relays)
 - d) Relay characteristics, performance and accuracy test as per IEC

60255

- * Steady state Characteristics and operating time
- * Dynamic Characteristics and operating time for distance protection relays and current differential protection relays
- * For Disturbance recorder and Event logger only performance tests are intended under this item.
- e) Tests for thermal and mechanical requirements as per IEC 60255-6
- f) Tests for rated burden as per IEC 60255-6
- g) Contact performance test as per IEC 60255-0-20 (not applicable for Event logger, Distance to fault locator and Disturbance recorder)
- 24.2 Steady state & Dynamic characteristics test reports on the distance protection relays, as type test, shall be based on test programme on simulator/network analyser/PTL. Alternatively, the files generated using Electromagnetic transient Programme (EMTP) can also be used for carrying out the above tests. Single source dynamic tests on transformer differential relay shall be/ should have been conducted based on general guidelines specified in CIGRE committee 34 report on Evaluation of characteristics and performance of Power system protection relays and protective systems.

25.0 STANDARDS:

The design, manufacture and performance of all the equipment and material provided under this specification shall generally conform to the latest issues of the following:-

Indian	Title	International &
Standard		Internationally
		Recognized standards
IS: 3231	Electrical Relays for Power system	IEC-255
	Protection	Part 1 to 3, BS:142
IS: 1248 &	Indicating Instruments	BS: 89
IS: 2419	-	
IS: 6236	Recorders	BS: 90
IS: 722	Energy Meters	BS: 37/IEC-521
(Part-I to		
IX)		
IS: 6875	Control Switches (LV switching	IEC: 337 & 337-1
	devices for Control and Auxiliary	
	circuits)	
IS: 1885	Electro-Technical Vocabulary,	
(Part-I &	Electrical Relays & Electrical Power	
II)	System Protection	
IS: 2705	Current Transformers	IEC: 185
IS: 3156	Voltage Transformers	IEC-186

IS: 375	Marking & Arrangements for Switchgear, Busbar, Main connection	
	and Auxiliary wiring	
IS: 5	Colours for ready mixed paints and channels stability tests	BS: 142
IS: 1554	PVC insulated cables upto and	
(Part)	including 1000 Volts	
IS: 3842	Application guide for Protective	
(Part-I to VIII)	Relays	
IS: 4483	Preferred Panel Controls and	
(Part-I & II)	Dimensions	
IS: 9224	HRC Cartridge fuse links	
(Part-II)	C	
IS: 2147	Degrees of Protection provided by	
	enclosures for LV switchgear and	
	control gear	
IS: 6005	Code of Practice for Phosphating Iron and Steel	
IS: 8686	Specification for static protective	IEC-255 Part-V
	relays & tests	& VI, IEC-801-4
IS: 4237	General requirement of switchgear	
	and control gear for voltages not	
	excluding 1.1 kV	
IS: 5578	Guide for marking of insulated conductors	
IS: 11353	Guide for uniform system of marking	
	and identification of conductor &	
	apparatus terminals	
IS: 13010	Energy Meters	
CBIP	Manual on Protection of Generators,	
Pub	Generator Transformers and 220kV &	
No.274	400kV network	
CBIP	Manual on Reliable fault clearance	
Pub No:	and Back up protection of EHV &	
296	UHV Transmission Networks	
IEC 60870	Communication Protocol	IEC 60870
IEC 61850	Substation Automation Protocol	IEC 61850

1. <u>BILL OF MATERIALS FOR 1 NO. 220 & 132 KV FEEDER BAY AS PER DOUBLE MAIN &</u> <u>TRANSFER BUS BAR SCHEME</u>

Sl. No	Item Description	Qty (Set / No)
1.	Simplex Panel, Panel Dimension : Powder coated as per design of orginal manufacturer	1
	Metering:	
2.	ABT Compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3 element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter.	1
3.	Test terminal block	1
	Control & Indication	
4.	Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways	1
	Protection	
5.	 Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: Synchrocheck & Energising Check(RSYN,25) Monitoring Metering Tripping Logic(PTRC,94) Disturbance Recorder(RDRE) Event Recorder (RDRE) 	1
6.	Line Distance protection relay with Main-I & Main-II of different Make as per IEC 61850 protocol with Quadrilateral characteristics with following features:	2

7.	Numerical relay type as per IEC 61850 protocol with following functions:	Inbuilt of
	• Directional O/C & E/F protection	Main-I&II
		relay
8.	DC Supply supervision relay	2
9.	Trip circuit supervision relay	6
10.	Three phase trip relay with Supervision and Reset push button	2
11.	Auxiliary flag relays.	2
12.	Contact multiplication & lock out relay	1 Set
13.	Supervision Relay for high speed trip relay	2
14.	Carrier In-Out Selector switch	As per
		requirement
15.	Selector switch for selecting A/R through Main-I relay or Main-II relay as	
	per described above.	
	Panel Accessories	
16.	Mounted inside:	1
	 1 no. Illumination lamp with ON/OFF switch 	
	• 1 no. Space heater with switch	
	• 1 no. 3 pin 15A socket with ON/OFF switch	
	• 1 no. Earth Bus	
	• 1 set Terminal Blocks	

2. <u>BILL OF MATERIALS FOR 1 NO. 160/100 MVA 220/132/11 KV AUTO TRANSFORMER BAY AS</u> <u>PER DOUBLE MAIN & TRANSFER BUS BAR SCHEME</u>

SI. No	Item Description	Qty (Set / No)
1.	Simplex Panels, Powder Coated – Panel Dimension : as per design of	1
	original manufacturer	
	Metering	
2.	ABT compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3	2
	element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import	
	& Export), KVARH (Import & Export), Lead & Lagging VAR	
	SCADA Compatible and with standard parameter.	
3.	Test terminal block	2
	Control & Indication	
4.	Control Switch for CB Type: Spring Return with LMD, Pistol Grip	1
	Handle, 3 Pos, 10Ways	
-	Protection	1
5.	Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with	1
	the following functions, FOR 220 KV:	
	• - Control of CB, Isolators & E/S	
	Iripping Logic, Trip Matrix	
	- Measured Values	
	-LOCALHIVI Integrated Craphical LIMI	
	SID for control & supervision	
	freely configurable LEDs	
	Settings & Disturbance Information	
	Front port with indication for communication	
	 Select-before operate for heigh security 	
	 Synchrocheck & Energising 	
	-Self Supervision	
	Check	
	- Monitoring	
	- Metering	
	- Disturbance Recorder	
	- Event Recorder	
	-Communication on IEC 61850	

6.	Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with	1
	the following functions. FOR 132 KV:	-
	- Control of CB. Isolators & E/S	
	- Tripping Logic Trip Matrix	
	 Measured Values 	
	 I ocal HMI 	
	Integreated Graphical HMI	
	SID for control & supervision	
	freely configurable LEDs	
	Settings & Disturbance Information	
	Front port with indication for communication	
	 Select-before operate for heigh security 	
	- Synchrocheck & Energising	
	-Self Supervision	
	- Monitoring	
	 Metering 	
	 Disturbance Recorder 	
	 Event Recorder 	
	 Communication on IEC 61850 	
7.	Numerical relay (871) as per IEC 61850 protocol with following features:	1
	• Three winding differential	
	 Over Load Protection 	
	 Over Excitation Protection 	
	• -Restricted Earth Fault Protection (REF)	
	- Tripping Logic	
	- Disturbance Recorder	
	• -Event Recorder	
	• -LBB (Breaker failure protection)	
	• -Local HMI	
	• -Pre- Defined & configurable Inter Locking Modules (Trip	
	Logic)	
	 Transformer Trouble Functions 	
	Integreated HMI	
	Freely Configurable LEDs	
	Settings & Disturbance Information	
	Front port with indication for communication	
	• -Self Supervision	
	• -Communication on IEC 61850	
	• -Tank Protection	
8.	Numerical relay with following functions:	2 (one each
	Directional O/C & E/F protection	for HV & LV)
9.	Auxiliary relays for bucholtz trip/alarm, winding temp, high trip/ alarm	As per
	etc., for HV & LV other annunciation relay	requirement
10.	Trip circuit supervision relay	As per
		requirement
11.	DC supply supervision relay	2

12.	High Speed trip relays	As per
		requirement
13.	Supervision Relay for high speed trip relay	As per
		requirement
14.	Separate Numerical Restricted Earth Fault Protection (REF) Relay	1
	Panel Accessories	
15.	Mounted inside:	1
	• 1 no. Illumination lamp with ON/OFF switch	
	• 1 no. Space heater with switch	
	• 1 no. 3 pin 15A socket with ON/OFF switch	
	• 1 no. Earth Bus	
	• 1 set Terminal Blocks	
	• Trip Relay	
	• CB Trip Circuit Supervision Relay for 220&132KV side	
	Contact Multiplication Relays	
	• D.C. Supervision Relay	

3. BILL OF MATERIALS FOR 1 NO.220 &132 KV BUS COUPLER BAY/ 1 no. 220KV TBC BAY AS PER DOUBLE MAIN & TRANSFER BUS BAR SCHEME

Sl. No	Item Description	Qty (Set / No)
1.	Simplex Panels,, Powder Coated –Panel Dimension : as per design of	1
	original manufacturer	
	Metering:	
2.	ABT compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3	1
	element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import	
	& Export), KVARH (Import & Export), Lead & Lagging VAR	
	SCADA Compatible and with standard parameter. In case of B/C panel	
2	Energy Meter shall not be required.	1
3.	Test terminal block	l
	Control & Indication	
4.	Control Switch for CB Type: Spring Return with LMD, Pistol Grip	I
	Handle, 3 Pos, 10 Ways	
		1
5.	Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with	I
	the following functions:	
	- Synchrocheck & Energising	
	Cneck Manitaning	
	• - Monitoring	
	• - Metering	
	- Tripping Logic Disturbance Recorder	
	Event Becorder	
6	• - Event Recorder Numerical relay for directional O/C & E/E protection with built in breaker	1
0.	failure protection (I BB)	1
7	Trin circuit supervision relay	Asper
/.	The chedit supervision relay	requirement
8.	DC supply supervision relay	2
9.	Trip lock out relays	1
10.	High speed tripping	2
11.	Supervision Relay for high speed trip relay	2
	Panel Accessories	
12.	Mounted inside:	1
	• 1 no. Illumination lamp with ON/OFF switch	
	• 1 no. Space heater with switch	
	• 1 no. 3 pin 15A socket with ON/OFF switch	
	• 1 no. Earth Bus	
	• 1 set Terminal Blocks	

4. BILL OF MATERIALS FOR 1 NO. 40 MVA TRANSFORMER BAY

Sl. No	Item Description	Qty (Set / No)
1	Simplex Panel (Powder coated), Panel Dimension : As per design of	1
	original Manufacturer	
	Metering	
2	ABT compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3	2
	element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import	
	& Export), KVARH (Import & Export), Lead & Lagging VAR	
	SCADA Compatible and with standard parameter.	
3	Test terminal block	2
	Control & Indication	
4	Control Switch for CB Type: Spring Return with LMD, Pistol Grip	1
	Handle, 3 Pos, 10Ways	
	Protection	
5	Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with	2(one each for
	the following functions:	HV & MV)
	 Synchrocheck & Energising 	
	Check(RSYN,25)	
	- Monitoring	
	• - Metering	
	 Tripping Logic(PTRC,94) 	
	• - Disturbance Recorder(RDRE)	
	• - Event Recorder (RDRE)	1
6	Numerical relay (8/1) with following features:	1
	• Two winding differential	
	• - Over load Protection	
	• - Tripping Logic	
	 Disturbance Recorder 	
	• -LBB(Breaker failure protection)	
7	Numerical relay with following functions:	2
	 Directional O/C & E/F protection 	
8	Auxiliary relays for bucholtz trip/alarm, winding temp, high trip/ alarm	As per
	etc., for HV & LV other annunciation relay	requirement
9	Trip circuit supervision relay	4
10	DC supply supervision relay	2
11	High Speed trip relays	3
12	Supervision Relay for high speed trip relay	3
	Panel Accessories	
13	Mounted inside:	1
	• 1 no. Illumination lamp with ON/OFF switch	
	• 1 no. Space heater with switch	
	• 1 no. 3 pin 15A socket with ON/OFF switch	
	• 1 no. Earth Bus	
	• 1 set Terminal Blocks	

5. BILL OF MATERIALS FOR 1 NO. 33 KV FEEDER BAY & 33kV B/C BAY

Sl. No	Item Description	Qty (Set /
1.	Simplex Panel (Powder coated), Panel Dimension : As per design of	1
	original Manufacturer	-
	Metering:	
2.	ABT compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3	1
	element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import	
	& Export), KVARH (Import & Export), Lead & Lagging VAR	
	SCADA Compatible and with standard parameter.	
3.	Test terminal block	1
	Control & Indication	
4.	Control Switch for CB Type: Spring Return with LMD, Pistol Grip	1
	Handle, 3 Pos, 10Ways	
	Protection	
5.	Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with	1
	the following functions:	
	- Monitoring	
	- Metering	
	- Tripping Logic	
	- Disturbance Recorder	
6	Event Recorder	1
6.	Numerical relay with following functions:	l set
	• Non -Directional O/C & E/F protection	
/.	DC Supply supervision relay type	2
8.	There also a trip relation relay	2
9. 10	Auxiliary flog relay	1 Set
10.	Contact multiplication & lock out relay	 1Set
11.	Supervision Relay for high speed trip relay	1 set
12.	Panel Accessories	1 500
13.	Mounted inside:	1
	• 1 no. Illumination lamp with ON/OFF switch	
	• 1 no. Space heater with switch	
	• 1 no. 3 pin 15A socket with ON/OFF switch	
	• 1 no. Earth Bus	
	• 1 set Terminal Blocks	

<u>TS-8B</u>

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 220/132 kV system or higher voltage. KEMA certificate/ equivalent certificate from development center authorized by UCA working group for having products including all IEDs and Ethernet switches conforming to IEC 61850 is to be furnished.
- 1.2. The Substation Automation System (SAS) is of centralised type shall be installed to control and monitor all the sub-station. The SAS system and control relay panel should be from the same original manufacturer for better inter-phase.

Control and protection functionality on IEC-61850 standard. The Bay Control and Protection IEDs shall communicate on the IEC61850 standard for Communication Networks and shall comply with the

- ▶ IEC61850-5 for communication data modeling,
- IEC61850-6 for Sub-station Configuration Description Language for communication &
- ➤ IEC61850-7-1 to 7-4 for Data Model and Services.

The SAS shall contain the following main functional parts:

- ✤ Bay control Intelligence Electronic Devices (IEDs) for Control and Monitoring.
- Bay Protection Intelligent Electronic device (IEDs) for Protection.
- Station Human Machine Interface (HMI)
- Redundant managed switched Ethernet Local Area Network communication infrastructure with hot standby. 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.
- ✤ Gateway for remote control via industrial grade hardware (to RCC) through IEC60870-5-101 protocol. All the IEDs shall be directly connected to the Ethernet Interbay LAN without use of any gateways.
- 2 nos. Gateway shall be provided with minimum 4 Data ports, 2 nos. for IEC 101 & 2 nos. for IEC 104 protocol in each gateway for State Load Dispatch Center (to SLDC), RCC, the gateway should be able to communicate with SLDC on IEC 60870-5-101 & 104 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 SLDC system for exchange of desired data. The exact I/O point shall be decided during detailed engineering. The bidder shall ensure that proposed automation system is compatible with the existing SCADA network. The bidder will quote for the equipment required for data transfer to the existing SCADA network to interface communication equipment.
- Provision for 2 pair of modem for IEC 101 protocol should also be provided.

- Remote HMI.
- Peripheral equipment like printers, display units, key boards, Mouse etc.
- 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.
- 1.5. The communication gateway shall facilitate the information flow with remote control centres. The bay level intelligent electronic devices (IED) for protection and control shall provide the direct connection to the switchgear without the need of interposing components and perform control, protection, and monitoring functions.
- 1.6 Following information is required to be communicated to RCC/ALDC/SLDC for 220/132KV s/s.

Analog Data	
MW & MVAR	All feeders & Transformers
MWH(units) & MVAR(units)	All feeders, Transformers (220/132/11
if required by ALDC/SLDC	kV)
Voltage (kV) & Freq. (Hz.)	1 measured per Each Main Bus
Transformer Tap Position	All Transformers
Oil / Winding Temperature	For all Transformers
Digital Data	
CB- Double status information.	All Circuit Breakers
ISO- single status information.	All Bus and Line isolators
Master Trip Relays – Single Status	All feeders, Transformers, Reactors and
Information	Bus Bar
Control	Presently not Required – future if
	Required provision shall be available.

- 1.7 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 through a **Single Fault Tolerant** Ethernet LAN on fiber optic medium and shall communicate as per the IEC61850 standard. The SAS shall be equipped with Gateway for remote communication as detailed further in the specification.
- 1.8 All the numerical IEDs must be fully IEC 61850 compliant and must have the following features.
 - Have peer-to-peer communication using GOOSE messages (IEC 61850) for interlocking.
 - Should be interoperable with third party IEC 61850 compliant devices
 - Should generate XML file for integration/engineering with vendor independent SCADA systems.
 - Should be directly connected to the inter bay bus on IEC 61850 without the use of any gateways. Connections of bay protection IEDs to the IEC 61850 bus through the bay control units is not acceptable.
- 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 as given in single line diagram (SLD).

The systems shall be of the state-of-the art suitable based on IEC61850 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, selfmonitoring, signalling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

Bidder shall offer the Bay level unit (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer), bay mimic along with relay and protection panels housed in air-conditioned Station HMI in Control Room building for overall optimization in respect of cabling and control room building.

Ethernet Topology

The Ethernet communication infrastructure to ensure a certain level of quality, performance and availability at least the following described criteria's have to be fulfilled concerning the Ethernet switches and the topology.

Ethernet Switches

Ethernet switches that fulfil the hardened requirements concerning temperature, EMC, power supply (110 V DC from the Station Battery) **and complying to 61850 part 3 of the specification** suitable to be installed in substations shall be provided, i.e. the same data as common for numerical protection. The use of Ethernet Hubs is not permitted as they do not provide collision free transmission. The switches shall support priority tagging and open standards for ring management like fast scanning tree to ensure that e.g. for later system extension utility has not to rely on one switch supplier only. External switches are preferred as they have the advantage that there is no interruption or reconfiguration of the Ethernet ring if one or several bay devices are taken out of service.

2.2 System architecture

The SAS shall be based on a centralized architecture and on a concept of bay-oriented, distributed intelligence.

Functions shall be centralized, 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. But incase of Circuit Breaker SF6 Gas Pressure, Operating Mechanism Pressure (i.e. Air/ Pneumatic, Hydraulic and SF6 Pressures), if SF6 CTs are Utilizing the Pressure of SF6 Gas, Transformer / Reactor Oil/ Winding temperatures, OLTC Tap Position & Operation (not AVR) can be interfaced with BCU or any Other device interface through Transducers. These parameters shall appear in Substation Automation System at Local and RCC and should be monitored regularly.

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 realized 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 fibre optic cable shall have four (4) spare fibres.

At station level, the entire station shall be controlled and supervised from the station HMI. It shall also be possible to control and monitor the bay from the bay level equipment at all times.

Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e. RCC, station HMI, bay level or apparatus level. The priority shall always be on the lowest enabled control level.

The station level contains the station-oriented functions, which cannot be realised at bay level, e.g. alarm list or event list related to the entire substation, gateway for the communication with remote control centres. The GPS time synchronizing signal (as specified in the section relay & protection) for the synchronization of the entire system shall be provided.

The SAS shall contain the functional parts as described in para 1.2 above.

2.3 FUNCTIONAL REQUIREMENTS

The high-voltage apparatus within the station shall be operated from different places:

- Remote control centres
- ➢ Station HMI.
- Local Bay controller IED (in the bays)

Operation shall be possible by only one operator at a time.

The operation shall depend on the conditions of other functions, such as interlocking, synchro check, 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:

(a) Bus Earth switch Interlocking

(b) Transfer Bus interlocking (if applicable)

It shall be a simple layout, easy to test and simple to handle when upgrading the station with future bays. For software interlocking the bidder shall describe the scenario while an IED of another bay is switched off or fails.

A software interlock override function shall be provided which can be enabled to bypass the interlocking function.

2.3.3 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 dis-connector, 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 of Switch Gear Parameters functionality.
- ✓ Bay protection functions

For 220 & 132 KV system Backup protection

Separate IEDs shall be provided for Bay Control function (BCU) and Bay Protection function (BPU).

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
- Synchro-check, 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 Monitoring & supervision (CB SF6 Gas Pressure, CB Operating Pressure i.e. Air/ Pneumatic / Hydraulic and SF6 CTs).
- Display of interlocking and blocking
- Breaker position indication per phase
- Alarm annunciation
- Measurement display. (Electrical Parameters & Transformer/ Reactor Parameters)
- Local HMI (local guided, emergency mode)
- Interface to the station HMI.
- ✤ Data storage for at least 200 events
- Extension possibilities with additional I/O's inside the unit or via fiber optic communication and process bus

3.1.1.2. Control mode selection

Bay level Operation:

As soon as the operator receives the operation access at bay level the operation is normally performed via bay control IED. During normal operation bay control unit allows the safe operation of all switching devices via the bay control IED.

EMERGENCY Operation

It shall be possible to close or open the selected Circuit Breaker with ON or OFF push buttons even during the outage of bay IED.

REMOTE mode

Control authority in this mode is given to a higher level (Remote Control Centre) and the installation can be controlled only remotely. Control operation from lower levels shall not be possible in this operating mode.

3.1.1.3. Synchronism and energizing check

The synchronism and energizing check functions shall be bay-oriented and distributed to the bay control and/or protection devices. These features are:

- > Settable voltage, phase angle, and frequency difference.
- Energizing for dead line live bus, live line dead bus or dead line dead bus with no synchro-check function.
- Synchronizing between live line and live bus with synchro-check function

Voltage selection

The voltages relevant for the Synchro-check functions are dependent on the station topology, i.e. on the positions of the circuit breakers and/or the isolators. The correct voltage for synchronizing and energizing is derived from the auxiliary switches of the circuit breakers, the isolator, and earthing switch and shall be selected automatically by the bay control and protection IEDs.

3.1.1.4. Transformer Tap Changer control

Raise and lower operation of OLTC taps of Transformer shall be facilitated through Bay controller IED.

3.1.1.5. For Status of Transformer cooler fan & Pump at HMI required contact multiplier relay (CMR) shall be provided by bidder.

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 C&R.

3.2. System level functions

3.2.1. Status supervision

Continuous monitoring of switching objects i.e. 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 singleline 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, Max / Min values for voltage (U) and current (I) shall be calculated.

In case of Circuit Breaker SF6 Gas Pressure, Operating Mechanism Pressure (i.e. Air/ Pneumatic, Hydraulic and SF6 Pressures), if SF6 CTs are Utilizing the Pressure of SF6 Gas, Transformer / Reactor Oil/ Winding temperatures, OLTC Tap Position can be interfaced with BCU or any Other device interface through Transducers. Max / Min values for the above parameters shall be calculated. These parameters shall be appear in Substation Automation System at Local and RCC and can monitor regularly.

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, Pressure values (wherever required) and measured values including OLTC Tap Position, WTI, OTI, Hydran DGA & Analog set values.
- Control dialogues with interlocking and blocking details. This control dialogue shall tell the operator whether the device operation is permitted or blocked and Tap changer operation & Select before Execute.
- Measurement dialogues, Statistics & Trends
- Alarm list, station / bay-oriented
- Event list, station / bay-oriented
- Substation Auxiliaries
- 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 addition to above Transformer WTIs, OTI, SF6 gas Pressures of Circuit breakers, CTs and CB Operating mechanism Pressures shall also be displayed.

In order to ensure a high degree of security against undesired operation, a "select-beforeexecute" 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/Dot matrix Printer / Line Printer of 132 Column.

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.
- Hourly time Stamping

Filters for selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:

- Date and time
- ➤ Bay
- > Device
- Function e.g. trips, protection operations etc.
- ➢ Alarm class

3.2.4.7. Alarm list

Faults and errors occurring in the substation shall be listed in an alarm list and shall be immediately transmitted to the control centre. The alarm list shall substitute a conventional alarm tableau, and shall constitute an evaluation of all station alarms. It shall contain unacknowledged alarms and persisting faults. The date and time of occurrence shall be indicated.

The alarm list shall consist of a summary display of the present alarm situation. Each alarm shall be reported on one line that contains:

- \blacktriangleright 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 / SLDC / 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 hr 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, temperatures (WTIs, OTI) 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) online 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 Center / State Load Dispatch Centre (ALDC/SLDC)

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 centers (RCC & ALDC/SLDC). The substation automation system shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each remote control centre. Also, each control centre's data scan and control commands may be different for different data points within the substation automation system's database.

3.3.2 Remote Control Centre Communication Interface

Employer will supply communication channels between the Substation Automation System and the remote control centre. The communication channels provided by Employer will consist either of power line carrier, microwave, optical fiber, VSAT or leased line, the details of which shall be provided during detailed Engineering .

3.3.3 Interface equipment:

The Bidder shall provide interface equipment for communicating between Substation Automation system and Remote control centre and between Substation Automation system and Area Load Dispatch Centre / State Load Dispatch Centre (ALDC/SLDC). However, the communication channels available for this purpose are specified in section project.

In case of PLCC communication any modem supplied shall not require manual equalization and shall include self-test features such as manual mark/space keying, analogue loop-back, and digital loop-back. The modems shall provide for convenient adjustment of output level and receive sensitivity. **The modem should be stand alone complete in all respects including power supply to interface the SAS with communication channel**. The configuration of tones and speed shall be programmable and maintained in non-volatile memory in the modem. All necessary hardware and software shall also be in the scope of bidder except the communication link along with communication equipment between substation control room and Remote Control Centre.

If PLCC / Microwave / Optical fiber /VSAT/ Leased Line equipment should have Modbus or any open Protocol system and this can be connected to SAS for monitoring, Events & Alarms and password for configuration. The communication Equipment system supervision & display as mentioned in section 3.2.4.5.

If the Protection Couplers also should have Modbus or any open Protocol system and this can be connected to SAS for monitoring the send and receive commands all channels along with Events & Alarms and password for configuration. The protection coupler Equipment system supervision & display as mentioned in section 3.2.4.5

3.3.4 Communication Protocol

The communication protocol for gateway to control centre must be open protocol and shall support IEC 60870-5-101 & 104 and IEC 61850 for all levels of communication for substation automation such as Bay to station HMI, gateway to remote station etc..

4.0 System hardware:

4.1 Redundant Station HMI, HMI View Node, Remote HMI and Disturbance Recorder Work station(Laptop):

The Bidder 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 RAM, Hard Disk and Bus should latest and with maximum Values.

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. 100GB space for OWNER'S use.

Supplier shall demonstrate that the capacity of hard disk is sufficient to meet the above requirement.

4.1.1 HMI (Human Machine Interface)

The VDU shall show overview diagrams (Single Line Diagrams) and complete details of the switchgear with a colour display. All event and alarm annunciation shall be selectable in the form of lists. Operation shall be by a user friendly function keyboard and a cursor positioning

device. The user interface shall be based on WINDOWS concepts with graphics & facility for panning, scrolling, zooming, de-cluttering etc.

4.1.2 Visual Display Units/TFT's (Thin Film Technology)

The Bidder shall provide three display units, one for station HMI, one for redundant HMI and one for DR work station(Laptap). 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 25" diagonally (3:4) in size or more 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 for Dot Matrix Printer. 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 (preferably MFD).

One Dot Matrix Printer(DMP) shall be exclusively used for hourly log printing & even recording.

All printers shall be continuously online through directly or printer server.

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 i.e CD Writer & DVD Writer (Both). The unit should support at least Read (48X), Write (24X), and Re-Write (10X) operations, with Multi-Session capability. It should support ISO9660, Rockridge and Joliet 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.

The All the data pertaining to Substation is to stored in a system year/ month / day wise. The daily data is stored in a day file of Particular Month and Year automatically from 00.00Hrs to 24.00Hrs.

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. Each switch shall have at least two spare ports for connecting bay level IEDs and one spare port for connecting station bus. The necessary switches are provided for yard to communication infrastructure as follows.

- ✓ One switch shall be provided to connect all IEDs for 2 Bays of 220KV , 2 bays of 132 kV Switch yard & 8 bays of 33 KV Switch yard .
- ✓ One switch shall be provided to connect all IEDs for Bus coupler, Transfer Bus Coupler, Bus Sectionaliser and Bus bar for 220/132 kV Switch yard accommodating.

4.2 Bay level unit/Bay Control 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 220/132 KV bay (a bay comprises of one circuit breaker and associated dis-connectors, earth switches and instrument transformer). The Bay level unit shall be equipped with analogue and binary inputs/outputs for handling the control, status monitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/ local bay mimic panel, with all bay interlocks in place, during maintenance and commissioning or in case of contingencies when the Station HMI is out of service.

The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

4.2.1 Input/Output (I/O) modules

The I/O modules shall form a part of the bay level unit and shall provide coupling to the substation equipment. The I/O modules shall acquire all switchgear information (i.e. data coming directly from the switchgear or from switchgear interlocking devices) and transmit commands for operation of the switchgear.

The measured values of SF6 Gas Pressures, Operating Mechanism Pressures, WTIs, OTI, on line DGA Hydran Value is received through transducers to Bay Level Unit

The digital inputs shall be acquired by exception with 1 ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state.

4.3 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 Bidder shall provide all necessary software tools along with source codes to perform addition of bays in future and complete

integration with SAS by the user. These software tools shall be able to configure IED, add additional analogue variable, alarm list, event list, modify interlocking logics etc. for additional bays/equipment which shall be added in future.

5.0 Software structure

The software package shall be structured according to the SAS architecture and strictly divided in various levels. Necessary firewall shall be provided at suitable points in software to protect the system. An extension of the station shall be possible with lowest possible efforts. Maintenance, modification or an extension of components of any feeder may not force a 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 Bidder 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 Bidder shall provide a network management system software for following management functions:

a. Configuration Management

- b. Fault Management
- c. Performance Monitoring

This system shall be used for management of communication devices and other IEDs in the system. This NMS can be loaded in DR work-station and shall be easy to use, user friendly

and menu based. The NMS shall monitor all the devices in the SAS and report if there is any fault in the monitored devices. The NMS shall

- (a) Maintain performance, resource usage, and error statistics for all managed links and devices and present this information via displays, periodic reports and on demand reports.
- (b) Maintain a graphical display of SAS connectivity and device status.
- (c) Issue alarms when error conditions occurs
- (d) Provide facility to add and delete addresses and links
- **5.1.2.4** The Bidder 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 substation equipment installed in sheltered area in the outdoor switchyard and specified ambient conditions:

6.1 Type Tests:

6.1.1 Control IEDs and Communication Equipment:

a. Power Input:

- i. Auxiliary Voltage
- ii. Current Circuits
- iii. Voltage Circuits
- iv. Indications

b. Accuracy Tests:

- i. Operational Measurd 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 Bidder 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, two switches (i.e. for two diameter) along with all IEDs for the Dia 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 colour. The operator prompting shall distinguish between:-

- Prompting of indications e.g. fault indications in the switchgear, and

- Prompting of operational sequences e.g. execution of switching operations

The summary information displayed in the message field shall give a rapid display of alarm/message of the system in which a fault has occurred and alarm 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 110V 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 and also acrobat 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)
- Control Room Lay-out
- Test Specification for Factory Acceptance Test (FAT)
- Product Technical Manuals
- Application Manuals
- Assembly Drawing
- Operator's Manual
- Testing and Commissioning Manuals
- Complete documentation of implemented protocols between various elements
- Listing of software's 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

Bidder personnel who are experienced instructors and who speak understandable English shall conduct training. The Bidder shall arrange on its own cost all hardware training platform required for successful training and understanding in India. The Bidder 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 and per-diem expenses will be borne by the participants. *Lodging, boarding, local transport and such other charges for the engineers sent for such training shall be borne by the bidder.* The bid price offered is deemed to have included this. Training offered shall be free of cost to the owner.

The schedule, location, and detailed contents of each course will be finalized during Employer and Bidder discussions.

10.2 Computer System Hardware Course

A computer system hardware course shall be offered, but at the system level only. The training course shall be designed to give Employer hardware personnel sufficient knowledge of the overall design and operation of the system so that they can correct obvious problems, configure the hardware, perform preventive maintenance, run diagnostic programs, and communicate with contract maintenance personnel. The following subjects shall be covered:

- (a) System Hardware Overview: Configuration of the system hardware.
- (b) <u>Equipment Maintenance</u>: 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) <u>System Expansion</u>: Techniques and procedures to expand and add equipment such as loggers, monitors, and communication channels.
- (d) <u>System Maintenance</u>: 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) <u>Subsystem Maintenance</u>: Theory of design and operation, maintenance techniques and practices, diagnostic procedures, and (where applicable) expansion techniques and procedures. Classes shall include hands-on training for the specific subsystems that are part of Employer's equipment or part of similarly designed and configured subsystems. All interfaces to the computing equipment shall be taught in detail.
- (f) <u>Operational Training</u>: Practical training on preventive and corrective maintenance of all equipment, including use of special tools and instruments. This training shall be provided on Employer equipment, or on similarly configured systems.

10.3 Computer System Software Course

The Bidder shall provide a computer system software course that covers the following subjects:

- (a) <u>System Programming</u>: 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) <u>Operating System:</u> 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
- (d) <u>Diagnostics</u>: Including the execution of diagnostic procedures and the interpretation of diagnostic outputs,
- (e) <u>Software Documentation</u>: Orientation in the organization and use of system software documentation.
- (f) <u>Hands-on Training</u>: 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 Bidder shall provide a comprehensive application software courses covering all applications including the database and display building course. The training shall include:

- (a) <u>Overview:</u> Block diagrams of the application software and data flows. Programming standards and program interface conventions.
- (b) <u>Application Functions:</u> Functional capabilities, design, and major algorithms. Associated maintenance and expansion techniques.
- (c) <u>Software Development:</u> Techniques and conventions to be used for the preparation and integration of new software functions.
- (d) <u>Software Generation</u>: Generation of application software from source code and associated software configuration control procedures.
- (e) <u>Software Documentation</u>: Orientation in the organization and use of functional and detailed design documentation and of programmer and user manuals.
- (f) <u>Hands-on Training</u>: 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 Bidder 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 Bidder shall take continual actions to ensure the guaranteed availability and shall make available all the necessary resources such as specialist personnel, spare parts, tools, test devices etc. for replacement or repair of all defective parts and shall have prime responsibility for keeping the system operational.

12.0 RELIABILITY AND AVAILABILITY

The SAS shall be designed so that the failure of any single component, processor, or device shall not render the system unavailable. The SAS shall be designed to satisfy the very high demands for reliability and availability concerning:

- Mechanical and electrical design
- Security against electrical interference (EMI)
- High quality components and boards
- Modular, well-tested hardware
- Thoroughly developed and tested modular software
- Easy-to-understand programming language for application programming
- Detailed graphical documentation and application software
- Built-in supervision and diagnostic functions
- ✤ Security
 - ➢ □Experience of security requirements
 - ➢ □Process know-how
 - \blacktriangleright \Box Select before execute at operation
 - ▶ □Process status representation as double indications
- Distributed solution
- Independent units connected to the local area network
- ✤ Back-up functions
- Panel design appropriate to the harsh electrical environment and ambient conditions
- Panel grounding immune against transient ground potential rise

Outage terms

1) Outage

The state in which substation automation system or a unit of SAS is unavailable for Normal Operation as defined in the clause 7.1 due to an event directly related to the SAS or unit of SAS. In the event, the owner has taken any equipment/ system other than Substation 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 $\frac{1}{4}$ th of an hour. Time less than $\frac{1}{4}$ th of an hour shall be counted as having duration of $\frac{1}{4}$ th of an hour.

3) Period Hours (PH)

The number of hours in the reporting period. In a full year the period hour are 8760h (8784h for a leap year).

4) Actual Outage hours (AOH)

The sum of actual outage duration within the reporting period AOH = \sum AOD

5) Availability:

Each SAS shall have a total availability of 99.98 % i.e. the ratio of total time duration minus the actual outage duration to total time duration.

12.1 Guarantees Required

The availability for the complete SAS shall be guaranteed by the Bidder. Bidder shall include in their offer the detailed calculation for the availability. The Bidder 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 Bidder 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 Bidder 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 Bidder 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 Bidder till the SAS is taken over by the owner. .

13.2 Availability of 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 Bidder shall be made available to the Bidder 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 Bidder. However, any additional spares required to meet the availability of the system (which are not a part of the above spares supplied by the Bidder) would have to be supplied immediately by the Bidder free of cost to the Employer.

14.0 LIST OF EQUIPMENTS

ii)

Quantity of equipments shall be decided by bidder in order to achieve guaranteed reliability and availability as declared by bidder.

- Station HMI (in Hot-stand by mode) of Latest Configuration and Latest OS Software with CD & DVD Multilayer Read, write, Rewrite with Possible all types of formats, Hard disk capacity of 320GB, Key Board, Optical Mouse, integrated VGA, Integrated LAN, 25" or More TFT Monitor (4:3 Screen).
 - Disturbance Recorder Work Station (Maintenance HMI/Laptop)
- iii) List of Printers with / without Printer server
 - 1. Laser Printer (A-4) with MFD 1 No. (Print, Scan, Fax & X-erox) (For Reports & Disturbance records)

- 2. Dot matrix printer Multi sheet paper Model preferably TVS 5 in 1 Printer (For log sheets, regular parameters at 15 min duration, alram and sequence of the events).
- 3. Necessary Furniture.
- iv) All interface equipment for 2 nos. gateway to RCC and ALDC/SLDC, 2 Ports for RCC & 2 Ports for ALDC/SLDC at each gateway.
- v) Communication infrastructure between Bay level units, Station HMI, Printers, gateways, redundant LAN etc. as required.(FO Cables) as required.
- vi) BCUs/RTUs for Sub Station Auxiliaries.
- vii) 2 pair of modem for IEC 101 protocol.
- viii) Any other equipment required to monitor and control the parameter of all the transformer through SCADA.
- ix) Any other equipment as necessary.

Specification of Main control room

15.0 Construction:

15.1 Main control room :

- a. The size of control room building will be as per approved drawing, it will consist of SAS panel, RTCC panel, ACDB, Battery charger & DCDB.
- b. The size of battery room will be as per approved drawing, it will consist of batteries.
- c. The size of office will be as per approved drawing with toilet.

16.0 Air-Conditioning:

The redundant air conditionings system shall be used for housing panels having control and protection IED's for performing sub-station automation and protection functions generally confirm to relevant IS codes as *detailed in section GTR*.

i. Operation:

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, shall be installed with environment control system comprising of two units of air conditioners working in conjunction through a micro processor based controller for desired operation. The system shall be designed for 24 Hours, 365 Days of the year to maintain the inside temperature for proper operation of the critical equipment. One of the air-conditioner shall be running at a time and on failure of the same or as described hereunder, the other unit shall start automatically. To ensure longer life of the system, the redundant units shall also be running in cyclic operation through the controller. However, during running of one air-conditioner unit, if inside temperature of the shelter reaches to a predefined (i.e. $23 \pm 2^{\circ}$ C) and gives alarm for such situation. After achieving this temperature, the other unit shall again shut off.

ii. Sequence of Operation of the Unit:

Suitable arrangement shall be made to operate the unit in the following order. However, the actual operation arrangement shall be finalised during detailed engineering.

- 1. Evaporator Fan
- 2. Condenser Fan

3. Compressor

iii. Construction:

The air conditioning unit shall be completely self-contained. All components of the units shall be enclosed in a powder coated cabinet and colour of same shall be matched with colour. The unit shall be assembled, wired, piped, charged with refrigerant and fully factory tested as a system to ensure trouble free installation and start up. Suitable isolation or other by passing arrangement shall be provided such that any unit/component could be maintained / repaired without affecting the running standby unit

iv. Required Features of Various Components:

The compressor shall be very reliable, trouble free and long life i.e. hermitically sealed Scroll type of reputed make suitable for operation. Compressor should be installed on vibration isolated mountings or manufacturer's recommended approved mounting. Valve shall be provided for charging/topping up of refrigerant. The bidder shall furnish details of their compressor indicating the MTBF, life of compressor and continuous run time of compressor without failure. The Bidder shall also furnish details of all accessories i.e. refrigeration system, evaporator coil, condenser coil, evaporator blower filter, cabinet, indoor supply and return grill etc.

Appendix-I Part-III

INTEROPERABILITY PROFILE OF IEC 60870-5-101 PROTOCOL FOR WR

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Certain parameter values, such as the number of octets in the COMMON ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters. The selected parameters should be marked in the white boxes as follows:

- □ Function of ASDU is not used
- Function or ASDU is used as standardized (default)

Note : In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

1.1 SYSTEM or DEVICE

(System-specific parameter, indicate the definition of a system or a device by marking one of the following with an 'X')

□ System definition

- □ Controlling station definition (master)
- Controlled station definition (Slave)

1.2 NETWORK CONFIGURATION

(Network-specific parameter, all configurations that are used are to be marked with □)

■ Point-to-point ■ Multipoint-party line

□ Multiple point-to-point □ Multipoint-star

1.3 PHYSICAL LAYER (Network-specific parameter)

Transmission speed (control direction) :

Unbalanced interchange	Unbalanced interchange	Balanced interchange
circuit V.24/V.28	circuit V.24/V.28	circuit X.24/X.27
Standard	Recommended if >1 200 bi	t/s
□ 100 bit/s	□ 2 400 bit/s	□ 2 400 bit/s
□ 200 bit/s	□ 4 800 bit/s	□ 4 800 bit/s
■ 300 bit/s	□ 9 600 bit/s	□ 9 600 bit/s
■ 600 bit/s		□ 19 200 bit/s
■ 1 200 bit/s		□ 38 400 bit/s
(for unbalanced transmiss	ion only)	□ 56 000 bit/s
		□ 64 000 bit/s

Transmission speed (monitor direction) :

Unbalanced interchange	Unbalanced interchange	Balanced interchange
circuit V.24/V.28	circuit V.24/V.28	circuit X.24/X.27
Standard	Recommended if >1 200 b	it/s
□ 100 bit/s	□ 2 400 bit/s	□ 2 400 bit/s
□ 200 bit/s	□ 4 800 bit/s	□ 4 800 bit/s
■ 300 bit/s	□ 9 600 bit/s	□ 9 600 bit/s
■ 600 bit/s		□ 19 200 bit/s
■ 1 200 bit/s		□ 38 400 bit/s
(for unbalanced transmission only)		□ 56 000 bit/s
-		□ 64 000 bit/s

1.4 LINK LAYER (Network-specific parameter)

Frame format FT 1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.

Link transmission procedure

Address field of the link

□ Balanced transmission

□ Not present (balanced transmission

only)

- Unbalanced transmission
- One octet
- \square Two octets
- \Box Structured
- Unstructured

Frame length

255 Maximum length L (number of octets) 1.5 APPLICATION LAYER

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter)	
■ One octet	□ Two octets

Information object address

(system-specific parameter)
□ One octet
□ Structured
■ Two octets
■ Unstructured
□ Three octets

Cause of transmission

(system-specific parameter)

■ One octet

□ Two octets (with originator address)

Selection of standard ASDUs

(station-specific parameter)

\blacksquare <1> := Single-point information	M_SP_NA_1
\blacksquare <2> := Single-point information with time tag	M_SP_TA_1
$\blacksquare <3> :=$ Double-point information	M_DP_NA_1
\blacksquare <4> := Double-point information with time tag	M_DP_TA_1
$\Box <5> :=$ Step position information	M_ST_NA_1
$\Box <6>:=$ Step position information with time tag	M_ST_TA_1
$\blacksquare < 7> :=$ Bitstring of 32 bit	M BO NA 1
$\square < 8 > :=$ Bitstring of 32 bit with time tag	M_BO_TA_1
■ <9> := Measured value, normalized value	M_ME_NA_1

 <10> := Measured value, normalized value with time tag <11> := Measured value, scaled value <12> := Measured value, scaled value with time tag <13> := Measured value, short floating point value <14> := Measured value, short floating point value with time tag <15> := Integrated totals <16> := Integrated totals with time tag <17> := Event of protection equipment with time tag <18> := Packed start events of protection equipment with time tag <19> := Packed output circuit information of protection equipment time tag <20> := Packed single-point information with status change dete <21> := Measured value, normalized value without quality description 	M_ME M_ME M_ME M_ME M_IT M_IT M_IT M_EP of M_E of M_E of M_E ction	E_TA_1 E_NB_1 E_TB_1 E_NC_1 E_TC_1 TA_1 TA_1 P_TB_1 TC_1 M_PS_NA_1 M_ME_ND_1
Process information in control direction		
(station-specific parameter)		
 <45> := Single command <46> := Double command <47> := Regulating step command <48> := Set point command, normalized value (required only for analog output command)* <49> := Set point command, scaled value <50> := Set point command, short floating point value <51> := Bitstring of 32 bit 	C_SC C_DC C_RC C_SE C_SE C_SE C_SE	_NA_1 _NA_1 _NA_1 _NA_1 _NA_1 _NB_1 _NC_1 _NA_1
System information in monitor direction (station-specific parameter)		
\blacksquare <70> := End of initialization	M_EI_	_NA_1
System information in control direction		
(station-specific parameter)		
 <100> := Interrogation command <101> := Counter interrogation command <102> := Read command <103> := Clock synchronization command (optional, if GPS is used for time synch. of the RTU)* <104> := Test command <105> := Reset process command <106> := Delay acquisition command (optional, if GPS is used for time synch. of the RTU)* 	C_IC C_CI C_RD C_CS C_TS C_TS C_RP C_CD	NA_1 NA_1 NA_1 NA_1 NA_1 NA_1 NA_1 NA_1
Parameter in control direction		
(station-specific parameter)		
 □ <110> := Parameter of measured value, normalized value □ <111> := Parameter of measured value, scaled value □ <112> := Parameter of measured value, short floating point value □ <113> := Parameter activation 	P_ME P_ME e P_ME P_AC	_NA_1 _NB_1 _NC_1 _NA_1

File transfer (for downloading of database from RLDC, may not be required)* (station-specific parameter)

	_ 1
$= <121> := Section ready \qquad F_SR_NA$	
■ $<122> :=$ Call directory, select file, call file, call section F_SC_N	_ 1
$\blacksquare <123> := Last section, last segment F_LS_NA$	<u>1</u>
$\blacksquare < 124 > := Ack file, ack section \qquad F_AF_N.$	_ 1
$\blacksquare <125> := Segment \qquad F_SG_N.$	_ 1
$\Box < 126 > := \text{Directory} \qquad F_D \overline{P_T}$	_ 1

1.6 BASIC APPLICATION FUNCTIONS

Station initialization

(station-specific parameter)

Remote initialization

General interrogation

(system or station-specific parameter)

- Global
- Group 1
- Group 2
- Group 3
- Group 4 ■ Group 5
- Group 6
- Group 9 ■ Group 10 ■ Group 11 ■ Group 12

defined

■ Group 7

■ Group 8

■ Group 16 Addresses per group have to be

■ Group 13

■ Group 14

■ Group 15

Clock synchronization

(station-specific parameter)

■ Clock synchronization (optional, if GPS is used for time synch. of the RTU)*

Command transmission (Required only when control command is envisaged)* (object-specific parameter)

- □ Direct command transmission □ Direct set point command transmission

No additional definition

Short pulse duration (duration determined by a system parameter in the outstation) Long pulse duration (duration determined by a system parameter in the outstation) Persistent output

Transmission of integrated totals

(station or object-specific parameter)

- Select and execute command
- Select and execute set point
- \Box C SE ACTTERM used

- Counter request
- Counter freeze without reset
- Counter freeze with reset
- □ Counter reset

- □ General request counter
- \Box Request counter group 1
- \square Request counter group 2
- \Box Request counter group 3
- \Box Request counter group 4

Addresses per group have to be defined

Parameter loading

(object-specific parameter)

 $\hfill\square$ Threshold value

- \Box Smoothing factor
- □ Low limit for transmission of measured value
- □ High limit for transmission of measured value

Parameter activation

(object-specific parameter)

□ Act/deact of persistent cyclic or periodic transmission of the addressed object

File transfer (station-specific parameter)

File transfer in monitor direction
 File transfer in control direction (*For downloading of database from RLDC, May not be required*)*

ADDITIONAL INFORMATION ON IEC 60870-5-101 FOR WRLDC

A. Telemetred Data and ASDU mapping

The following table explains the type of the telemetred data and corresponding ASDUs used to transmit this data as per IEC 60870-5-101 protocol

Type of	Data Unit	Description	Data polling	Scan group	Transmitted	Info Obj.
power system	type as	as per IEC	method		after Class-	Address
Data	per IEC				X request	range
Analog inputs	ASDU-9	Measured	By periodic	Group-3	Class 2	3001-4000
(P,Q, V, f)		value	Group scan			
		normalized				
		value				
Digital inputs	ASDU-1	Single point	By exception	Group-1	Class 1 after	1-1000
 Single status 		information	(spon-		exception,	
(Isolators,			taneous) and		Class 1 after	
Protection			on periodic		Group 1 scan	

Signals)			Group scan			
	ASDU-2	Single point	By exception		Class 1 after	1001-2000
	(for SOE)	information	(spon-		exception	
		with time	taneous)			
		tag				
Digital inputs – Double status (Circuit breaker)	ASDU 3	Double point information	By exception (spon- taneous) and on periodic Group scan	Group 2	Class 1 after exception, Class 1 after Group 1 scan	2001-3000
	ASDU-4	Double point information with time tag	By exception (spon- taneous)		Class 1 after exception	Same address range as above
Pulse accumulators	ASDU-15	Integrated totals	By periodic counter interrogation	Group-1 (counter interro- gation)	Class 2	5001-6000
Analog Outputs (Setpoint)	ASDU-48	Set point command Normalized value				
Digital Control command (CB Trip/Close)	ASDU-45	Single command				
Digital Control command (CB Trip/Close)	ASDU-46	Double command				

B. DATA POLLING METHOD

- 1. The RTU shall respond to the Master stations request for the at least the following commands as per the protocol:
 - Status of Link
 - Reset of Link
 - Delay acquisition command *
 - Clock synchronization command *
 - General interrogation command
 - Interrogation of Scan group 1 command (all single status digital data)
 - Interrogation of Scan group 2 command (all double status digital data analog data)
 - Interrogation of Scan group 3 command (all analog data)
 - Class ¹/₂ data polling

If supervisory control commands are envisaged, then SBO procedure is to be used.

2. Normal data polling is by Scan groups

3. All single digital inputs are assigned to Scan group-1, all double digital inputs are assigned to Scan group-2 and all Analog values are assigned to Scan group-3

4. Analog values are acquired periodically by using the Scan group-3 polling. This periodicity is ranging from 10-15 seconds based on the quantity of analogs and the communication channel bandwidth.

5. Digital input state changes are reported spontaneously by RTU as class 1 data and a integrity scan is performed for all the digital inputs using Scan group-1 and Scan group-2 at every 10 minutes interval.

* These features may not be required

Appendix-I

Part-IV Sub-station Automation System Rev 03

Sub-station Automation System Rev 03 Sub-station Automation System Rev 03

Sub-station Automation System Rev 03 Sub-station Automation System Rev 03

Appendix-II

Technical Specification – Sub-station Automation System Rev 03 Page 1 of 1

List of IO Points to be transmitted to RSCC

a) MW and MVAR for all lines , transformers ,reactors and Capacitors

- b) Voltage of all buses
- c) Frequency of all 400Kv and 765kV Buses
- d) Frequency of one 220Kv Bus
- e) All Breakers
- f) All isolators
- g) Tap Position for all transformers
- h) Master protection signal for all feeders, transformers Units and Bus Bar
- i) Loss of Voltage signal for Bus bar
- j) All the points identified in point (e),(h) and (i) above as GPS Time stamped.
- k) Temperature value per substation.
- 1) Any other point decided during detailed engineering

8. Bill Of Material For Substation Automation System

Sl No	Item Description	Qty No.	
1.	 Simplex type panels equipped with the following: Micro SCADA Pro based Control and monitoring system, including system configuration, database engineering, IEC 61850 communication system. The following hardware is included: 2 nos. : of HP/Dell/Compaq/Laxsons/equivalent make Industrial Grade PC with latest Processor, 2GB RAM, 1 x 320 GB HDD, 1x 24x DVD Combo Drive, OS: Latest for station servers. Managed IEC 61850 compliant 16/8 port Ethernet switches for inter bay bus LAN connected in fault tolerant ring configuration, including fiber optic cable. Ino DR workstation. Ino. Remote HMI. 1 no. APC/equivalent UPS with 30 mins battery backup (1x1000VA) 1 no: 80 column Dot Matrix Printer incl. cable 	No. 1 set As per scheme	
	 1 no A4 size Laser Printer for Graphics & reports Functionality 		
	All Basic Monitoring functions		
	All Basic Control functions		
	 Advanced monitoring functions: Measuring reports and trends Remote parameter setting and reading Uploading disturbance fault record files Disturbance record analysis 		
	Communication with RLDC integrated gateway on IEC101/104 protocol. Communication with DCS of Power plant.		
	Advanced control functions: Automatic sequence control		
2.	GPS receiver on SNTP protocol including antenna and cable with following ports for time synchronization:	1 set	
	 RJ45 - 2 nos. RS232 port - 1 no 		
3.	FO Cables for connecting IEDs to Switches	1set	

ROTATIONAL UNDER FREQUENCY RELAY PANEL

The Rotational Under Frequency Panel having logic controls system programmable for load shedding of various feeders at S/s at different frequencies as well as rate of change of frequency shall also be provided as per following bill of material.

1. PLC System

- SLC 5/03 (CPU) Module	1 Set
- Power Supply	1 No.
- 4 Slot I /O Rack	1 No.
- 4 Ch. Analog I/O Module	1 No
-16 Ch. Digital I/P Module 24 VDC	1 No
- Channel Output Module Relay	1 No
- EEPROM Memory Module	1 No
- Isolator Transformer	1 No
- Noise Filter	1 No

2. PLC Panel

3.

-		
-	Wiring of cabinet for PLC System of 14 Gauge CRC sheet duly painted	1 No
	Space for PLC ICAM bardware	1 No
-	The Deferre (Centre stere Ceil Velt	1 NU
-	220/110/48 VDC	ΙΝΟ
-	110V PT fail Relay	1 No.
-	Contractors DC fail Relay (Main)	1 No
-	Main DC fail Relay	1 No
-	Terminal lugs, ferrule , PVC channel Wire, terminal block, fusible terminal	
	Block, MCBs, indicators glass relays etc.	1 Set
	For completion of the under	
	frequency	
	relay panel	
Under	Frequency Relays	1 No.
-	Make	ABB/ Siemens/ other standard make
-	Cat. No.	
-	Frequency setting range	45 –to- 55 Hz
-	Least Count	0.0 1 Hz
-	Input AC Voltage	110 VAC
-	Relay operation Voltage	30% -90% of UN
-	DC Auxiliary Supply	110 V
-	Output Contacts	Four no for trip
		Four no for alarm

Inherent time delay	Not more than 100 ms
Time delay over inhere time delay	Settable from front face
Immunity	Immune to harmonics & transients
Trip indications	On face of relay
DF/DC stage	Four stages each stage programmable for flat of df/dt
DF/DT settings	0.1 Hz/Sec -9.9 Hz /sec
Mode of operation	Rate of fall
Operation delay	Settable from front face

WORKING PRINCIPLE OF ROTATIONAL LOAD SHEDDING SYSTEM

- 1. At any given day, if frequency falls to 48.1 Hz level, a load of substantial MW will be shed anywhere in the system depending on the time of the day.
- 2. The load shedding can take place by tripping a group of feeders from the substation. The group is so selected, that 120MW is shed. At a time, in the entire system only this quantum of load shedding can be carried out.
- 3. The shedding for a group can be for a maximum period of up to one hour "slot". In case frequency recovers, power can be switched on. Nevertheless if frequency sinks again, the power can trip again, but not beyond 1 hour slot. Thus in one hour's slot, if frequency improves, closing of breaker can be permitted as many times as and when frequency recovers.
- 4. The feeder tripped once during its slot time (1 hour), will not trip again if frequency sinks to 48.1 Hz but shedding will shift to another batch of feeders in the same station or some other station, in the next slot of 1 hour, depending on the time of the day.
- 5. Efforts will be made so that a group of feeders will trip only twice in a day. To achieve this, 12 groups have been formed and each group will be effected for one hour slot and shedding will repeat after 12 hours if frequency falls to 48.1 Hz. Thus, this programme is highly selective in nature and will cause minimum power interruption to every consumer. The complaint of continuous load shedding to a particular group of people/area will also be avoided.
- 6. The arrangement is such that the same group of feeders i.e. in a particular area does not suffer repeatedly, in the event of under frequency conditions. Instead the shedding is shared equally by all consumers or areas.



- 7. It may also be possible to rotate the shedding programme automatically so that a particular does not suffer constantly at the same time on all days. Instead a shift of 1 hour has been arranged so that all consumers undergo similar type of inconvenience. After 12 days of rotation, the shedding will come to its original state. An example of rotation is displayed in Figure 1.
- 8. It is also possible to incorporate another shedding programme pertaining to the next stage of under frequency i.e. at 48.0 Hz when additional about 300 MW is required to be shed. In this programme it will be possible to incorporate the second stage of under frequency control by way of clubbing tow groups either in one station or in different stations so that a total amount of about 420 MW is shed.

The programme runs for 14 days. There are 12 groups explained above and each groups remains off for 2 hours, thus covering 24 hours of each day. To cover 12 groups in 14 days it becomes necessary to cover the distance between 14-12= 2 days. This is done by giving rest to each group after 6 days i.e. twice in a fortnight when covers all the 14 days. Thus a marix of 14/12 is coverd.
TECHNICAL SPECIFICATIONS FOR BUS BAR PROTECTION SYSTEM

1.0 SCOPE

This specification covers design, inspection and testing, supply, and commissioning of Stand Alone type numerical bus bar protection system with integrated disturbance recorder, event logger etc. to be incorporated in existing 220kV transmission substations of UPPTCL, utilizing 3-phase bay wise current measurement through CT secondary current of 1 A, with biased current differential relaying, implementable without the need of replacing the purchaser's existing instrument transformers with specific current and voltage transformers. Also, the scheme offered shall be viable for single main and transfer bus, split bus, or double main and transfer bus without requiring any modification by the purchaser.

However, auxiliary relays, trip relays, flag relays and multi tap auxiliary CTs (for biased differential protection), if required, including necessary programming and system software, shall be deemed to have been covered under the scope of this specification.

2.0 DESIRED FEATURES

- 2.1 The design shall have a distributed layout whereby either a standard rack mounted or a flush mountable stand alone cubicle shall be vermin ,moisture and dust proof and shall be provided to house
 - a. Bay wise independent units (Peripheral units) for accessing bay parameters. These bay units or peripheral units shall accept analogue inputs of CT currents, VT voltages, Circuit breaker and Isolator contacts.
 - b. All peripheral units (Bay units) with in a substation shall be interfaced with the Central Control Unit via an OFC link.
 - c. Local breaker back up protection shall also be provided within, subject to jurisdiction of 3.4 below, as an integrated system.
 - d. For fool proof measurements, two separate samples shall be drawn by the peripheral units as main and check samples. These samples shall then be processed through different algorithms and preferably by different processors so as to accurately arrive at a correct tripping decision within a time of not more than 15 ms., as per contact dependency indicated at 3.9.
- 2.2 The Central Control Unit (2.1b) above, shall also provide for an optical or LAN (RJ-45) output which shall essentially comply to IEC 61850 communication protocol.
- 2.3 Selective detection of faults shall be provided for bus faults on main and transfer bus.
- 2.4 The system shall be powered with available two sources of 110V/220V DC Supplies in substations respectively. In the event of failure of any one DC source, the system shall automatically changeover to the second source.
- 2.5 Numerical Bus Bar protection shall be with extensive self supervision and diagnostic facilities.

2.6 The system shall allow reading of status of respective bay.

3.0 TECHNICAL REQUIREMENT

- 3.1 The independent bus bar protection scheme shall not be of any manufacturer specific design.
- 3.2 The scheme /equipments supplied under this specification shall be fully interchangeable at the cubicle level.
- 3.3 The Central Control Unit shall be capable of system configuration via a PC. It shall also be compatible for communication to a SCADA system without requiring a proprietary protocol. Any proprietary protocol externally converted to IEC 61850 with the help of a protocol converter to be used for communication with an outside network shall not be acceptable.
- 3.4 The breaker failure protection, as per 2.1 c above shall selectively trip the affected bus-bar section with the faulty circuit breaker with selective pick-up.
- 3.5 The offered scheme shall, in no way, necessitate the need of any on site modification of existing control and protection panels, except to the extent of tapping the analogue inputs essentially required for individual bay control equipment.
- 3.6 The design shall require each bay unit to be separately powered with an available DC source of 220V DC/110V DC. The Central Computing Unit shall not be connected with the same DC bus. The design shall include continuous DC supervision.
- 3.7 Available substation DC supply shall be suitably filtered and step down voltages shall not use resistive networks as far as possible.
- 3.8 The system shall take care of all harmonics and transients established to appear due to switching surges arising out of capacitor bank switching and circuit breaker switching.
- 3.9 Main and Check zone sample drawl as per 2.0 d above shall be isolator status dependent for main zone , and isolator independent for the check zone.
- 3.10 Easy by-pass switch for bay maintenance/bus-bar protection out shall also be provided allowing manually selectable bus protection IN / OUT for each zone.
- 3.11 The bus bar protection should be suitable for through faults upto 40kA with a suitable margin for safety. The primary fault setting (pick up value) of the protection should be independent of the number of feeders and highest loading of any feeder.
- 3.12 The circuit breakers are single pole operated having 2 trip coils for each phase. The scheme shall provide 2 sets of independent tripping contacts for both trip coils on each pole. The high speed tripping relays (two per circuit breaker) should have at least 18 N/O and 6 N/C hand reset contacts. The make carrying and breaking capacity of contacts should be sufficient to handle the tripping circuits of circuit breakers. The operating time of the tripping relays should not exceed 10 milli seconds. Individual tripping relays for bus coupler and transfer breakers shall be provided.

- 3.13 Any type of fault on the bus bar shall result in three phase lock out tripping. Suitable interlocks will be provided to prevent operation of the main protections in the event of a fault on the image bus bar.
- 3.14 The bus bar protection shall not mal-operate or non-operate due to CT saturation during external faults or internal faults. Any special measure required for this purpose shall be part of the scheme. 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. Shall be capable of accommodating different CT ratios of upto 50% to 200% of the base CT ratio. Zone CT selection shall be through Isolator replica without uses of external CT switching relay.

4.0 SYSTEM FEATURES

- 4.1 Contact voltages of both N/O and N/C isolator contacts shall be monitored using pulses.
- 4.2 Operational indicators such as, but not limited to, shall be provided for isolator status errors, loss of auxiliary contact voltage, alarms, bus short circuit fault, Circuit Breaker failure, etc. Shall be logged in separate registers.
- 4.3 Time synchronization between peripheral units, and also with the central unit shall be feasible by means of IEC 61850 communication link / IRIG-B and GPS.
- 4.4 The central unit of offered bus-bar protection system shall have provision of available 220kV bays (including bus coupler and transfer bus coupler) at substation along-with spare 3nos bays. Similarly offered bus-bar protection system shall have peripheral bay unit as available 220kV bays (including bus coupler and transfer bus coupler) at substation with spare 3nos peripheral unit alongwith separate Trip Relays . Supply of complete programming software required for relays shall be in the scope of Tenderer.
- 4.5 The system shall allow adaptive protection so as to follow changes in network configuration or network independent system shall be provided.
- 4.6 All terminals shall be clearly marked with identification mark to facilitate connection to external wiring. Terminal block shall have shorting and disconnecting arrangement for testing of CT circuits.
- 4.7 The Bus bar Protection shall include a Disturbance Recorder function in each bay unit which shall record the bay phase currents.
- 4.8 The Bus bar Protection shall also include an Event Recorder function.
- 4.9 The Disturbance Recorder and Event Recorder buffer memory shall be of non volatile type and shall not require the use of batteries.
- 4.10 It shall be possible to prepare the bus bar protection to include, in the protection scheme, future bays as and when they are added. In such cases, the system shall be easily extendable by adding Bay units for the new bays and activating the same in the Bus bar Protection. Such extension work shall not require any other wiring changes to the existing system.

<u>TS-9</u>

TECHNICAL SPECIFICATIONS FOR MICROPROCESSOR BASED THREE PHASE FOUR WIRE 0.2s ACCURACY CLASS STATIC ELECTRONIC ABT TYPE TRIVECTOR ENERGY METERS

1.0 <u>SCOPE</u>

This specification covers the design, engineering, manufacturing, assembly, and testing before supply and delivery at site supply, installation, testing at site and successful commissioning CT and VT operated microprocessor based 3-phase 4-wire metering system with 0.2s accuracy class energy meters, associated essential equipments, along with accessories, and associated Base Computer Software (as detailed in this specification) One static type composite meter along with one check meter shall be installed for each circuit, as a self-contained device for measurement of power transmittals, as described herein, in each successive 15 minute block, and certain other functions, detailed in the following paragraphs.

All meters shall be capable for implementing the Availability Based Tariff (ABT) on user configurable data.

The metering system shall be capable for transferring all the required metering data of each substation to remote computers on line and on real time basis, (supply of computers is not under the scope of this specification) to a central location, as per requirements of Meter Polling Software enclosed herein.

The metering system shall include a MODEM also for transferring all the relevant metering data of each substation to remote computers. (Supply of computers is not under the scope of this specification and shall be arranged by the purchaser) via GPRS/Optical fibre, using standard protocols.

1.1 The material shall, however, conform in all respects to the best industry standards of engineering, design and workmanship and shall be capable of performing for 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 in all respects including all components, accessories and devices for effective and trouble free operation according to the specifications. Such components, devices, software, time correction utility etc., shall be deemed to be within the scope of contractor's supply irrespective of whether they are specifically brought out in the scope of supplies, or not.

If desired, the supplier may be required to coordinate with the prospective SCADA vendor to ensure that the supplied meters are successfully integrated with the purchaser's communication system.

2.0 <u>APPLICABLE STANDARDS</u>

2.1 STANDARDS FOR METERS

2.2

The meters shall conform (for testing, performance and accuracy) in all respects the relevant Indian/International standards with latest amendments thereof unless otherwise specified. **IEC: 687-1992** - Alternating Current Static watt-hour meters for measurement of active energy, class 0.2.

CBIP Technical Report No. 88 (read with latest amendments issued) – specifications for AC Static Electricity Energy Meters.

IEC:1268 (1995) Alternating Current Static VAr hour meters for reactive energy.

IS:14697 (1999) AC static transformer operated Watt-hour and VAR-hour meters for class 0.2s and 0.5s.

IS:15959:2011 – Indian standard for Data exchange for Electricity Meter Reading, Tariff and Load control- Companion specification.

Degree of Protection – IS :12063

Climatic Proofing of Electrical Equipment – IS: 3202.

Color for ready mixed paints **IS:5** (For Metering Cubicles)

3.0 <u>SERVICE CONDITIONS</u>

The meters to be supplied against this specification shall be required to operate satisfactorily, accurately and continuously under the following tropical conditions of hot, humid, dusty, rust and fungus prone environment.

i.	Location	At 400/220/132kV
		Sub Stations in Uttar Pradesh
ii.	Max. ambient air temperature (° C)	50
iii.	Min. ambient air temperature (° C)	2
iv.	Average daily ambient air temp. (° C)	32
v.	Max. Relative Humidity (%)	74
vi.	Max. Altitude above mean sea level (m)	1000
vii.	Average Annual Rainfall (mm)	1200
viii.	Max. wind pressure (Kg / Sq.m)	195
ix.	Isoceraunic level (days per year)	50
х.	Seismic level (Horizontal Accn.)	0.3 g

4.0 PRINCIPAL PARAMETERS

The energy meters shall be indoor/outdoor type connected with the secondary side of out door current and voltage transformers.

<u>Sl.No.</u>	Item	<u>Specification</u>
i.	Type of Installation	Indoor
ii.	CT secondary	1 A
iii.	VT secondary	110 V/ $\sqrt{3}$ Volts
iv.	System frequency	50HZ <u>+</u> 5%
v.	Earthing System	Solidly Grounded

5.0 <u>TECHNICAL REQUIREMENTS</u>

5.1 The meters shall be suitable for being connected directly through its terminal block to voltage transformers (VTs) having a rated secondary line- to- line voltage of 110 V, and to current transformers (CTs) having a rated secondary current of 1A. Any further transformers/transducers required for their functioning shall be in-built in the meters. Necessary isolation and/or suppression shall also be built-in, for protecting the meters from surges and voltage spikes that occur in the VT and CT circuits in extra high voltage switchyards.

5.2 The active energy (Wh) measurement shall be carried out on 3 phase, 4 wire principle with an accuracy as per class 0.2 of IEC –687 1992-06 (Second edition). The energy shall be computed directly in CT and VT secondary quantities, and indicated in watt-hours. The meters shall compute the active energy and load import (W & Wh), active energy and load export (W & Wh) from the substation bus bars during each successive 15 minute block, and store it in its memory. It shall also display on demand the 15 - minute energy (Wh) (Import and Export Shall be displayed in separate registers, or with a +/- sign) for the previous 15-minute block. Additionally, the meter shall also display cumulative active energy import (Wh) and active energy export (Wh) using same option.

Meters shall be suitable for working under balanced / unbalanced loads at full power factor range i.e. Zero lag-Unity-Zero lead. The display shall preferably indicate direct values without having to apply any multiplying factor.

The meters shall also be able to work correctly on railway traction feeders, which has a provision of only two phases. No. of meters, to be allotted for railway traction feeders, shall be intimated at a time of allotment.

- **5.3** The meter shall continuously compute the average of the RMS values (fundamental only) of the three line-to-neutral VT secondary voltage as a percentage of 63.51 V, and display the same on demand.
- 5.4 The meter shall also compute the reactive power (VAR) on 3-phase, 4-wire principle, with an accuracy as specified in clause 5.6, and integrate the reactive energy (VARh) algebraically into two separate registers, one for the period for which the average RMS voltage is 103% or higher, and the other for the period for which the average RMS voltage is below 97.0%. The current reactive power (VAR), with a minus sign if negative, and cumulative reactive energy (VARh) readings of the two registers shall be displayed on demand. The readings of the two registers at each midnight shall also be stored in the meter's memory. The reactive power and reactive energy transmittals shall be computed in VAR/VARh directly calculated in CT and VT secondary quantities. Lagging & Leading reactive power flow on both export and import events shall either be recorded through a +/- sign or on separate registers.
- **5.5** The meters shall fully comply with all stipulations in IEC Publication 687 1992-06 (Second Edition) for 0.2s class Static watt-hour meters, except those specifically modified by this specification. The reference ambient temperature shall be 27+/-02 ° C.
- **5.6** Errors shall comply with CBIP recommendations for all power factor angles from 0 to 360 degrees. For reactive power (VAR) and reactive energy (VARh) measurement limits of errors

for both active as well as reactive energy in all the four quadrants shall be in accordance to IEC 687, as detailed herein separately.

- **5.7** The meter display shall be of dot matrix format Alfa numeric LCD (with back-lit) or LED type. Suitable, protected and sealable enclosure shall be provided for conveniently accessing all the metering data using soft keypad/push buttons.
- **5.8** The three line-to-neutral voltages shall be continuously, monitored. In case any of these falls below a value likely to cause malfunctioning of the meter, a visual indication/display shall appear, which shall go off if all three voltages become normal. The time blocks in which such a voltage failure occurs/persist shall also be recorded in the meters memory.
- **5.9** The meters shall normally operate with the power drawn through the VT supply. The total burden imposed by a meter for measurement or operation shall not exceed 10 VA on any of the phases. An automatic backup for continued operation of the meter's calendar& clock, and for retaining all data stored in its memory, shall be provided through a long life battery, which shall be capable of supplying the required power for at least two years. The meters shall be supplied duly fitted with the batteries, which shall not require to be changed for at least ten years, as long as total VT supply interruption does not exceed two years. All the metering data shall be stored in non-volatile memory, which shall not be affected in the event of battery failure.

The meters shall be of self powered type and back up shall be provided through internal recharge - able battery which allows data downloading/data communication to a remote terminal through optical port/remote communication port in the event of supply failure.

- **5.10** Each meter shall have a built in calendar and clock, having an accuracy of +/-02 minutes per year or better. The calendar and clock shall be correctly set at the manufacturer's works. The date (day-month-year) and time (hour-min-sec) shall be displayed on the meter front on demand. Only limited clock adjustment by authorized users, after password authentication shall be possible at site, using the MRI or remotely using time synchronization signal through remote network. All clock corrections shall be registered in the meters memory and suitably shown on print out of collected data.
- **5.11** Each meter shall have a unique identification code, which shall be marked permanently on its front, as well as in its memory. All meters supplied to UPPTCL as per this specification shall have their identification code starting with "UP", which shall not be used for any other supplies. UP shall be followed by a dash and a four digit running serial number, further followed by a dash and "A". ('A' being adopted to indicate 1Amp CT secondary).
- **5.12** Each of the metering system shall measure and display the following quantities/parameters as required:
 - a) Processor's identification code and model: UP1234A.
 - b) LED/LCD segment check
 - c) Real Time
 - d) Date dd-mm-yy
 - e) Cumulative active energy import (kWh)
 - f) Last 15 minutes block average of the active power / load import.
 - g) Cumulative active energy export (kWh).
 - h) Last 15 minutes block average of the active power / load export.

- i) Cumulative Reactive energy for the voltage high condition. (ie. Net kVarh when RMS voltage >103%Vn.
- j) Cumulative Reactive energy for voltage low condition. (ie. Net kVarh when RMS voltage <97%Vn.
- k) Instantaneous three phase average power factor with sign/display/legend for lag/lead.
- l) Instantaneous Phase Voltage.
 - i) R Phase ii) Y Phase iii) B Phase
- m) Instantaneous Line Currents (Amps).i) R Phase Line Current ii) Y Phase Line Current iii) B Phase Line Current.
- n) Instantaneous Frequency.
- o) Phase Sequence of voltages (alternatively, this may be provided at MRI/BCS end.
- p) Instantaneous Active Load in Watt (kW).
- q) Instantaneous Reactive Load in kVar.
- 5.13 Other display on selection through key pad
 - a) Cumulative active energy import reading (kWh) of predefined date & time for monthly billing purpose.
 - b) Cumulative active energy export reading (kWh) of predefined date & time for monthly billing purpose.
- **5.14** Each meter shall have a non-volatile memory in which the following shall be automatically stored in each successive 15 minutes' block:
 - 1. Active Energy Import
 - 2. Active Energy Export
 - 3. Average frequency
 - 4. Average load (kW)
 - 5. Average system voltage
 - 6. Reactive Energy lag (when Active Energy Import).
 - 7. Reactive Energy lead (when Active Energy Import).
 - 8. Reactive Energy lag (when Active Energy Export).
 - 9. Reactive Energy lead (when Active Energy Export).
 - 10. Power off time.

15-minute average of the above parameters shall be available for last at least 35 days. The load survey data should be available in the form of bar charts as well as in spreadsheets. The BCS shall have the facility to give complete time synchronized load survey data both in numeric and graphic form.

The offered metering system shall store the midnight values of the following electrical parameters:

- 1. Active energy import in 6 digits.
- 2. Active energy export in 6 digits.

5.15 BILLING PARAMETERS

The metering system shall store following parameters corresponding to defined bill dates-

- 1. Active energy import,
- 2. Active energy export,
- 3. Reactive high energy register

- 4. Reactive low energy register
- 5. Maximum Demand (Import and Export).

The meters shall store all the above listed data in their memories for a period of minimum thirty five (35) days.

5.16 Each meter shall have an optical port on its front for tapping all data stored in its memory. Portable or hand held Common Meter Reading Instruments (CMRI) shall be used for this purpose to serve as the interface between the meters specified above and the local personal computers (PC). The overall intention is to transmit the desired data on line in real time and also tap the data stored in the meter's memories once a week/month, and dump the same via CMRI to a PC running the BCS software, via an independent communication bus architecture. It shall also be possible to obtain a print out (hard copy) of all data collected from the meters, using the local PC.

The whole system shall be such as to provide a print out (both from the local PC, and from remote central computer) in a user defined format to be informed later on. The BCS software shall be programmed to get customized outputs.

Each meter shall also have a visual test output device having either a single switch able output device or two separate output devices for checking the accuracy of active energy (Wh) as well as reactive energy (Varh). Suitable pulsing rate shall be adopted for wh and varh measurements.

- **5.17** The meters shall safely withstand the usual fluctuations arising during faults etc. In particular, VT secondary voltage 115% of rated voltage applied continuously and 190% of rated voltage applied for 3.0 seconds, and CT secondary current 150% of rated current applied continuously and 30 times of rated applied for 0.5 seconds shall not cause any damage to or mal-operation of the meters. The immunity to external magnetic field shall be strictly as per latest CBIP recommendations.
- **5.18** In addition to optical port & RS-232 port for data communication, the ABT meter should also have RS-485(in & out) port. Also all the communication ports should work & communicate simultaneously.
- **5.19** The meters shall also withstand without any damage or mal operation, reasonable mechanical shocks, earthquake forces, ambient temperature variations, relative humidity etc. They shall have not less than an IP-51 category of construction, and shall be capable of satisfactory operation in an indoor/outdoor, non-air-conditioned installation.
- **5.20** The meters shall continue to function, as specified above, in case of failure of one or two phases of VT supply. In case of a complete VT supply failure, the computation of average frequency shall be done only for the period during which the VT supply was available in the 15 minute block. Any time block contraction or elongation for clock correction shall also be duly accounted for.
- **5.21** The harmonics shall be filtered out while measuring Wh, VAR and VARh, and only fundamental qualities shall be measured/computed.
- **5.23** Meters shall be able to store reactive energy consumption during the specified peak hour period in addition to total active energy consumption.

Peak - hour period will be as intimated by the Engineer Of Contract. It shall be possible to retrieve this data through communication ports. Meters shall also be able for implementing the TOD consumption on multiple tariff rates on per day basis.

The TOD Zones shall be as follows:

- **a)** 17:00 to 22:00 hrs.
- **b)** 22:00 to 06:00 hrs.
- **c)** 06:00 to 10:00 hrs.
- **d)** 10:00 to 17:00 hrs.
- **5.24** If desired by the purchaser, all features of the meter including remote communication via an adopted communication network shall be demonstrated by the bidder at a randomly selected site so as to ensure complete integration of the offered system with the communication system of the purchaser.

6.0 TAMPER AND ANOMALY DETECTION FEATURES

The meters shall have an appropriate recording system whereby any attempt of tampering the meter is promptly registered with date and time tagging. The system should be able to provide the following information pertaining to tampering events taken place since last demand reset.

The meter should have features to detect the occurrence and restoration of, at least, the following anomaly:

a) Potential Imbalance: The meter shall be capable of detecting and recording occurrence and restoration of unbalance of voltage. In case of occurrence of such an event a pulse output shall be given through a volt free contact. The rating of the contact shall be 110/220 V DC, 100mA.)

Following tamper features shall be available on the display units:

- Voltage unbalance
- R phase potential missing
- Y phase potential missing
- B phase potential missing
- Feeder supply fail
- **b)** Current Imbalance: The meter shall be capable of detecting and recording occurrence and restoration of unbalance of current. In case of such a event a pulse output shall be given through a volt free contact. The rating of the contact shall be 110V DC, 100mA.

Following tamper features shall be available on the display units:

- Current imbalance
- R phase current missing
- Y phase current missing
- B phase current missing
- R phase CT reversal
- Y phase CT reversal
- B phase CT reversal

Logic for calculation of voltage and current imbalance shall be furnished by the tenderer. Last 20 such events shall be stored in the meter.

Tamper data shall be available in the specified format below:

- i) Date of first occurrence of tampering.
- ii) Time of first occurrence of tampering.

- iii) Time of first restoration of tampering.
- iv) Date of last restoration to normal condition.
- v) Number of occurrence of tampering events.

7.0 <u>SELF DIAGNOSTIC FEATURES</u>

The meter shall have the facility of continuous and automatic monitoring of the healthiness of its various electronic devices and circuits. In case of malfunctioning of any of the device and circuit, the meter shall indicate the same with convenient means.

8.0 <u>CUBICLES FOR METERING SYSTEM</u>

- 8.1 Suitable metering cubicles shall be supplied to mount the meters and associated terminal blocks, MODEMS, power supply etc. as a stand alone unit to be installed at each substation, which shall be capable of supporting all Main & Check meters. At least eight meters (Four main and four check) along with necessary hardware shall be installed in one metering cubicle. Provision shall be made to enable a MODEM to communicate across all the Main/ Check meters, thereby providing remote access using networks as per 8.3. A total of two nos. modems, one no. for all Main meters and one no. for all Check meters are to be provided in each metering cubicle. The metering cubicle shall have a door switch and space heater controlled by thermostat and switch, powered by 220V auxiliary AC supply.
- **8.2** The cubicles, confirming to at least IP 55 degree of protection shall be properly treated and painted with light gray shade no. 631 as per IS 5. The wiring shall be carried out with multi-core super flexible, fire retardant, low smoke, PVC insulted colour coded wires of 2.5 Sq. mm. cross section and 1.1 KV grade.

The load bearing members and frames shall be made of 2 mm CRCA and doors and covers shall be fabricated from 1.6 mm CRCA.

- **8.3** All meters within one cubicle shall be connected to a common data highway through a standard RS232 link. A suitable AC powered MODEM to communicate via GPRS/Optical fibre at a minimum speed of 512 kbps should be provided for data exchange with purchaser's remote computer, via an arrangement using separate MODEM for main meters and check meters.
- **8.4** The MODEM and the power supplies as described shall be suitably partitioned from the main & check meters.
- **8.5** A total of eight nos. Test Terminal blocks (TTB), one for each meter, are to be provided in each metering cubicle. The TTB are to be provided with sealable top covers screws and these are to be mounted inside the metering cubicle in such a way that they are accessible only when the door of the metering cubicle is in open condition. The cables coming from the outdoor CTs/PTs for each of the eight nos. meters are to be connected to the Terminal blocks, suitable nos. of which are to be provided inside the metering cubicle. Necessary wiring is to be provided between the Terminal blocks and each of the TTBs and between the TTBs & location where each meter is to be housed inside the metering cubicle.
- **8.6** The front side of the meter shall be clearly accessible for accessing the data directly or through the MRI.
- 8.7 Suitable sealing arrangements are to be provided in each metering cubicle.
- **8.8** The bidder has to provide the detailed drawings of the metering cubicle, alongwith its all accessories.

8.9 The minimum dimensions of the metering cubicle shall be 1500mm x 600mm x 600mm (HxWxD)

8.10 The metering cubicle of the ABT metering system shall be its integral part and the bidders are intimated that the price evaluation shall be carried out after including the prices of the ABT meters and the metering cubicle. The successful bidder shall have to supply the ABT meters alongwith the metering cubicle.

9.0 <u>SEALING ARRANGEMENT</u>

Each meter, shall be able to be sealed individually, including the optical communication port.

Suitable arrangement shall be provided for frequent access to meter readings only, without requiring to fiddle the meter seals and that of the metering cubicle.

10.0 The bidder shall be responsible for commissioning of the metering cubicle along with the ABT meters, mounted inside the metering cubicle at each substation. Normally one cubicle is allotted for one substation. Separate rates are to be quoted for commissioning of the metering cubicle and each ABT meter, mounted inside the cubicle, as the no. of ABT meters to be installed inside the cubicle may vary from substation to substation.

REQUIREMENT AND FEATURES OF THE BASE COMPUTER SOFTWARE

The BCS shall have at least the following facilities/features:

- i) It shall be possible to read data received from the meter reading instrument/data collection device.
- ii) It shall be possible to dial the ABT meters installed at remote sites and read.
- iii) It shall be possible to schedule the metering system for a sequence of automatic dialling and reading the metering module.
- iv) It shall be possible to export the data in both ASCII and XML formats for detailed analysis and billing.
- v) It shall be include appropriate multilevel security/password protection for control inputs and data output so that unauthorised person does not have access to the critical system data.
- vi) The BCS shall be executable on MS WINDOWS 98/2000/XP operating system.
- vii) The application software shall be fully compatible for implementing ABT, TOD, Tamper and anomalies in a user friendly and user definable format.
- viii) It should be possible to have selective print out of all the available data of the meter. The user need not revert back to the supplier of the software for modifying the software in case of change in print out data eg. TOD, ABT, Tamper and other data are required.
- ix) It is very important that the BCS has the feature to export the available data to ASCII and XML or spread sheet format for integrating with the UPPCL's billing system taking into account the ABT and TOD features.
- **x)** The BCS shall have a multilevel password for data protection and security. The first level should allow the user to enter the system. The different software features shall be protected by different passwords. The configuration of password should be user definable.
- xi) Any deviation of readings of main and check meter, beyond a prescribed limit as defined by the user, shall be clearly indicated on priority by the application software.
- **xii)** The BCS software shall also allow computing the net energy, ie. the difference of import and export energy during the desired billing cycle.
 - BCS software shall be installed and a copy in the form of Compact Disk shall be provided to the respective consignees and as well as to SLDC, UPPTCL.
 - Compatible MRI software for reading the supplier's meters shall also be supplied in the form of Compact Disk to the respective consignees.

TECHNICAL SPECIFICATION OF METER POLLING SOFTWARE

(Not under the scope of Supply)

Data Connectivity Requirement

The Energy Meters procured by UPPTCL and commissioned at most of the interface points are of 0.2s accuracy class, ABT Compliant electronic energy mounted in rack/panel arrangement. Each metering rack/panel provides at least three communication ports: (a) One Galvanically isolated RS232C serial port (b) Two Optically isolated RS232C serial ports/optical ports for local/remote data transfer. UPPCL has envisaged implementing the scheme for Real time data transfer as well as on-demand data transfer from these meters. Real time data transfer would be used primarily for monitoring (of energy generation/drawl and other relevant parameters in view of ABT application) at the central station. Further, on-demand data transfer will be used for reading the meter (load, frequency, voltage profiles etc.) on a periodic basis as required (say monthly/fortnightly/weekly/daily) for energy accounting and settlement application. The bidder shall be responsible for setting up separate channels for real time data transfer and on-demand data transfer from all these meters using suitable multiplexers / converters and communication cables at each location [One RS232 serial port shall be used for on-demand remote communication and other RS485 serial ports shall be used for real time data transfer. These communication ports shall thus be used for setting up independent channels for on-line and on-demand data transfer]. These ports shall be capable of Data transfer to a remote computer over suitable communication media (GPRS/leased line/OFC) using suitable communication hardware (modems/multiplexer/communication cables etc.) as required for proper functioning of remote meter reading scheme. Integration of metering system with these communication mediums shall be the responsibility of the bidder.

Base Computer Software has been supplied by meter manufacturer for on-demand remote communication of data from these meters using PSTN network at present. UPPTCL shall use the above mentioned communication media (GPRS/leased line/OFC) for on-line real time data collection from energy meters. Suitable software for on-line monitoring and on demand data collection using the above communication medium shall be provided by the bidder. Integration of meters and the above communication medium will require physical interconnection between the communication medium and metering systems (having RS232, RS485 serial port outputs) as well as implementation of the suitable comprehensive single software for on-line and on-demand data transfer on the above mentioned communication channel(s). The instantaneous parameters (data) from each energy meter shall be retrieved at central site at least once in five (5) minutes. However, flexibility shall be provided to UPPTCL to increase or decrease the polling cycle time as per requirements in future.

Instantaneous real-time data from each energy meter shall be made available to UPPTCL in ASCII & XML formats also. The exact format (may change from time to time), in which UPPTCL shall require data, will be provided to successful Bidder.

- Primarily, the meter data includes, but not limited to, following:
- a) Real-time Data Transfer: Instantaneous parameters to be polled once in five (5) minutes (Note: Option of "parameter selection" by the User may be provided from given superset of parameters):
 - (i) Active Import

14.1

- (ii) Active Export
- (iii) Reactive Lag while active import
- (iv) Reactive Lead while active import

- (v) Reactive Lag while active export
- (vi) Reactive Lead while active export
- (vii) Apparent Import
- (viii) Apparent Export
- (ix) Reactive High
- (x) Reactive Low
- (xi) Average Frequency (Hz)
- (xii) Average RMS Voltage
- (xiii) Meter Time-stamp (Date "DD MM YY" and Time "hh mm ss")
- **14.1.1** It should be possible to monitor energy and/or demand data for parameters as specified at Sr. Nos. (i) to (x) above.
 - b) On-demand Data Transfer: Load survey parameters (stored in meter memory in block of 15-minutes for at least 35 days) to be polled once in a month / once in a fortnight / once in a week. Facility shall be provided to poll all meters automatically (without any human intervention) depending upon the User defined sequence of meter serial numbers:
 - (i) Watt (Import)
 - (ii) Watt (Export)
 - (iii) Volt Ampere Reactive (Lag) when Watt Hour (Import)
 - (iv) Volt Ampere Reactive (Lead) when Watt Hour (Import)
 - (v) Volt Ampere Reactive (Lag) when Watt Hour (Export)
 - (vi) Volt Ampere Reactive (Lead) when Watt Hour (Export)
 - (vii) Average Frequency (Hz)
 - (viii) Average RMS Voltage (kV)
 - (ix) Voltage Low
 - (x) Time Retard
 - (xi) Time Advance

10.0 TESTING AND TEST PROCEDURES

Sl.	Type Tests	Acceptance	Routine	Sub
No		-		Clause
Α	Type Tests For Meters			
1	Tests Of Insulation Properties	-	-	5.4.6
	Impulse Voltage Test	-	-	5.4.6.2
	A.C. Voltage Test	Yes	Yes	5.6.3
	Insulation Resistance Test	Yes	Yes	5.6.4
2	Tests Of Accuracy Requirements	-	-	5.6
	Tests On Limits Of Error	Yes	Yes	5.6.8
	Test Of Meter Constant (If	Yes	Yes	5.6.6
	Applicable)	Yes	Yes	5.6.5
	Test Of Starting Condition	Yes	Yes	5.6.4
	Test Of No Load Condition	Yes	-	5.6.9
	Repeatability Of Error Test	-	-	5.6.3
	Test Of Ambient Temp. Influence	-	-	5.6.2
	Test Of Influence Quantities	-	-	6.6.2(Refer
	Measurement Of Phase Current			Note)*
			-	
3	Test Of Electrical Requirements	-	-	5.4
	Test Of Power Consumption	Yes	-	5.4.1
	Test Of Influence Of Supply	-		
	Voltage		-	5.4.2
	Test Of Influence Of Short Time	-	-	5.4.4
	Over currents	-		5.4.5
	Test Of Influence Of Self Heating			
4			-	5.5
	Tests For Electromagnetic	-	-	5.5.5
	Compatibility	-		
	Radio Interference Measurements		-	5.5.4
	Fast Transient Burst Test	-		
	Test Of Immunity To		-	5.5.3
	Electromagnetic HF Fields.	-		
	Test For Immunity To Electrostatic			
	Discharge			
5		-	-	5.3
	Tests Of Climatic Influences	-	-	5.3.1
	Dry Heat Test	-	-	5.3.2
	Cold Test			
	Damp Heat, Cycle Test			_
6		Yes	-	5.2
	Tests Of Mechanical Requirements	Yes	-	5.2.3
	Vibration Test	-	-	5.2.2
	Shock Test			
	Spring Hammer Test	-	-	5.2.1

The offered meter should be fully type tested as per IS:14697. The Bidders shall have to submit the detailed type test report.

Test Of Protection Against	-	-	5.2.5
Penetration Of Dust And Water			5.2.4
Test Of Resistance to Heat And			
Fire			

Notes:

- **1.** For type testing all the above tests are to be carried out except test 2.8 for which refer note 2.
- 2. *However, test 2.8 is valid only for meters having additional features as per clause 6.6 (Of CBIP Recommendations), which, in this case, is not applicable
- 11.1 If desired by the purchaser, one (1) out of the ordered quantity of meters may be subjected to the complete range of type tests as per CBIP recommendations and IEC-687 1992-06(Second Edition), after final assembly. In case of any failure to pass all specified tests, the contractor shall arrange to carry out the requisite modifications/replacements in the entire lot of meters at his own cost. After any such modifications and final assembly, two (2) meters selected out of the lot by the owner's representative shall be subjected to the full range of type tests. The manufacturer shall further commence manufacturing only after these are successfully tested.

11.2 ACCEPTANCE & ROUTINE TESTS

11.2.1 ACCEPTANCE TESTS

All acceptance tests as stipulated in the relevant standards shall be carried out by the supplier in the presence of purchaser's representative.

Following additional tests shall be carried out on meters as per procedures of CBIP Technical Report 88 on randomly selected samples.

- i) Shock Test
- ii) Vibration Test
- iii) Magnetic Induction of external origin (AC & DC)
- iv) Tamper & Fraud Protection as per clause 6.0
- (v) High Voltage test on Metering Cubicles.

11.2.2 ROUTINE TESTS

All routine tests as stipulated in the relevant standards shall be carried out. In addition, the following tests including tamper and fraud protection tests shall also be carried out and such routine test certificates shall be submitted for approval of the purchaser.

- i) Display of all metering parameters.
- ii) Remote communication capabilities.
- iii) Data downloading through MRI.

<u>TS-10(A)</u>

TECHNICAL SPECIFICATION FOR TUBULAR TYPE LEAD-ACID STATIONARY BATTERIES IN TRANSPARENT SAN CONTAINER.

1.00.0 SCOPE

- 1.00.01 This specification covers design, manufacture, assembly of components, testing at manufacturer's works, packing, supply and delivery to site, Tubular type lead-acid stationary batteries in Transparent SAN container and associated accessories for indoor installation.
- 1.00.02 Supervision of erection and commissioning of the battery bank shall have to be undertaken.

2.00.0 APPLICABLE STANDARDS (LATEST REVISION)

IS-1885 :	Electrical vocabulary, secondary cells and batteries
IS-1069 :	Water for storage batteries
IS-266 :	Sulphuric acid for storage batteries
IS-8320 :	General requirements for methods of tests for lead-acid Storage batteries.
IS-1146 :	Specification for rubber and plastics container for lead acid storage
batteries	
IS-6071 :	Synthetic separator for lead acid batteries
IEEE-485 :	IEEE Recommended practice for sizing of large lead acid Storage batteries for generating stations and substations.
IEEE-484 :	Recommended practice for design and installation of Storage batteries.
IEC896-1 :	Stationary Lead-acid Batteries
DIN40736:	Stationery cells with positive Tubular plates in transparent plastic
containers.	

3.00.0 DESIGN AND CONSTRUCTIONAL FEATURES OF BATTERY

3.01.01 Type:

The battery shall be lead acid Tubular type in Transparent SAN container (OpzS). Sealed Maintenance Free VRLA type/Nickel Cadmium type batteries are not acceptable. The batteries should preferably be of 2 volts units for 500 AH capacity for compactness and lower foot-print.

3.01.02 Positive Plates :

The plates shall be of first class material and workmanship and shall be free from blowholes, cracks and other imperfections. The tubular positive plates shall consist of a suitable bar with spines cast of suitably alloyed lead to give adequate mechanical strength and minimum electrical resistance.

The tubular spines shall be cast of an alloy of Pb and Antimony with Antimony content not greater than 3% by weight. The casting shall be done using proper controlled procedure preferably sing high pressure casting machine with an operating pressure not less than 90- 100 Bars. Low antimony alloy (not greater than 3%) will ensure low water loss and a guaranteed topping up frequency of not more than once in 12 months. High pressure cast spines will ensure a long life and trouble-free operation.

Porous, acid resistant and oxidation resistant tubes shall be inserted one over each spine. After insertion, the tube shall be adequately filled and packed with active material (preferable through a rotary shaking machine) before their lower ends are closed by common plastic bar. The construction and material of tube shall be such as to reduce the loss of active material and shall be able to withstand normal internal stresses developed during service.

3.01.03 Negative Plates :

The negative plates shall be of flat pasted type and should be made of lead-calcium alloy. The pasting shall be done on an automated machine for better control of process parameters. It should have adequate mechanical strength and would be so designed that active material is maintained in intimate contact with the grid under normal working conditions throughout the life of the battery.

3.01.04 Separators:

The separators shall be micro-porous type to avoid direct as well as side shorts. It should be acid resistant, chemically inert and should have excellent oxidation resistance and high degree of porosity to ensure minimum internal resistance. Average volume porosity should be more than 45%. It should not exhibit any tendency to swell or shrink at temperature encountered during operation. Micro- porous synthetic separators shall conform to latest IS: 6071

3.01.05 Containers :

Containers shall preferably be made of transparent SAN copolymer giving excellent clarity, outstanding chemical resistance, rigidity and toughness with very high insulating qualities which eliminate the need for separate cell insulators. It shall have adequate mechanical strength to prevent bulging, cracking etc. during the life span of battery when operating under expected temperature range and due to action of static and dynamic loads and the action of electrolyte. These containers should enable the electrolyte level and the cell condition to be monitored at a glance. The containers shall conform to latest edition of IS-1146.

3.01.06 Cell Lids:

It should be moulded from opaque SAN or ABS and sealed to the container. It should be easily removable if the need arises.

3.01.07 Micro-porous Ceramic Vent Plugs :

The vent plugs should be specially designed incorporating a micro-porous ceramic filter which effectively returns all acid spray to the cell, but allow free exit of oxygen and hydrogen which is generated at the end of boost charging. On removal, the plugs shall permit drawing of the electrolyte sample for servicing and of checking of the electrolyte level. The vent plug should preferably be flame-retardant type to prevent any fire hazard in the battery room.

3.01.08 Connectors and fasteners :

Connectors shall be made of copper and completely insulated with rubber/plastics. Connectors should be adequately designed to carry maximum duty cycle as specified and shall offer minimum resistance. The current density for Copper connectors shall not be more than 15 Amps/ sq. mm. While considering the terminal voltage of the cell at the time of testing for discharge, the voltage drop due to inter-row and intercell connectors shall be considered. Connectors shall be adequately designed to withstand various stresses due to temperature changes, attack of acid and dynamic forces that could occur during the operation of the battery. Fasteners should be made of suitable material and should also be completely insulated.

3.01.09 Electrolyte :

The electrolyte shall be battery grade sulphuric acid conforming to latest edition of relevant IS 266. The strength of the electrolyte in the cell during operation shall conform to the governing IS specification for the cell. Required quantity of electrolyte for the initial filling with 10% extra quantity shall be supplied in no-returnable non-degradable acid resistant strong plastic containers.

3.01.10 Water :

Water used in preparation of electrolyte and also to bring the level of electrolyte to the correct position during the course of operation or testing shall conform to the latest edition of IS-1069.

3.01.11 Terminal Post :

Positive and negative terminal posts of the cells shall be clearly and unmistakably identifiable. Terminal posts shall be designed to accommodate external bolted connections conveniently and positively. All metal parts of the terminals shall be of lead coated type. Bolts, heads and nuts, except seal nuts, shall be hexagonal and shall be lead coated. Terminal posts shall be adequately fixed to prevent its turning or twisting when the connectors are being fixed or removed. The junction between terminal posts and cover and between the cover and container shall be adequately sealed to prevent any seepage of the electrolyte. All terminals shall be provided with insulated covers. The pole terminal should be of lead with a brass core insert, which shall increase the conductivity. The pole should have a double layered protection against crevice corrosion. The lead lining of the terminal should be protected against any contact with the electrolyte at the place where it emerges out of the cell interior through an injection moulded plastic encapsulation.

3.01.12 General Requirements for Tests

Specific Gravity of Electrolyte:

The specific gravity of fully charged cells shall be adjusted to 1.240 ± 0.005 at 27° C. Temperature Correction:

The capacity of the cell shall be corrected to 27° C using the proper temperature correction factor pertaining to the type of the cell and the rate of discharge. The temperature correction should be made using factors supplied by the manufacturer but shall generally conform to some national or international standard for the similar type of cell.

3.01.13 Tests:

3.01.13.01 Test for Capacity:

The cell shall be tested for its rated capacity output. The fundamental requirement shall be a discharge for 10 hours whilst discharge at other rates, as decided mutually between the manufacturer and purchaser, may also be performed. A fully charged cell shall be allowed to stand idle for a period of 12- 24 hours before performing this test. The cell shall be discharged at a constant current of $I_{10} = C/10$ where C is the rated 10 hour discharge capacity of the subject cell till the voltage of the cell reaches 1.80 volts per cell. In case of more than one cell being tested at a time (in most of the cases), the discharge to be discontinued at a time when the voltage of the group has reached 1.80 x n volts where n is the number of cells in the group. The capacity of the cell thus established shall have to be corrected for temperature variation during the test if the temperature is different from 27 deg. C. The temperature correction shall be as per the relevant IS for the type of the cell in question. The capacity output, at the first discharge, corrected to 27° C shall not be less than 85% of the rated capacity of the cell. The cell shall reach 100% of its rated capacity within 5 charge-discharge cycles.

3.01.13.02 Test for Charging Efficiency:

Since the cells are expected to operate at various state of charge (SOC), the charging efficiencies at various depth of discharge needs to be measured and standardized for this application. Typically, charge efficiencies at 80%, and 10% SOCs are to be notified.

Charge Efficiency at 80% SOC :

A fully charged cell shall be discharged at a constant current of I_{10} for 2 hours. The voltage at the end of 2 hours (V₁) to be very meticulously noted. The cell, then, shall be charged at a constant current of I_{10} for 2 hours and after a rest period of 2-4 hours shall again be discharged at a constant current of I_{10} . The time taken to reach the voltage V₁ is to be noted during this discharge. The ratio of these two times would be designated as the charge efficiency of the cell. The time of discharge shall change to 9 hours for 90% SOC. The rest procedure being similar to the one explained. The cell appropriate for this application should have the following charging efficiencies:

0	00	
80% SOC		80%
10% SOC		90%

3.01.13.03 Retention of Charge

The charge retention of a cell is the capability of the cell to retain its capacity during the period of no charge, i.e. when not connected to the system, during transportation or storage. A fully charged cell shall be discharged for capacity appreciation and recharged to full state of charge. The capacity output shall be noted as C1. After recharge the cell shall lie in open circuit condition for a period of 28 days. During this period, the temperature of the cell shall be kept close to 27 deg. C as much as practically possible. After completion of 28 days of idle standing, a second capacity discharge is to be performed. The capacity, corrected to 27 deg. C thus obtained, shall not be lower than 95% of the earlier actual capacity C1.

3.01.13.04 Water loss :

The cell/ battery after being fully charged shall be kept on a float charge of 2.4 volts per cell at a temperature of 40 deg. C for 21 days at a stretch. The loss of water due to evaporation and self discharge shall not be more than 0.65 grams per Ah. The battery shall reach an equilibrium state of charge within 72 hours of such charging. This shall be indicated by the float current after 72 hours of constant float. The float current shall not be more than 3 mA per Ah.

3.01.14 Battery Racks :

The battery racks shall be constructed from good quality wood or of high strength good quality mild steel sections. These battery racks shall be painted by the bidder with two coats of acid/ alkali resistant paint of approved make. When steel stands are used, they should either be epoxy painted or epoxy powder coated with acid resistant grade of pigment as per approved coating process to provide a non-peel able protective coat. Theracks shall be of single tier/ two tier construction depending on the final layout based on space availability.

3.01.15 Marking :

Each cell shall be marked to meet the requirements of relevant Indian standards. In addition, each cell shall be legibly numbered serially to identify the cell during manufacture, testing, installation and operation of battery to identify after having assembled into battery bank in battery racks.

Following marking however, shall be provided

- a) Manufacturer's type and trade name
- b) Electrolyte level (min & max)
- c) Type of container and standard AH capacity as per IS
- d) Polarity marking as per relevant IS

A set of loose stickers shall be provided to mark the cells position in the assembled battery bank at site so that a cell removed for maintenance can be put back in original

Sl. No	Description of Item	Quantity
1.	Teak Wood Battery stand with acid proof	1 Set
2.	paint	As Required
3.	Interconnections	-do-
4.	Hard rubber cell insulators with 20% extra	-do-
5.	Stand insulators (PVC) with 2 nos. extra	55 nos.
6.	Cell number plate with fixing pins	1 No.
7.	Syringe type hydrometer	1 No.
8.	Thermometer(Gravity Correction) with stand	1 No.
9.	Cell Testing Voltmeter with leads (3-0-3V)	1 No.
10.	Spanner set	1 No.
11.	Rubber syringe	2 Nos.
12.	Acid Resistant Funnel	2 Nos.
13.	Acid Resistant Jug-1 litre	1 No.
	Wall Mounting Hydrometer & Thermometer	
14.	holder Teakwood	3 Nos.
15.	Battery containers as spare	110 Nos.+ 5% extra
16.	Nuts & Bolts with 5% extra	As Per Requirement plus
	Electrolyte in non-returnable containers.	10% extra
17.		2 Nos.
18.	Rubber Apron	4 Sets
19.	Rubber Gloves	2 Pairs
20.	Knee height Rubber Boots	1 No.
21.	Cell Lifting Straps	55 nos.
22.	Vent Plugs	-do-
	Float Plugs	

LIST OF ACCESSORIES TO BE SUPPLIED WITH EACH SET

TECHNICAL SPECIFICATIONS FOR 110/30A BATTERY CHARGERS AND 110V/ 30A DC DISTRIBUTION BOARDS

1.0 <u>REQUIREMENT OF BATTERY CHARGER</u>

1.1 <u>TYPE & RATING</u>

Each battery charger shall be of 3 phase type which must be able to meet the above requirement plus 20 Amps station load current on both float and boost charging modes with a voltage variation from 350 V to 470 V A.C. 50 Hz \pm 5% separately or simultaneously.

The charger shall be stand-alone, floor mounted indoor type. The panels shall consist of fabricated sheet steel enclosures on the sides, front, rear and top. The rear door of panel shall be in the form of lockable, hinged tight fitting flap door which should close and open without keys. The front and rear sheets shall be folded construction for providing rigidity and strength (without using any frame works or screwed & bolted sheet steel sections) of not less than 14 SWG. All the switches, knob should be such mounted that only their operating handles protrude out of the panel. Suitable support channels shall be provided inside the cubicle. The charger unit will be completely vermin proof and neoprene gaskets will be provided around the edges of the door.

Important identifications/ markings shall be made on anodized plate with etching process (not with screening process) which shall be riveted.

All screws, nuts and bolts shall be rust proof and spring washers shall be provided wherever required.

Terminal blocks should be easily accessible and transparent flexible top covers (easily removable) shall be provided to cover the live parts.

1.2 <u>TECHNICAL REQUIREMENTS</u>

1.2.1 <u>Annunciation</u>

Following state of battery when the charger is in the must be suitably displayed as follows:

- i. Battery set under Boost charge.
- ii. Battery set under trickle charge.
- iii. A.C. supply failure Battery on load.

This shall also be displayed with a reset table audio beeper /alarm and centre zero ampere meter without any scale multiplier.

iv. Contactor circuit healthy.

- v. Battery out off indication to prevent deep discharge (below 1.85V per cell) in case battery is loaded for prolonged time.
- vi. Battery charger ON.
- vii. Incoming supply voltage High/Low.

Annunciation supply shall be 110 V D.C. through the battery set.

- **1.2.2** The output of float charger shall be automatic so as to maintain float current of 30A regulated within \pm 01% over an output D.C. voltage between 0 to 140%, input voltage variation of 350 to 470V A.C. input frequency 50 Hz \pm 5% and station D.C. load variation from 5 to 20A. The output voltage of 20 A station load shall be 110 V \pm 1%.
- **1.2.3** The output of boost charger shall be manual, step less type with charge current of 30A (max. limit 40 A) plus station load or 20 A. The output current shall remain constant (30A± 1%) on varying station load conditions and supply input variations as per 1.3.2 above. The batteries shall automatically be placed on trickle mode upon full charge. During this change over, station D.C. load on charger shall not be interrupted. One N/o and one N/C contact (potential free rated not more than 5A shall be provided for remote annunciation. (Not in the scope of supplier). Additional switch and socket shall be provided for emergency D.C. light inside the control room.
- **1.2.4** The internal wiring of charger shall be carried out with PVC insulated multi strand flexible copper cable or suitable size of 650V grade. Both ends of wiring shall have the numbered plastic ferrules for identification. The cubicle wiring shall be suitably branched and neatly tied up.

The cubicle should be equipped with necessary links and HRC fuses of approved make as per annexure-II which shall be mounted on sheet steel brackets. Each fuse shall be identified with a suitable engraved label as per item 2.2 above.

The dimension of the charger cubical should preferably match with the D.C. distribution boards.

The inside surface of charger shall be painted with white synthetic paint after properly treating the same with suitable anti rusting treatment, The outer surface of charger shall be light gray as per shade no. 631 of ISS. Only powder coating paint will be accepted.

1.2.5 **PROTECTIONS**

Following minimum protections will be provided.

- i. Output overload protection both in float and boost mode.
- ii. Output over voltage protection.
- iii. Input/Output under voltage protection (93 V D.C. for output)
- iv. Phase failure protection (single phase prevention).

- v. Output earth fault protection .
- vi. Trickle charging system failure. The battery if under full charge should be prevented from connecting with the boost charger in case of failure of trickle charging circuit.

Indication circuits may be protected through a common single fuse.

- **1.2.6** Sufficient louvers shall be provided on the top side of the battery charger panel and on the back door of the panel. No louvers shall be provided on sides of battery charger. Fine steel wire mesh of 16 SWG which can not be locked by the dust shall also be provided under the louvers so that any undesirable element/insects may not enter into the charger through louvers.
- **1.2.7** The dimensions of charger shall be as follows:
 - a) Depth 600 mm (can not be changed).
 - b) Height & width shall be so kept that all the components of the charger which has to be mounted on the sides of the charger panels, may be accommodated suitably & nicely so that no problem arises during maintenance and removal/replacement. However, height & width shall not be in any case less than 1500 mm respectively.
- **1.2.8** Any scratch in the paint even during transit shall be attended at site. therefore, packing should be made in such a way that panel may reach the destination without scratches/ damages in the paint.
- **1.2.9** Every marking/ identification of any component/any circuit shell be made on anodized plate (not on plastic sheet) prepared with itching process (not with screening process/ or paint) and should be reverted .
- **1.2.10** All internal wiring of the charging unit shall be carried out with PVC insulated Multi-storeyed/ single strand cable of 650 V grade. Both ends of each wire shall be, marked with good quality ferrules. All wires should be suitably bunched and clamped on suitable metallic support to give straight line /90° turning appearance.

1.3 Fuse

Each semi-conductor and thyristor shell be supervised by separate fuse and relays in addition to this all circuits shall also be supervised with individual fuses. All fuses may be numbered on metallic sheet (not with sticker etc.) and number should be so clearly put under each fuse, so that it may be easily readable by a skilled man and their annunciation LED & relay should also be given same number duly marked on it (refer drawing enclosed at annexure-I) in a similar fashion. The size & rating of the fuse strip (auxiliary fuse) shall be fixed by UPPTCL later on the recommendation of successful bidder.

1.3.1 ALL HRC FUSES WILL BE OF APPROVED MAKE AND ALL FUSES WILL BE SUPERVISED BY SEPARATE AUDIOVISUAL ANNUNCIATION.

- 1.4 All annunciation fuses (auxiliary fuses) shall be placed in side the panel.
- 1.5 Aesthetic view may also be kept in mind while placing the switches, meters on front panel or inside the panel.
- 1.6 The dimensions of the charger cubicle should match with that of D.C. distribution board. The outside surface of the cubicle shall be synthetic enamel painted in light grey as per shade no. 631 of ISS. The inside surface of the cubicle shall be painted with white synthetic enamel paint. Before paining the cubicle surface should be properly treated to make it rust resistant.
- 1.7 The charger cubicle shall be delivered complete with all relays, instruments, switches, indicating lamps and other equipments duly mounted.
- 1.8 In order to keep battery available to meet any heavy load condition when boost charging is on, a suitably selected no. of the cells of the battery (42nd cell) should under all conditions be connected to the load through 4 nos. blocking diodes, connected in series and parallel combinations. Each of these diodes should independently provide necessary blocking.
- 1.9 Under the normal operation the boost charging and float charging of the battery should be done by the boast charger and float charger circuits respectively. However, a provision should be made for an emergency operation under which it should be made for an emergency operation under which it should be possible to use the boost charger circuit for the purpose of trickle charging of battery and also supplying simultaneously the continuous load of the substation equipment.
- 2.0 The drawings for plate No. 1,2,3 & 4 with a proposed list of Do's and Don't shall be submitted along with drawing referred under clause 7.20 for approval, UPPCTL decision shall be final.
- 2.1 Special arrangements have to be made so that two numbers of battery sets can be charged (boost charging) one by one through a special selector switch on boost charging section.
- 2.2 After boost charging both the batteries of 30A charger have to be transferred on float charging for trickle charging.
- 2.3 For 30A charger, provision shall be such that during the period when either of the battery is in boost charging, other battery should be on trickle charge and also should be in the circuit through suitable D.C. contactor to meet any load demand to the load circuit beyond the rated capacity of the Float charger unit.
- 2.4 Illuminated indication of main switch positions (i)Boost charging ON (ii) Float charging unit ON (iii) Battery I under Float (iv) Battery I ind under float (v)

both Battery under float (vi) Battery Ist under Boost charge, (vii) Battery Iind under Boost charge should be shown on facia window on the top of the cubicle of 30A chargers.

2.5 Necessary details required for such arrangement to be indicated. Bidders may submit their drawings along with their offers.

3.0 <u>TECHNICAL DETAILS OF IMPORTANT COMPONENTS</u>

3.1 TRANSFORMERS

Charger should be suitable for working on 3 phase A.C, supply where phase to phase voltage may vary from 310 V to 720 V and frequency variation may be up to \pm 3% which may occur simultaneously or separately but charger should give constant D.C. output voltage of 119 \pm 1% during float charging, station load may vary from zero to 120% of rated current.

3.1.1 FLOAT CHARGER UNIT

AC transformer shall be suitably rated and should have two separate copper windings, naturally air cooled as per ISS 2026 : 1977 . The capacity of transformer may be so rated that the voltage of each cell may be maintained from 2.15V to 2.2V at even maximum rated load current. Adjustment of the Voltages shall be step less.

3.1.2 BOOST CHARGER UNIT

Transformer suitably rated for full variation of voltages and frequency and must have two separate copper winding, naturally cooled as per ISS: 2026:1977 with necessary taps on the primary winding as well as on secondary winding (if required) for coarse and fine adjustment of the voltage in steps of 10% and 5% respectively. Capacity of the transformer may be so adjusted that the voltage of each cell of storage battery may be achieved from 1.8 Volt to 2.8 Volts.

- 3.1.3 Suitable interlocking switch maybe provided in the primary and secondary windings of the transformer so that at the time of switching of the charger. It can be switched ON only when full primary & secondary winding of the transformer are in the circuit.
- 3.1.4 There will be separate and individual transformer for float charging and boost charging section.
- 3.1.5 Transformer should be copper wound and before putting it into insulating varnish both, it should be dehydrated and varnish should be impregnated under pressure.
- 3.1.6 The core of the transformer shall be GKW grade.
- 3.1.7 The capacity of the transformer shall be suitable for 120% of rated load. Necessary calculation for driving the capacity of the transformer showing wire

size, no. of turns, flux density core size, total weight etc, has also be enclosed along with the tender positively.

3.2 SEMI CONDUCTORS

- 3.2.1 There will be two separate, full wave bridge i.e. for float charging and boost charging.
- 3.2.2 All semiconductors shall be provided with S.C.R. Control with a continuous current rating suitable for full load.
- 3.2.3 Each semi conductor shall be mounted on separate suitably rate naturally air cooled heat sink.
- 3.2.4 Calculation for selection of rating and type of heat sink shall also be submitted along with the other details.

3.3 FLOAT CHARGING OUT PUT VOLTAGE REGULATION

The output of float charging unit shall be automatic type and D.C. voltage shall be regulated electronically within \pm 1% of rated output voltage (119 D.C,) This automation shell be achieve with properly rated thyristors.

3.4 <u>SURGE SUPPRESSOR UNIT</u>

Each semi conductor bridge shall be suitably protected with surge suppressor unit of proper rating

3.5 <u>RIPPLE CONTENTS</u>

- 3.5.1 Float and boost unit of each charger should give smooth D.C. output with ripple content not more that \pm 3% without connecting any load or Battery at full rated current and A.C. Voltage of 520 Volts.
- 3.5.2 Choke provided in the filter circuit, it necessary, shall be of copper wire, iron core type and shell also be supervised and protected with separate fuse and annunciation.

3.6 <u>CURRENT LIMITING</u>

Float charging unit and boost charging unit of charger should be provided with proper electronic current limiting features.

3.7 **VOLTAGE REGULATION**

- 3.7.1 Battery charger's float unit should be rated for 119 volts D.C. output with a variation of not more than \pm 1% charger scheme should be so designed that boost charging, unit and float charging unit both will remain simultaneously and continuously.
- 3.7.2 Float charger should be capable to give rated D.C. Voltage automatically by

step less adjustment in such a way that the voltage of each cell may be maintained between 2.1 volt to 2.2 volts and please note load current may vary from zero to rated capacity.

- 3.7.3 The boost charging unit shall be so suitably rated that with the help of coarse and fine adjustment the voltage of each cell may be achieved from 1.8 V to 2.8 volts.
- 3.7.4 Normally D.C. load and batteries shell always be connected with the charger unit. The load shall be supplied by the float charging unit only and rated trickle charging current to the battery shall also be fed by the float charger unit. For a short failure of A.C. supply, D.C, load shall be fed by the batteries and after restoring the A.C. power supply battery charging shall be done by the float/boast battery charger.
- 3.7.5 The boost charger shall automatically be connected to the bus of float charger through a D.C. contactor when A.C main fails hence proper interlocking shall be provided with the main A.C, Supply. Also during boost charging of batteries the boost charger bus should remain isolated with float charger bus which connects the load.
- 3.7.6 Float and boost charger unit should be so designed that in the event of any damage to the float charger unit, the battery shall be charged through boost charger manually and to adjust the voltage for load from battery , which may be higher then 120 V, parallel and series combination of dropping diodes may be provided, if necessary so that voltage may be adjusted accurately with course and fine arrangement ,nearest 119 V D.C. if not necessary than proposed method may be explained to achieve this requirement UPPTCL decision be final
- 3.7.7 The rating of dropping diodes should be sufficiently rated.
- 3.7.8 The range of voltage adjustment through dropping diodes may be from 148 V D.C. 115 V D.C.
- 3.7.9 A tap for connecting 42nd cell shall provided to the load point through four number blocking diodes in series parallel combination.
- 3.7.10 D.C. volt meter (moving coil type 144 X 144 mm) shall be provided on load side with a rotator switch capable of showing the voltages of float, boost 42 nd position, dropping diodes position and off position. the least count of the voltmeter should be 1.0 volt.
- 3.7.11 A.C. Supply for both the transformers shall be connected through separate A.C. contactor with over load protection along with a main switch.
- 3.7.12 Moving coil type A.C. Voltmeter (144 x 144 mm) shall also be provided with a rotary switch capable of showing input voltage .Least count of the voltmeter should be 1.0 volt.
- 3.7.13 2 Nos. separate suitable moving coil type D.C, Ammeter (141X 144 mm) shall

also be provided on float and boost charger unit with a least count of 1.0 Amp. with D.C. center zero type amp. meter in the boost charging circuit.

- 3.7.14 All switches used in the circuitry shall be of reliable manufacturer and of reasonable rating (refer annexure –II)
- 3.7.15 Pilot lamp showing A.C, supply shall be provided with glass lens. Color of the lens should be red.

3.8 <u>LED</u>

All lamps for annunciation circuit shall be infrared red colour LEDs of high illumination only, not less than 2.5 mm at 20 mill amp or less with a wide angle lens (not less than 150 °) The size of the LED, if round should not be less than 5 mm and if rectangular than illuminated area should not be less than 12.7x 6.35 mm.

3.9 <u>RELAY</u>

3.9.1 For audio alarm PLA/ OEN (plug in type) relay should be used shall submit his Recommendations with manufacture technical data, catalogue for finalization of rating of relays . Each thyristor/ semi-conductor of the rectifier must have individual relay for annunciation.

3.10 PUSH BUTTON

All push buttons used shall be of approved make.

4.0 **<u>PROTECTION</u>**

4.1 <u>CURRENT LIMITING</u>

The circuit of the charger unit should be so designed the connected load may not draw the current beyond 110% of rated current of the charger. Float charger unit should have automatic control while boost charger unit should have audiovisual indication on 110% and tripping arrangement on 120% of rated load.

4.2 OVER VOLTAGE

Over voltage protection should be provided and individual audio- visual indication should come on each unit. The over voltage setting for float charger should be at 120 V D.C. and for boost charger 150 Volts.

4.3 <u>UNDER VOLTAGE</u>

Under voltage protection should be provided and individual audio- visual indication should come on both units and the setting should be 118.0 Volts D.C

5.0 <u>ELECTRONIC CIRCUIT FOR THYRISTOR CONTROLLED MODULE</u>

5.1.1 PRINTED CIRCUIT BOARD (P.C.B.)

The P.C.B. for electronic circuit shall be made of glass epoxy cooper laminated of thickness not less than 2.3 mm sheet and shall be of draw out module type so that at the time of servicing it can be taken out along with its presets (pots) without de soldering any wire/ connection.

The layout drawing of the P.C.B. and size shall be got approved from UPPTCL . the design should allow replacement at component level.

- 5.1.2 P.C.B. of each electronic control & power supply shall be separate & shall be mounted with Suitable edge connectors .
- 5.1.3 Reference voltage sensing shall be done through IC-723/3140/324/741 metal pack only.Surface mount devices will not be accepted .Optical isolators may also be used.
- 5.1.4 Sensing for under voltage/ over voltage shall also be done with any of the above IC (Metal pack only).
- 5.1.5 The rating & make, catalogue number of all connected electronic components viz transistors, resistors and capacitor relays switches etc. have also to be got approved from UPPTCL, before proceeding for manufacturing.
- 5.1.6 UPPTCL reserves all rights to change/ suggest any component(s) as per Purchaser's requirement/ suitability.

6.0 <u>ANNUNCIATION CIRCUIT</u>

- 6.1 Refer clause 2.3.1
- 6.2 All annunciation should operate on110V D.C. output taken from output terminal of the float charger.
- 6.3 There should be a push button to test all annunciation circuit and a separate push button to accept the alarm/audio indication but visual indication should not go off till the fault is removed. If there is another fault in between/before the removal of earlier fault, still the circuit should be capable of giving its audiovisual annunciation.

7.0 DRAWINGS

7.1 The scheme of charger shall be strictly as per enclosed drawing at Annexure –I

However successful bidder can submit his proposal with full justification for any change in the drawing/rating for improvement purposes. The decision of UPPTCL shall be the final and binding on successful bidder.

7.2 DRAWING INSTRUCTION BOOKLETS, ERECTION AND MAINTENANCE MANUALS.

6.sets of the following drawings shall be furnished for approval within one month from the date of order in quadruplicate

- 1. General arrangement drawing of battery charger & DCDB.
- 2. Schematic & Wiring drawings of battery charger & DCDB.
- 3. Layout and list of components showing make & ratings including the components used on P.C.Bs
- 4. Service diagrams.
- 5. Layout of all annunciation LEDs & its description.
- 6. List of important DO's& DON'TS
- 7. Drawing including name plate drawing.
- 7.3 The supplier shall submit the layout and component details of P.C.B. within 15 days of the finalization of drawings referred under para 7.2.
- 7.4 Any amendment suggested by the Purchaser in the layout of P.C.B and the components shall be acceptable to the Contractor.
- 7.5 The Contractor shall submit the service diagram of electronic circuit showing all the important parameters viz currents and voltage within 10 days from the approval of the drawing of layout. Otherwise delivery shall not be accepted.
- 7.6 The Contractor shall also submit 1 set of drawing in the form of plastic reproducible of capable of producing clear legible prints to this office (Engineer of contract).
- 7.7 Any other drawings if required by the Purchaser shall also be supplied by the Contractor Without extra charges.
- 7.8 The Contractor shall submit ,the detailed drawing of equipment showing the rating and make of each component (Annexure-II) including connected electronic circuit.
- 7.9 Any change in the drawing by the Purchaser shall have to be accepted by the Contractor.

7.10 <u>ANY DELAY IN APPROVAL OF DRAWINGS SHALL NOT BE THE</u> <u>REASONS FOR EXTENSION IN DELIVERY</u>

The Contractor shall provide four number anodized plates of size not less than 500x300mm and plate shall be made with itching process. Plate no.1 shall consists important circuitry ,all fuses and annunciation circuit .The circuit should be so simple so that anybody can understand and preliminary fault location like fuse failure etc. can be attended by a skilled man at the substation. Plate no.2 shall have important DO's and DON't in red colour. Plate No.1 shall be riveted inside the back door panel and plate no.2 shall be riveted on front

panel . Plate no.3&4 shall have the details of annunciation.

7.11 The list of DO's and DON'ts shall be submitted along with drawings.

All LEDs should also be mounted on anodised plate separately giving all details of indication, indicated by each LED (Para 7.2 of item 5).

7.12 Rating of all fuses used, should also be printed on separate plate showing fuse number and 1no.fuse cartage rating to facilitate at the time of replacement of blown fuse. Drawing showing the format of this plate shall also be submitted along with the other relevant drawings.

8.0 <u>RATING & MAKE</u>

8.1 Make of Important components shall be as per Annexure –II . The successful bidder can submit his proposal for the rating with full justification and manufacturers catalogue Number. The decision of UPPTCL shall be final and binding. All ratings should be of continuous type.

9.0 <u>CHARACTER OF LOAD</u>

Bidders attention is also drawn against clause 4.3 of IS: 4540:1968 character of load is counter emf load.

10.0 <u>MEASUREMENT OF VOLATAGE REGULATION(CLAUSE 6,7,8 IS-1540)</u>

Bidders shall provide D.C. voltage –current characteristics for rated character of the load along with the tender.

12.0 <u>TYPE TEST</u>

Type test shall be conducted on minimum 10% chargers or two chargers which ever is higher at different interval and following tests shall be conducted during type tests.

- i. D.C. voltage Current characteristics.
- ii. Automatic voltage regulation.
- iii. Conversion efficiency.
- iv A.C. component on D.C. side.
- v. Temperature rise.
- vi High voltage test(2KV test)
- vii Inspection Charger shall be subject to general inspection for the quality of work-man ship and finish.
- viii Auxiliary devices:-Such as contactors ,relays electronic circuits.
- ix In addition to above if any additional test is required by any relevant ISS shall also be conducted. Type test shall also be conducted on transformer as per IS:2026(Part-I)1977.

13.0 <u>ROUTINE TESTS</u>

Routine tests listed below shall be conducted on each and every charger and DCDB along with acceptance test at manufacturers works at his cost as per latest ISS such as IS 3136-1965.

- i. D.C. Voltage –Current characteristic.
- ii. High voltage
- iii. Inspection
- iv Auxiliary devices.
- 12.2.2 The battery charger capacity test may also be carried out at site at the time of commissioning of each set.

1.0 **GENERAL**

The D.C. distribution board shall be similar in construction to the charger having preferably the same height using 14SWG sheet steel. The DCDB shall have single aluminum bus bar arrangement and arrangement for connecting the out put of charger. Automatic switching of D.C.emergency light circuit in the event of A.C. failure shall also be provided.

- 2.0 Each D.C.D.Bs shall be provided with at least the following:
 - i) 1no.circuit (HRC fuse protected) with suitably rates changeover switch for charger input.
 - ii) 1no. A.C. single phase fuse protected circuit for A.C. supply monitoring emergency light switching and space heater.
 - iii) 20 Nos. 20 amp.110V D.C. outgoing circuits with suitably rated ON/OF switches(HRC fuse protected).
 - iv) Audio and visual indications shall be provided for tripping and under voltage D.C. (below 85% of 110V) conditions.
 - v) Audio and visual indication (230V AC operated) will also be provided for D.C.earth fault condition.
 - vi) Two series bulbs with center tap earthed and other ends connected to the battery shall also be provided.

3.0 DISTRIBUTION CIRCUIT FOR 300AH BATTERY

- 3.1 2 Nos. D.C. distribution boards along with 2 nos. chargers with 2 separate sets of the batteries shall be used at each 220KV substation.
- 3.2 Distribution board shall be provided with the following circuits with suitable rated Switches, protection, alarm and indication etc.
- 3.3 One number circuit through suitably rated change over switch with HRC fuses for connecting respective battery charger.
- 3.4 1No. 230V single phase supply for connecting A.C. contactor for switching on D.C. emergency light in the event of A.C. supply failure.
- 3.5 1no. D.C. emergency light for 25Amps. load with suitable rated rotary switch HRC fuses.
- 3.6 20 numbers outgoing circuit for rated 15Amps.load with suitably rated ON/OFF switches, HRC fuses.

- 3.7 All outgoing circuits emergency light circuit shall be supervised with individual circuits to give audio-visual alarm for fuses failure
- 3.8 Suitable earth fault on D.C. system may also be provided.
- 3.9 Two bulbs connected in series with center point earthed and the other ends of the two bulbs connected with the positive and negative bus bars shall also be provided.
TECHNICAL SPECIFICATION FOR 630 AMP 20KA 433 VOLTS L.T. SWITCH BOARD

1.0 STANDARDS

The switchboard shall conform to following specifications latest amendments thereof:-

(a)	IS-2516 (Part I&II/)	Specification for alternating current C.B. Sec.I)
(b)	IS-4237	General requirements for switchgear and Controlgear for voltages not exceeding 1000 Volts.
(c)	IS-6875	Control switches (Switching devices for control and auxiliary circuits including Contractor, Control switches (Switching devices for control and auxiliary circuits including Contractor, AC & 1200V DC)
(d)	IS-2705(Pt-II)	Specification for current transformers.
(e)	IS-1248	Specification for direct acting electrical indicating instruments.
(f)	IS-8623	Specification for factory built assemblies of switchgear and control gear for voltage up to and including 1000V AC and 1200V DC.
(g)	IS-8623(PtII)	Particular requirements for bus bar trunking system.
(h)	IS-375	Marking and arrangements for switchgear bus bars main connections and auxiliary wiring.

2.0 LT SWITCH BOARD REQUIREMENTS

- 2.1 The details and arrangement for the incoming and outgoing feeders on the L.T. switchboard shall be as per enclosed sketch no.I
- 2.2 Front operated L.T. switchboard shall be operative on $433 \pm 10\%$ volts, 3-phase, 4 wire, $50 \pm 5\%$ Hz grounded A.C. system having a rupturing capacity of not less than 20KA at rated operating voltage.
- 2.3 The board shall be made of MS sheet steel clad totally enclosed ,dust and vermin proof,

- 2.4 Cubicle suitable for indoor floor mounting with separate compartments for individual feeders.
- 2.5 Neoprene rubber gasket shall be used at all joining surfaces to achieve dust tight and vermin proof sealing.
- 2.6 The switchboard shall be of sheet steel construction with M.S. sheet not less than 3mm, thickness. Frame work shall be rigid without using any external bracings.
- 2.7 The switch board shall be designed to facilitate inspection/cleaning/repairs.
- 2.8 All equipments, bus bars with covers removed and other connections shall be easily accessible from the back or front. No live parts of switch shall be accessible unless it has been put in 'OFF' position.
- 2.9 All switches shall be suitable for front on board operation and interlocked with the doors.
- 2.10 The design of switchboard shall be such that it covers minimum floor space, however, ample space shall be provided in the cable duct for accommodating PVC insulated aluminum conductor cables with enough space for carrying out jointing works etc.
- 2.11 Brass cable glands, suitable for PVC aluminium conductor cable of sizes, as per table A&B shall be provided for all feeders.
- 2.12 Switches shall be placed in multitier arrangements, below with common bus bar chamber ,the switchboard shall be complete with foundation bolts ,small wiring wherever required, earthling strips upto nearest earth bar etc. Bimetallic connectors shall be used where aluminium to copper or vice-versa connections are required.

2.13 BUS BARS

- i) The bus bars shall be made of copper with PVC sleeving having rectangular cross sectional area of one square inch. These shall be adequately designed and supported to withstand the electro-dynamic forces arising from a short circuit in the system.
- ii) Vertical bus bars shall feed the outgoing feeders. These shall be completely enclosed and adequately ventilated. It should be possible to work on the circuit outgoing connections without any danger of accidental contacts with the live connections between vertical bus bar and circuit terminal.
- iii) The bus bar chamber shall be adequately ventilated and shall be provided with removable covers for easy access. The bus bars shall be PVC sleeved /taped except at T-off joints. At T-off joints sticking tape /molded tape shall be used. Connections between vertical bus bars and circuit terminals shall preferably be fully insulated or enclosed so as not to leave any exposed live parts. However these shall not be considered for any up-rating of the bus bar current rating due

to sleeving / taping.

iv) The bus bar should be taped with suitable colour code for ready identification of phases.

3.0 <u>AIR CIRCUIT BREAKERS</u>

- 3.1 Triple pole air circuit breakers shall be trip free manually operated horizontal draw out type fitted with mechanical ON and OFF indicator.
- 3.2 The A.C.B. should be designed for quick make and quick break operations and shall be fitted with C.T. operated thermo magnetic release for over load and short circuit protections.
- 3.3 The detailed specification of air circuit breakers are as follows:-
 - I Breaking capacity shall not be less than 20KA at rated operating voltage and breaker shall be rated for 630Amp.continuous.
 - II Set of mechanical interlocks with automatic safety shutter gear for completely shielding the stationary contacts, when breaker is removed.
 - III 1 no. auxiliary switch.
 - IV 1no. neutral link
 - V 1 set of contacts to give audible and visual (mechanical flag indication)alarm in case of tripping of the circuit breaker on fault with alarm bell and cancellation switch.
 - VI 3nos. C.T. 400/5A for metering having accuracy class 1 and instrument security factor 5.
 - VII 3nos current transformer of ratio 400-200/5.15VA burden and accuracy class 5P 10 for protection.
 - VIII 1 no. flush mounted voltmeters.
 - IX 1no. Voltmeter selector switch.
 - X 1no. flush mounted ammeter suitably scaled.
 - XI A meter selector switch.
 - XII Suitable for 3 core, 400sq.mm. PVC cable split type cable terminal box.
- XIII Push button for emergency tripping.
- XIV Label inscriptions, terminal boards and instruments fuses etc. All equipments and fuses etc. mounted on circuit breaker cubicle should be properly wired according to the equipments.

The CTs ammeter and voltmeter etc. shall be of reputed make well tried and proven by actual use. Terminal block shall be of Kirlkoskar-Asea or Easun make.

The A.C.B. shall be of CG- Schienider/ LARSEN AND TUBRO/ ALSTOM make.

4.0 MOULDED CASE CIRCUIT BREAKERS / ISOLATOR

- 4.1 The MOCB / isolator shall be suitable for flush mounted sheet steel clad, totally enclosed, cubicle type switchboard. It shall be possible to remove the switch for inspection or replacement from the face of the switch board such that connecting wirings are not disturbed.
- 4.2 The rupturing capacity of each MCCB/ Isolator shall not be less than 20KA at rated operating voltage.
- 4.3 Making current capacity of MOCB shall be twice the short circuit rating
- 4.4 The MOCB shall be manually operated with mechanical ON/OFF indicator; it shall be quick make/quick break type and trip free.
- 4.5 The MOCB shall be provided with tripping device with inverse time current characteristics for overload protection and device for instantaneous protection against short circuits.
- 4.6 The mounded case circuit breakers/isolators shall be of CG-Schiender /LARSEN AND TUBRO/ ALSTOM make, L.T boards shall have ACB and MOCB of same make only.

5.0 DETAILD SPECIFICATION FOR L.T. SWITCHBOARD

- 5.1 This switchboard is proposed to be installed at132KV substation for distribution of L.T. supply as per single line diagram shown in the enclosed sketch No.-1.
- 5.2 This switchboard shall be fed through two incoming circuits. The bus isolator on the switch board shall be mechanically and electrically interlocked with the incoming switched on the board such that bus isolator is not closed if supply is being fed through both the incomers. However, in case of failure of supply it shall be possible to energise the complete bus bar of the switchboard through either of the incoming switch.
- 5.3 The main bus bar shall be of 800 Amps, rating for phases and 400 Amp. for neutral and shall have following circuits:-
 - 1. Incoming circuit with 630Amp.ACB-2 Nos.
 - 2. Bus isolator 630Amp.rating moulded case type-1 No.
 - 3. Out going circuit with MOCBs of desired rating for following feeders.

MOCB	Thermal	No.	Cable terminals to be suitable for.
Rating	setting of	01	
	MOCB of	fdrs.	
	Fdrs.		
200Amp.	125 Amp.	1	95sq.mm. 3-1/2 core PVCAlum
_	_		cable
100Amp.	063Amp.	6	50sq.mmdo
100Amp.	040Amp.	2	50sq.mmdo

5.4 Neutral termination of each incoming and out going feeder from L.T. switch board should be done through a link provided adjacent to respective ACB/ MOCB.

6.0 ALARM SCHEME

- 6.1 110 volts DC operated suitable audible and visual (Mechanical Flag indication) alarm scheme shall be provided to indicate tripping of ACB-1,ACB-II and MOCBs. (common). There should also be 3 sets of audible and visual (Mechanical flag indication) alarm for station transformer indications viz Buchholz alarm, winding temperature high alarm.
- 6.2 The switchboard shall be provided with following indicating lamps:
 - i. Coloured Red to give CB closed indication.
 - ii. Coloured Green to give "C.B. open" indication.
 - iii. Coloured Yellow to give "DC supply healthy indication.

Schematic diagram giving the details of operation of the required alarms and mechanical Flag indication have been shown in the sketch no. II enclosed.

7.0 <u>TESTS</u>

The successful Tenderer shall be required to carry out the following tests at their works free of cost.

7.1 ASSEMBLY AND TEST AT MANUFACTURER'S WORKS

The L.T. switchboard and other associated equipment shall be assembled at the manufacturer's works and shall be subjected to routine and other acceptance tests specified in the latest relevant Indian Standard specification, Four copies of the certificates of the routine and acceptance tests on all the equipments shall be furnished by the Contractor to the "Engineer of the Contract" before dispatch for his approval showing that the L.T. switchboard has been tested and has been found to be sound electrically and mechanically and is in working order in all respect and that it complies with the terms of the order . The Contractor shall also provide facilities for the inspection of the routine and acceptance tests by the representative of the Purchaser, if so required. In addition to above routine and acceptance tests, the Contractor shall carryout temperature rise test on one of the L.T. switchboard of each category free of cost and shall submit test certificates for approval of the Purchaser. In respect of

all bought out components test certificates of their manufacturer must be submitted to the Purchaser. Details of these manufacturers shall be furnished to the Purchaser well in advance.

(1) <u>CIRCUIT BREAKERS</u>

Type test certificates on one breaker of each type i.e. ACB and MOCB of different rating shall be supplied. Routine tests shall be carried out on all the breakers which are to be supplied.

(2) <u>SWITCH BOARD</u>

Each component parts of the L.T. switchboard and other associated equipments shall be assembled and tested for accurate assembly and satisfactory operation at manufacturer's works before dispatch.

(3) **INSTRUMENT TRANSFORMERS**

All instruments transformers shall be subjected to tests at manufacturer's works in accordance with relevant Indian Standard Specifications. Ratio and phase angle calibration curves shall be submitted for each type. Copy of test certificate from manufacturer of these instrument transformers shall be supplied.

(4) <u>METERING INSTRUMENTS</u>

High voltage tests shall be carried out on all meters. Accuracy tests and calibration curves shall be submitted for one instrument of each type.

$(5) \qquad \underline{\text{TEST AT SITE}}$

The Purchaser reserves the right of carrying out at site such tests as he may decide upon, provided the test levels are within the limit laid down in Indian Standard Specifications. Such test shall be carried out in consultation with the Contractor and shall be at the expenses of the Purchaser.

8.0 <u>LABELLING</u>

The equipment shall be dispatched fully labeled describing type ,make, rated voltage ,frequency ,current rupturing capacity, this office tender specification no, year of order and substation for which purchased etc.

9.0 INTERCHANGEABILITY

All parts shall be made to standard gauge wherever possible so as to facilitate replacement and repair. All corresponding parts of similar apparatus shall be interchangeable.

10.0 <u>PAINTING</u>

The switch board shall be synthetic enamel painted in light grey as per shade

no.631 of ISS. To achieve a durable finish, careful surface pretreatment shall be carried out at per following process:

- i. Removing of rust and corrosion by treating all sheet metal with acid.
- ii. After acid treatment rinsing with cold water for removing traces of acid.
- iii. Rubbing and cleaning with sand paper for complete removal of scales/rust, if any.
- iv. Rinsing with cold water for a final cleaning.
- v. Air drying completely.
- vi. Spraying of one coat of best quality zinc chrome primer on dry sheet.
- vii. Removing minor surface flaws by rubbing and applying putty after first coat has air dried.
- viii. Spraying of one coat of air drying synthetic enamel paint light gray colour as per shade no.631 of ISS of best quality ICC make.
- ix. Spraying of 2nd, zinc chrome primer.
- x. Removal of surface flaws by applying putty and rubbing the sheet steel to a smooth level after the first coat has sufficiently air dried.
- xi Spraying of final coat of air drying synthetic enamel paint of shade no.631 of IEC make .
- xii Half liter paint of the same shade shall also be supplied with each board for final touch of boards or any minor scratches caused during transportation.





SKETCH-III

<u>SCHEMATIC DIAGRAM OF AUDIABLE VISUAL</u> (MECHANICAL FLAG INDICATION) ALARM SCHEME REQUIRED IN L.T. SWITCH BOARD



+Ve

-Ve

TECHNICAL SPECIFICATION OF 1.1 KV, PVC FRLS, UNARMOURED COPPER CONROL CABLES AND ALLUMINUM POWER CABLES

1.0 STANDARDS

The design, manufacture and testing of cables covered under this specification shall comply with following standards (with subsequent amendments thereof) unless otherwise specified :-

- 1. IS :1554 (Part-I) PVC insulated (Heavy duty electric cables).
- 2. IS :1554 (Part-II) PVC Insulated (Heavy duty) Electric Cables.
- 3. IS :5831 PVC Insulation and sheath of Electric Cables.
- 4. IS :8130 Conductors for insulated Electric Cables and Cords.
- 5. IS :3961 Current Ratings of Cables.
- 6. IS :502 Extended solid di-electric insulated power cables for rated voltage from 1 KV to 30 KV.
- 7. IEC-540 & 540A Test methods for insulation and sheath of electric cables and cords.
- 8. IEEE 383 Standard for type tests for class IE Electric Cables, field Splices and connections for nuclear power generating stations.
- 9. Swedish Standard SS Flammability Test 4241475 Class F-3
- 10. IEC 332-I Test on electric cables under fire conditions.
- 11.
 ASTMD-2843
 Standard test method for density of smoke from burning/decomposition of plastics.
- 12. IEC 754-I Test method for acid gas generation.
- 13. BICC hand book for cables in fire regarding temperature index- Chapter-6.

14.	ASTMD-2863	Ox	ygen index and temperature index tests.
15.	NEMA-WC-5	i)	Accelerated water Absorption test.

ii) Dielectric strength Retention test

PRINCIPAL PARAMERERS

S.No.	Part	iculars	Size of PVC, FRLS Control Cable			Cables.
			2x2.5	4x2.5	6x2.5	10x2.5
						mm²
1.	Туре	Type of cable		1.1 KV grade, PVC, FRLS, Unarmoured control cables.		
2.	Standard applicable		IS : 1551	(Part-I).		
3.		IDUCTOR				
	(a)	Material	Plain a copper a	nnealed s per IS :8	high coi 3130.	nductivity
	(b)	Shape of conductor	Solid co section.	pper hav	ing circul	ar cross
	€	Size (Dia) nom. in mm.		1.	78	
	(d)	Max. ^m D.C. resistance of conductor of completed cable at 20 ⁰ C (ohm/km.)		7.4	41	
4.	INSU	JLATION				
	(a)	Туре		PVC Ty	/pe-A of IS	S :5831.
	(b)	Thickness (Nom.) in mm.		0.9	9	
5.	INNE	ER SHEATH				
	(a)	Туре		PVC Type	ST-1 of I	S :5831
	(b)	Thickness (min. ^m) in mm.		0.3	8	
6.	<u>OUT</u>	ER SHEATH				
	(a)	Туре	F	PVC Type	ST-2 of IS	S :5831
	(1-)	Thistory (Name) in more		4.0		2.0
	(D)	Thickness (Nom.) in mm.		1.8		(10x2.5 mm ²)
7.	Stan	dard drum length		500 metr	es <u>+</u> 5%	
8.	Extru	usion of inner and outer sheath.	In two c	listinct sep	oarate ext	rusions.

2.1 Control Cables shall be 1.1 KV grade, high conductivity, solid copper conductor, PVC insulated, extruded PVC inner sheathed and separate

extruded PVC outer sheath overall having FRLS properties as per above standards, conforming to IS :1554 (Part-I)

- 2.2 Two distinct sheaths i.e., inner and outer should be provided in two separate operations. Single operation sheathing shall not be accepted. The outer sheathing shall be designed to afford a high degree of mechanical protection against fire and also shall be oil, chemicals and weather resistant. Common acids, alkalies and saline solutions should not have any adverse effect on PVC sheathing materials used. The outer sheathing shall be of PVC having FRLS properties.
- 2.3 The Control Cables shall be suitable for running in conduits, ducts, channels, racks and trays, covered trenches with removable covers in outdoor substations and also in ground.

2.4 **CONDUCTOR**

The conductor shall be made from plain annealed high conductivity solid copper having resistance and diameter specified in the technical particulars (on page TS-9).

2.5 **INSULATION**

The PVC insulation shall be Type-A, extruded PVC 1.1 KV grade and free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. It shall be of consistent quality and free from all defects.

2.6 **INNER SHEATH**

The inner sheath shall be of extruded PVC (Type-ST1). The sheath shall be suitable to withstand the site conditions and the desired temperature. It shall be of min.^m thickness as per technical particulars (page TS-9) and applied by a continuous process to produce a sheath of consistent quality and free from all defects.

2.7 **OUTER SHEATH**

It should be of extruded PVC (Type ST₂) having min.^m thickness as per technical particulars (page TS-9). Outer sheath shall be applied in distinct separate extrusion. It should be of consistent quality and free from all defects. Suitable additives are also applied to prevent attack by rodent and termites. The outer sheathing must be fire retardant and low smoke type.

2.8 **NUMBERING OF THE CORES**

The colour code of cores shall be as per IS : 1554 and also each light grey core of 6 and 10 core cable shall be numbered and the colour of core printing shall contrast with the colour of insulation. The numbers shall be repeated at regular intervals at every 10cm. of the entire length of cable.

2.9 CONSTRUCTION

2.9.1 The cable shall have PVC fillers to provide a uniform circular cross section before the inner sheath is applied. The PVC fillers should be suitable for the

operating temperature of the cable compatible with the insulating material.

- 2.9.2 All materials used in manufacturing of cable shall be new, unused and of finest quality. All materials should comply with the applicable provisions of the tests mentioned in this specification, ISS, IER, Indian Electricity Act and any other applicable statutory provisions, rules and regulations. The PVC material used should be of reputed manufacturers. No recycling of PVC is permissible. The Purchaser reserves the right to himself to ask for documentary proof of the purchase of material to be used for the manufacture of the cables and to check that the manufacturer is complying with quality control.
- 2.9.3 The workmanship shall be neat, clean and of highest grade.

2.9.4 CURRENT RATINGS

- 2.9.5 Current ratings and de rating factors under normal conditions of installation shall be as per latest amendment of IS : 3961 (Part-II).
- 2.9.6 The current ratings shall be based on maximum conductor temperature depending on the type of insulation for continuous operation at the rated current.

2.9.7 **LENGTHS**

The control cables should be supplied in standard drum lengths of 500 metres for all the sizes with a tolerance of \pm 5%. Only 5% of ordered quantity may be accepted in non standard drum lengths but not less than 100 metres.

However, in case allotted quantity for 6x2.5 sq.mm. & 10x2.5 sq.mm. cable is less than 500 metre for particular s/s, the drum length shall be as per allotment issued by Purchaser, without any extra cost, which may be beyond 5% limit specified above.

3.0 <u>1.1 KV GRADE POWER CABLES</u> PRINCIPAL PARAMETERS

S.No.	Particulars		Sizes of PVC, FRLS, Power Cable			
			3½x400	3½x30	3½x9	3½x5
			sq.mm	0	5	0
				sq.mm	sq.m	sq.m
					m	m
1	2		3	4	5	6
1.	Type & make of the cable		1.1 KV armoure	Grade, F ed Power	VC, FRI Cable	LS, Un-
2.	Conductor					
	(a) Size of Conductor (in sq.mm) Main	400	300	95	50
	(b) Aluminium Grade	leutral	185	150	50	25
3.	Number of cores			H4-		

4.	Insulation	
	(а) Туре	As per IS :5831/1984
	(b) Thickness in mm.	As per IS :1554(I)
5.	Inner Sheath	
	(а) Туре	Extruded PVC Type-ST1 of IS :5831/1984
	(b) Thickness	As per IS :1554(I)
6.	Outer Sheath	
	(а) Туре	Extruded PVC Type-ST2
	(b) Thickness	As per IS :1554(I)
7.	Standard drum length of cable on drum (in mtrs.)	As desired by Purchaser vide allotment letter.
8.	Standard specification to which the cable will conform.	IS :1554 (Pt-I) & other applicable standards with latest amendments.
9.	Rating factors under various conditions of installation.	As per IS :3961 (Pt-II) 1967
10.	Minimum bending radius	12 x O.D.
11.	Inner & other sheath in single of two distinct extrusions.	Two distinct extrusions.

The power cables of various sizes shall be of high conductivity stranded aluminum conductor, PVC insulated, extruded PVC inner sheath and black PVC overall sheath fire retardant low smoke 1100 V grade conforming to IS :1554 Part-I/1985 (with latest amendments).

3.1 CONDUCTOR

The cable conductor shall be made from stranded aluminium to form compact sector shaped conductor having resistance within the limits specified.

3.2 INSULATION

Insulation of the cable shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The insulation of the cables shall be in conformity with IS :5831-1984.

3.3 INNER SHEATH

The inner sheath shall be of extruded PVC Type ST-1 as per IS :5831-1984. The sheath shall be suitable to withstand the site conditions and the desired temperature. It shall be of adequate thickness and applied by the continuous process to produce a sheath of consistent quality and free from all defects.

3.4 OUTER SHEATH

Extruded PVC serving Type ST-2 of IS :5831/1984 shall be applied with suitable additives to prevent attack by rodents and termites. All servings must be given anti-termite treatment. The outer sheathing must be fire retardant and low smoke type.

3.5 CONSTRUCTION

- 3.5.1 Cables shall have fillers of PVC to provide substantially circular cross section before the inner sheath is applied. The fillers should be suitable for the operating temperature of the cable and compatible with the insulating material.
- 3.5.2 All materials used in the manufacture of cable shall be new, unused and of finest quality. All materials should comply with the applicable provisions of the test mentioned in this specification, Indian Standard specification, Indian Electricity Rules, Indian Electricity Act and any other applicable statutory provisions, rules and regulations. The PVC material used in the manufactures of cable should be of reputed manufacturer. No recycling of the PVC is permissible. The Purchaser reserves the right to ask for the documentary proof of the purchase of the material to be used for the manufacture of the cables and to check that the manufacture is complying with quality control as per this specification.
- 3.5.3 Workmanship shall be neat, clean and of highest grade.

3.6 **CURRENT RATINGS**

3.6.1 Rating factors of the cables under normal conditions of installation as per IS :3961 Part-II-1967 and subsequent amendments thereof should be mentioned. The rating factors for different conditions of laying installations should be furnished. The 1 sec. and 3 se. short circuit current rating should also be furnished.

3.7 LENGTHS

The cable shall normally be supplied in standard drum lengths as given below :-

SI. No.	Size of cable (sq.mm.)	Drum lengths (mtrs.)	Tolerance
1.	3½ x 400	150 or 200	<u>+</u> 5%
2.	3½ x 300	400	- do -
3.	3½ x 95	150	- do -
4.	3½ x 50	300 or 400	- do —

4.0 **PACKING**

4.1 The cables will be supplied duly packed in standard non returnable wooden drums in conformity to relevant ISS, suitable for transport by goods train or

truck and for storage at site.

4.2 The wood used for construction of drum shall be properly seasoned and sound. All ferrous parts shall be treated with a suitable rust preventive finish.

5.0 **IDENTIFICATION**

- 5.1 Name of manufacturer, Specification No. SD--- ,year of manufacture, UPPTCL property shall be embossed at regular intervals of one meter in addition to the length in meters on the outer sheath of cable.
- 5.2 Followings shall be stenciled on each drum :-
 - (a) Reference to the Indian Standard.
 - (b) Manufacturer's Name, brand name or trade name
 - (c) Type of cable and voltage grade.
 - (d) Number of cores.
 - (e) Nominal cross sectional area of conductor.
 - (f) Cable code.
 - (g) Colour of core, if any.
 - (h) Length of cable on the drum.
 - (i) Numbers of lengths on a drum-preferable one only.
 - (j) Direction of rotation of drum-arrow mark.
 - (k) Gross weight.
 - (I) Year of manufacture/ Specification No. SD-

5.3 SERVICE CONDITIONS AND OPERATION

- 5.4 Cables shall be suitable for installation in tropical monsoon areas and hot, humid climatic conditions of U.P.
- 5.5 Cables shall be capable for being laid horizontally, inclined or even vertically.

6.0 **TESTS DURING MANUFACTURE**

During the manufacture of cables, manufacturer's standard tests shall be performed and copies of test certificates shall be furnished.

7.0 **ROUTINE, ACCEPTANCE, TYPE AND SPECIAL TESTS**

7.1 After completion of manufacture of Cables, routine, acceptance, type and special tests shall be performed at their works, strictly as per provisions of this specification and relevant standard specifications. Test certificate shall

be submitted and got approved before dispatch of the material. Approval of the test certificates will be issued within 10 days from submission.

7.2 The Purchaser reserves the right to witness all tests and the supplier shall provide all facilities, to the Purchaser in this regard and shall inform the Purchaser to depute his representative to witness the same.

7.3 **ROUTINE AND ACCEPTANCE TESTS**

Following tests shall constitute Routine and Acceptance Tests :-

- (1) Annealing test (Copper) as per IS : 8130.
- (2) Conductor resistance test as per IS : 8130.
- (3) Test for thickness of insulation and sheath as per IS : 5831.
- (4) Insulation resistance Test as per IS : 5831.
- (5) High Voltage Test at room temperature IS : 1554 (Part-I)
- (6) Tensile strength and elongation test for insulation and sheath as per IS : 5831.

Contractor shall submit routine test reports of cables for each drum and packing lists of drum along with his offer of inspection. During inspection, acceptance tests as per sampling plan specified in IS :1554 (Part-I) separately for each size of cable, shall be performed in presence of Purchaser's representative.

Apart from above, conductor examination, check of dimensions & physical conditions of cable and drum shall also be carried out as routine and acceptance tests.

7.4 **TYPE TESTS**

Following tests shall constitute type tests :-

- (1) Annealing test for copper as per IS : 8130.
- (2) Conductor resistance test as per IS : 8130.
- (3) Test for thickness of insulation and sheath as per IS : 5831.
- (4) Tensile strength and elongation test for insulation and sheath as per IS : 5831.
- (5) Ageing test for insulation and sheath as per IS : 5831.
- (6) Loss of Mass test for insulation and sheath as per IEC-540 and IEC-502.
- (7) Shrinkage test for insulation and sheath as per IS : 5831.

- (8) Hot deformation test for insulation and sheath as per IS : 5831.
- (9) Cold impact/cold bend test as per IS : 5831.
- (10) Heat shock test for insulation and sheath as per IEC-540 and IEC-502.
- (11) Thermal stability test for insulation and sheath as per IEC-540A.
- (12) Test for bleeding and blooming of pigments for insulation and sheath as per IS : 5831.
- (13) Flammability test on completed cables as per IS : 1554.
- (14) Measurement of insulation resistance as per IS : 5831.
- (15) High voltage test as per IS : 1554 including water immersion test (AC & DC).

During inspection, type test shall be performed on one drum of each of 2 each size of cable in each lot. The tests shall be conducted as per methods elaborated in applicable standards and the results shall be in conformity with Schedules whether specified by the standard or not.

The long duration type tests viz. ageing test (at SI.No.5) loss of mass test (at SI.No.6) Bleeding & Blooming test (at SI.No.12) & D.C. High Voltage Water Immersion Test (at SI.No.15) above shall be got conducted from some Government Laboratory like CPRI, ERDA etc. The samples for above test shall be sealed by inspecting officers during inspection.

7.5 SPECIAL TESTS

Following shall constitute special tests :-

- (1) Oxygen Index test as per ASTMD-2863.
- (2) Temperature Index test as per ASTMD-2863.
- (3) Flammability test on finished cables as per Swedish Standard SS 4241475, IEEE-383 and IEC-332-I.
- (4) Acid Gas Generation during fire of sheath as per IEC-754-I
- (5) Smoke Generation by sheath under fire as per ASTMD-2843.
- (6) Test for rodent and termite repulsion of sheath.

During inspection the special tests shall be performed on one drum of each size of cable in each lot. The tests shall be conducted as per methods elaborated in applicable standards and the results shall be in conformity with Schedule-S whether specified by standard or not.

7.6 All expenditure incurred on such acceptance, Type & special tests as well as cost of cable consumed during testing shall be to the supplier's account. Dispatch lengths shall be taken after deducting the length of the cable

consumed in above tests.

All expenses regarding testing charges including cost of cable sample & transportation there of etc. in respect of type tests to be got conducted from Govt. laboratories shall also be borne by the Contractor.

7.7 The Purchaser reserves the right to modify/ delete or add any test. The tenderers shall confirm that all test equipments and testing facilities are available at their works for carrying out all above tests by them. The compliance to the above test clause is pre qualifying condition for this tender and the bidder shall confirm to carryout the specified tests.

SCHEDULE-S

COMPARATIVE PROPERTIES

S.No.	Parti	culars		Requi	rement	
			Standard	Insulation Type-A	Inner sheath Type ST- 1	Outer sheath Type-ST-2
1.	Tens elong	ile strength and gation	IS :5831			
(A)	<u>Befo</u>	re ageing				
	(a)	Tensile strength (Kg/Cm ²) Min.		125	125	125
	(b)	Elongation at break(%) Min.		150	150	150
(B)	<u>After</u> <u>80⁰C Varia</u>	ageing at /100 ⁰ C For 168 hrs. ation.				
	(a)	In tensile strength (%) (Max.)		<u>+</u> 20	<u>+</u> 20	<u>+</u> 25
	(b)	In elongation at break (%) (Max.)		<u>+</u> 20	<u>+</u> 20	<u>+</u> 25
2.	Loss in Mass at 80 ^o C for 168 hrs. (Max. ^m (mg/sg.cm.)		IS :5831	2	2	2
3.	Heat for 1	Shock test at 150 ⁰ C hr.	IEC-540	shall not crack	shall not crack	shall not crack
4.	Ther 200 ⁰	mal stability Test at C (Minutes) (Min.)	IEC- 540A	80	40	80
5.	Shrir	nkage Test (%) Max.	IS :5831	4	4	4
6.	Hot deformation test thickness retained (%) Min.		IS :5831	50	50	50
7.	Bleeding and blooming test		IS :5831	Colour sha either case	III not be tra	ansferred in
8.	Cold	bend test	IS :5831	No signs of	cracks or so	ales
9.	Cold	Impact test	IS :5831		- do-	
10.	Oxyg	jen Index test (Min.)	ASTMD 2863			29

11.	Rodent and termite repulsion property					shall have repulsion property
12.	Fla	mmability Test				
	a)	Unaffected (uncharred) portion from the lower edge of the top clamp (mm.) min.	IS :1554			50
	b)	period of burning after removal of flame (Secs) Max.	IS :1534			60
13.	Vo Ins (Mi	lume Resistivity of ulation (Ohm. cm.) n.)				
	i)	At 27 [°] C		1x10 ¹³		
	ii)	At 70 ⁰ C		1x10 ¹⁰		
14.	Fla	mmability tests :	Swedish Standar d SS- 4241475 and class F ₃			Should pass
14.1			IEEE 383	-	-	Should pass
14.2			IEE332-I			Should pass
15.	Smoke Generation Test (Min.)		ASTMD 3843			40% (Light Trans- mission)
16.	Temperature Index Test (Min.)		ASTMD 2863			250°C
17.	Aci Ma	id Gas Generation (%) x.	IEC- 754-I			20
18.	Hig	h Voltage Test		As per Is	S :1554(I)	

TECHNICAL SPECIFICATION OF LATTICE TYPE MAIN/ AUXILIARY STRUCTURES

1.0 <u>STANDARDS</u>

The finished structure shall conform to the latest revisions with amendments available of relevant standards rules and codes, some of which are listed herein for reference.

Sl.No.	Standard	Title
1	IS-2062	Steel for general Structural purposes
2	IS-6639,1363	Specification for Hexagonal bolts, nuts for structures
	IS-1367,2614	
3	IS-2016	Specification for Plain washers
4	IS-5258	Specification for hot dip galvanized coating on fasteners
5	IS-7215	Specification for tolerances in fabrication
6	IS-2629	Specification for testing of galvanizing
7	IS-2633	Specification for process of hot dip galvanizing
8	IS-209	Specification for quality of zinc
9	IS-800	Code of practice for general construction in steel
10	IS-4759	Specification for tests on galvanizing

2.0 PRINCIPAL PARAMETERS

The Contractor shall be fully and solely responsible for the procurement of all the raw material for fabrication of main / auxiliary structures. The drawings for individual structures will be issued to the successful bidder.

a) <u>STEEL</u>

- i) Steel used for fabrication of structures shall be mild steel of tested quality, as per IS : 2062 or any latest revision thereof.
- ii) The bidder should take into account any fabrication wastage while quoting rates and Employer shall not accept any liability in connection with wastage of steel during fabrication or otherwise.
- iii) The steel shall be procured exclusively from the main steel Producers. However angle sections below 110x110x10 mm. required for fabrication can be procured from Reroller provided the Contractor certifies with sufficient documents that :
 - a) These are not available from Main Steel Producers.
 - b) Rerolling of structural steel sections is done from billets of tested quality.

- c) Rerolled sections are duly tested as per IS: 2062.
- iv) If a particular section is not available in the market then Contractor shall use next available higher section with specific approval of the employer, and, additional cost on account of using higher section shall not be payable to the Contractor.

b) <u>ZINC</u>

- i) Zinc of purity not less than 99.95% shall be used, Zinc shall conform to IS 209/1979 or its latest revisions.
- ii) All wastage, excess consumption, during galvanising or otherwise of zinc, shall be to Contractor's account.

c) <u>BOLTS, NUTS & WASHERS</u>

Galvanized bolts & nuts required shall be of GKW make. Bolts and Nuts shall be duly galvanised as per IS: 1367 Part XIII/1983. Bolts shall conform to IS 6639-1972 and nuts to IS 1363 with their latest amendment. The mechanical properties shall conform to Clause 4.6 for bolts and Clause 4 for nuts of IS: 1367-1972. Testing of bolts & nuts shall be as per above referred IS and IS: 2614. Flat washers shall be 5 mm. thick or as required and shall be made of mild steel and duly galvanised.

Spring washers shall be suitable for 16mm. size bolts, 3.5 mm. thick non square section as per IS: 3063/-1972. These shall be galvanised as per IS: 1573.

The quantity of various sizes of bolts, nuts and washers are indicated in relevant drawings of the employer.

3.0 DRAWING AND DATA

The substation structures proposed to be procured against this specification, shall be as per the designs of the employer. Outline structural drawings of each structure shall be made available by the employer to the successful bidder for developing detailed shop drawings and actual bill of material. Two copies of such shop drawings prepared by the Contractor shall be made available to the Employer. The Contractor shall be fully responsible for checking the drawings made available by the Employer and developing the shop drawing correctly. However 3 copies of detailed bills of materials will be submitted by the Contractor to employer for Approval. Typical drawings (Typical for guidance) are enclosed at annexes.

4.0 FABRICATION

Based on the drawings of the employer and his own detailed shop drawings the Contractor shall prepare the model assembly of each structure within one month and send a call for inspection of the model assembly and also to verify the bill of material. The Engineer shall check in detail such model assemblies and verify the bills of material of each. Any modification, rectification, corrections required in the structures to make it conform to the approved drawings and requirements to this specification or standards, shall be made by the Contractor and get approved from the Engineer, Any approval of the model assemblies shall not relieve the Contractor in any way of his responsibility to supply correctly fabricated / galvanised structure in conformity with approved designs, Standards Specification.

After approval of each model assembly, the mass fabrication of the structures shall be started by the Contractor as soon as employer's approval is received by him and complete as per the approved delivery schedule. During mass fabrication, the Contractor shall ensure that complete structures of different types are made available to the employer @ 150 MT Per month, and, the fabrication shall be so programmed so as to make this possible on a regular basis. Mass fabrication of one type of structure may be required to be done at more than one time, depending upon the site requirement of the employer.

Following points relevant to the fabrication work shall be complied by the Contractor. The employer, however, reserves the right at all times to inspect the fabrication of structures at Contractor's or his sub – Contractor's works.

- a) All parts of the structures shall be fabricated in accordance with the drawings approved by the employer and detailed shop drawings prepared by the Contractor. Main structures shall have bolted connections, except connection of the bottom base plate with the leg members as per the approved drawings. No other welding shall be permitted at any point, unless, otherwise previously approved by the employer for main structures. For auxiliary structures angle or channel boxes may be required by welding as per the drawings of the employer.
- b) Fabrication of structures shall be carried out in conformity with the latest practice employed in the manufacture of similar structures, using power driven cropping, punching, shearing and drilling machines. The extent of various operations shall be governed by relevant Indian or any other approved standard specification, and the standard practices followed for such operations.
- c) No rough edge shall be permitted anywhere in the entire structure. The flanges of the angle sections at the ends of members shall be properly chamfered.
- d) Full inter-changeability shall be guaranteed.
- e) No welding, filling or plugging shall be permitted unless previously approved. Welding of two or more pieces to obtain length of a member will not be permitted.
- f) All sections, plates and bars, before any work is done on them, shall be straightened, made free from twists, carefully levelled and made true to

detailed drawings by methods, which will not injure the materials, so that when assembled, the adjacent surfaces are in close contact throughout. Hammering will not be permitted for straightening or flattening of members.

- g) Cutting of members shall be affected by cropping, flame cutting or sawing. Members over 10mm thickness shall be sawn or flame cut followed by grinding. The surface so cut shall be clean, smooth, reasonable square and free from any distortion.
- h) Holes in the members shall be either punched or drilled with the help of jigs and fixtures. Drilled holes will be preferred. However, members up to 12 mm thickness may be punched. Members over 12 mm thickness shall be drilled. All burrs left after drilling or punching shall be removed completely. Holes adjacent to the bends shall to drilled or punched after bending.
- i) Holes for bolts shall be circular or oval, lobbed forms of holes shall not be permitted. The diameter of hole shall be 1.5 mm more than the diameter of bolts.
- j) The holes shall be perpendicular to the plates or angles.
- k) The accuracy of location of holes shall be such that for any group when assembled, it shall admit the bolt at right angles to the planes of connection.
- Members shall be bent hot, in case of small bends, cold bending may be done with the prior approval of the Engineer, provided no fracture of material occurs. All the bending operations shall be done by pressure. No bending of members shall be done for slope above 45 degree.
- m) When members are spliced by a lap joint, heel of inside angle shall be rounded to the minimum possible radius, consistent with proper fit with the fillet of the outside angle. The thickness of the ground heel shall not be less than that of the leg. Flat heeling will not be allowed. Detail of joints is available in structure drawings.

n) Tolerances-

- I) The maximum allowable difference in diameter of the hole on the two sides of plate or angles shall not exceed 0.8mm.
- II) The tolerance cumulative and between consecutive holes shall be within ± 0.5 mm.
- III) The tolerance on the overall length of member shall be within ± 1.6 mm.
- IV) The tolerance on back mark shall be within ± 0.5 mm.

o) The minimum spacing from center to center of bolt holes should be as shown below: - As per IS 802 (Part II)

Size of Bolts	Minimum Spacing
12 mm	32
16 mm	40
20 mm	48

p) The minimum distance from center to center of any hole to any edge should be as shown below:-

Bolt dia (mm)	Hole dia (mm)	Rolled Edge Distance (mm)	Sheared Edge Distance (mm)
12	13.5	16	20
16	17.5	20	23
20	21.5	25	28

Holes shall be perfectly circular.

5.0 <u>WELDING</u>

- a) Welding is to be resorted to only where indicated in the structural drawings.
- b) Surface to be welded shall be made absolutely free from grease, paint & loose scales etc. The joints shall be prepared in accordance with the approved fabrication drawings.
- c) All welds shall be free from defects like blow holes, slag inclusions, lack of penetration etc. Welds shall show uniform sections, and, .weld size need not exceed thickness of thinner part joined.

All fillet welds shall be inspected for flaws by the following methods.

- i) Radio graphic inspection,
- ii) Magnetic particle examination as per ASTM E125-63.

6.0 <u>CONNECTIONS</u>

a) For main structures:

All the connections are bolted type, the details of which will be available in structure drawings supplied to the Contractor for developing detailed shop drawing and bills of materials except for bottom of members with the base plate which may be welded as per drawing.

b) For auxiliary structures:

The joints etc. shall be specified in each drawing separately however they are either bolted or welded connections.

7.0 <u>MARKINGS</u>

All pieces covered under supply of the structures shall have distinct erection marks as given on the drawings and approved bills of materials, made with a steel punch and sufficiently indented with letters and figures, not less than 12mm x 18mm. in sizes, so that these are clearly visible after galvanising. The letters shall indicate the type of structure (ATM, BTM, CTM or other) for which the member is meant and numeral shall indicate the member mark as per drawing and approved bills of materials. These erection marks shall be stamped near one end, and, in the same relative position on each piece, in such a way that the mechanical properties of members are not affected. Special care must be taken to stamp the correct erection mark. The Contractor shall be entirely responsible for any disruption of work, or delay in completion of work of delay in payment of Contractor's bills on account of wrong erection marks.

8.0 <u>GALVANISING</u>

- i) All members of the structures and special structures along with its cleats, bolts, nuts & washers, fixing attachments, if any, shall be hot dip galvanised.,
- The galvanizing shall be done after all fabrication work is completed on the ii) members. Galvanising on fabrication member shall be done by hot dip process in full compliance with the latest revision of IS : 2629. Galvanising of bolts & nuts shall be in accordance with IS: 1367 Part XIII/63 and that for spring washers in accordance with IS: 1573. Material to be galvanized, is to be kept free from grease and paint etc., during and after fabrication. After galvanising, the surface shall be free from all sharp edge and metal nodules and there shall be no clogging of bolt holes due to stay of zinc. The bidders shall submit with their bids, the process of galvanizing adopted by them, along with the devices and facilities available with them. For more authoritative and better control on quality of galvanizing, they shall also state the minimum and maximum percentage increase in the weight of the completely galvanized materials compared to their black weight and the quantity of zinc required per metric ton of the black steel weight of the fabrication structures.
- iii) Tests on the galvanised samples of fabricated material shall be carried out regularly in strict accordance with the IS 4759. If the galvanizing does not satisfy testing requirements, entire batch represented by the sample piece shall be rejected and regalvanised to satisfy the test requirement without any extra expenditure to the employer's account.
- iv) In addition, strict inspection of the galvanised material shall be carried out by the Contractor before dispatch and any visible or suspected defect shall be rectified forthwith.

9.0 <u>TESTS</u>

All materials offered shall be fully tested by the bidder as per the relevant standards.

All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the supplier in the presence of employer's representative.

10.0 **INSPECTION**

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In addition to the provisions in clause no. 2.4.0 of General conditions, the following shall also apply:-

- a) Should any member of the structure be found not to comply with the approved designs/ drawings or with the provisions of the specifications, it shall be liable to rejection. No member, once rejected shall be resubmitted for inspection, except in cases where the employer or his authorized representative considers the defect as rectifiable.
- b) Defects which may appear during fabrication shall be made good with the consent of, and, according to the procedure laid down by the employer.
- c) All gauges and templates necessary to satisfy the employer shall be supplied by the manufacturer.
- d) The correct grade and quality of steel and zinc shall be used by the manufacturer. To ascertain the quality of steel / zinc used, the inspector may at his discretion, get the material tested at an approved laboratory.
- e) The Contractor will offer his material for inspection in following two stages.
 - 1. Model assembly inspection
 - 2. Fully fabricated galvanized material inspection.
- f) The employer representative shall inspect the Model assemblies offered for inspection and on being satisfied give clearance to the Contractor, for mass fabrication, of the cleared structure.
- g) The representative shall also carry out galvanized tests on the randomly selected pieces of galvanized structures.

On successful inspection, the Contractor will submit to the employer

- manufacturer's test certificates inspection report etc.
 - and will request for issue of dispatch clearance from the employer.

11.0 PACKAGING & FORWARDING

- i) Light angle sections shall be wire bundled and heavy angle sections may be sent loose.
- ii) Cleat angles, plates, hangers, 'U' bolts, pack washers and similar loose pieces shall be nested and bolted together in multiples or securely wired together through holes.
- iii) Bolts, nuts washers and other attachments shall be packed in non returnable double gunny bags and accurately tagged in accordance with contents.
- iv) The packing shall be made in such a way as to avoid losses / damages during transit, each bundle or package shall be appropriately marked. Any loss or damage during transit shall be made up/rectified by the Contractor at no extra cost to the employer.
- v) No extra charges for packing shall be admissible. Bidders may include its cost in their quoted rates.

12.0 MODE OF CALCULATION OF WEIGHT

The weight of structure ordered against this specification mentioned in "quantity" clause is black weight of the structure which is defined as below:-

Black weight of the structure is the weight without galvanising and without deduction for holes, notches, bevel cuts etc. for irregular shapes the minimum size of the rectangle covering the irregular shape will be taken for weight calculations. Bill of materials for each structure shall indicate this black weight.

13.0 <u>PRICE</u>

The rates quoted in the schedule shall be applicable on black weight of structure and are inclusive of cost of zinc and other raw materials, fabrication, galvanising, packing, forwarding, unloading & stacking at site (including transit up to site) including cost of MS angles, channels, plates, welding, flat washers, spring washers fasteners, step bolts, U bolts etc. The price shall include supply of 2.5 % extra bolts, nuts & washers in nos. for each individual structure to cater for wastage during erection of structures. The Contractor shall transport the fabricated steel structure through rail / road or by any means of transport and shall be fully responsible for any shortage or loss during transit. Rate should also include transit insurance. Any shortage / damage shall be made up/rectified by the Contractor within one month time without any extra cost to the employer.

INFORMATION ON ESSENTIAL FACILITIES AVAILABLE WITH THE FABRICATOR

(To be filled in by the bidder)

Straightening:

Is there any facility for Straightening of section i.e. Angles / Channels / Rounds etc?

If yes, intimate the type of Machine.

1. Section Cutting:

Is there any facility for section cutting? If yes intimate the type of machine; also intimate the maximum of thickness of angle flanges and diameter of round, which can be cut by above machine. Capacity of machine may also be intimated.

2. Cropping:

- i) Indicate the facility for cropping of plates
- ii) Intimate the type of machine and the thickness and width it can be crop.

3. Punching / Drilling:

- i) Indicate the facilities for Punching and drilling of holes.
- ii) Thickness of plates/angles flanges that can be punched or drilled may be intimated

separately for punching and drilling machine respectively.

4. Welding / Gas cutting:

Indicate the facilities available for performing this operation. Bidder should clearly specify whether facility of radiographic inspection and magnetic particle Examination of welds are available.

5. Facilities for checking design of structures including availability of qualified Personnel etc.

B: GALVANIZING:

Is there any facility for hot dip galvanizing of structures available at your works? If yes then furnish the following information:

- a) The galvanizing plant is coal fired or oil fired.
- b) The dimensions of the galvanizing tank to assess the maximum size of the members that can be galvanized.

- c) Facilities for management and control of temperature of zinc during galvanizing process.
- d) Test facilities available for thickness of the coating of zinc on members.
- e) Test facilities to check gm/ sq.m coating of zinc on members.
- f) Availability of various IS codes pertaining to galvanizing at the test laboratory.
- g) Minimum and maximum percentage increase in weight of galvanized structure compares to their black weight.
- h) Quantity of zinc required per MT of black weight of steel structure.

TECHNICAL SPECIFICATION OF FOUNDATION ANCHOR BOLTS

1.0 <u>STANDARDS</u> :

The finished foundation anchor bolts shall conform to the latest revisions with amendments available of relevant standards rules and codes, some of which are listed herein for reference.

SI.No	Standard	Title
1	IS-2062	Steel for general Structural purposes
2	IS-1608	Method of Tensile Testing
3	IS-5624	Specification for markings
4	IS-4218	Specification for Threading
5	IS-2614	Specification for sampling & acceptance
6	IS-2629	Specification for testing of galvanizing
7	IS-2633	Specification for process of hot dip galvanizing
8	IS-209	Specification for quality of zinc

2.0 PRINCIPAL PATRAMETERS

- 2.1 All the raw material required for fabrication and partial galvanizing of the anchor bolts shall be procured by the Contractor. The MS rounds and MS plates used for manufacturing the anchor bolts shall be free from all rust, pitting, greasing etc. They should conform to technical parameters for Grade A steel of IS-2062. M/S GKW make nuts, or equivalent quality approved by the employer, shall be supplied with anchor bolts. In case galvanized nuts are not available, the Contractor may purchase black nuts from M/S GKW and galvanize them as per relevant IS.
- 2.2 All the above anchor bolts shall be fitted and supplied with GKW make double nuts duly galvanized.

3.0 DRAWING AND DATA

The foundation anchor bolts proposed to be procured against this specification shall be as per the design of the employer and shall be fabricated as per the drawing enclosed as per drawing no. W-04921/1.

4.0 FABRICATION

- 1. The anchor bolts shall be fabricated out of tested quality MS-Rounds only, in accordance with the drawing provided with this specification.
- 2. The threads shall conform to the metric series IS-4218 Part I corresponding

to the nuts of size of M/S GKW make and shall be undercut by .0043 mm for galvanizing.

- 3. The anchor bolts shall be supplied fitted with double nuts of M/S GKW make, or equivalent approved quality, duly galvanized. The top portion of anchor bolts including threads shall be galvanized as indicated in the drawing.
- 4. All the anchor bolts shall be duly marked as per IS-5626.
- 5. Welding shall conform to relevant ISS for fillet welding.

5.0 <u>GALVANIZING</u>

The anchor bolts as well as nuts shall be galvanized by hot dip process conforming to latest revisions of IS-2629 and 2633. Minimum weight of coating of zinc during galvanizing shall be 305 gms. per sq.m. for threaded portion and 610 gms. per sq.m. for the other surfaces. The galvanized external threads shall not be recut. The zinc used shall be not less than 99.5% pure conforming to IS-209 and shall be free from sulfur, carbon or silica. The galvanizing shall be done at correct temperatures and shall provide for substantial diffusion of Hydrogen, maintaining the molten zinc bath free from impurities. The nuts and bolts shall be meticulously cleaned before galvanizing. The galvanized surfaces shall be free from defects like strain, dross , excessive projections or other imperfections, metals etc. which would impair serviceability ,quality, strength or finish of the anchor bolts. There should not be any clogging of threads due to staying of zinc on them during galvanizing. The threads must fit properly and freely throughout the threaded portion. This shall be specifically ensured before dispatch of the material.

6.0 <u>TESTS:</u>

All materials offered shall be fully tested by the bidder as per the relevant standards. The sampling and acceptance criteria of foundation bolts shall be in accordance with IS-2614 and test results shall conform to parameters as specified for Grade- A steel in IS 2062.

7.0 **INSPECTION**

In addition to the provisions of General conditions, the following shall also apply:a) On successful inspection, the Contractor will submit to the employer

manufacturer's test certificates for each lot purchased

inspection report etc. and will request for issue of dispatch Clearance from the employer.

8.0 <u>PACKAGING & FORWARDING</u>:

i) Nuts and other attachments shall be packed in non returnable double gunny bags and accurately tagged in accordance with contents.

- ii) The packing shall be made in such a way as to avoid losses / damages during transit, Each bundle or package shall be appropriately marked. Any loss or damage during transit shall be made up/rectified by the Contractor at no extra cost to the employer.
- iii) No extra charges for packing shall be admissible. Bidders may include its cost in their quoted rates.

9.0 <u>PRICE :</u>

The price shall include cost of all raw materials including MS Rounds, nuts, plates ,zinc and including fabrication ,partial galvanizing, delivery at site, unloading and stacking and inclusive of wastage. Price shall be quoted per number as indicated in schedule.

INFORMATION ON ESSENTIAL FACILITIES AVAILABLE WITH THE FABRICATOR

(To be filled in by the bidder)

Straightening:

Is there any facility for Straightening of section i.e. Angles / Channels / Rounds etc?

If yes, intimate the type of Machine.

1. Section Cutting:

Is there any facility for section cutting? If yes intimate the type of machine; also intimate the maximum of thickness of angle flanges and diameter of round, which can be cut by above machine. Capacity of machine may also be intimated.

2. Cropping:

- i) Indicate the facility for cropping of plates
- ii) Intimate the type of machine and the thickness and width it can be crop.

3. Punching / Drilling:

- i) Indicate the facilities for Punching and drilling of holes.
- ii) Thickness of plates/angles flanges that can be punched or drilled may be intimated

separately for punching and drilling machine respectively.

4. Welding / Gas cutting :

Indicate the facilities available for performing this operation. Bidder should clearly specify whether facility of radiographic inspection and magnetic particle Examination of welds are available.

5. Facilities for checking design of structures including availability of qualified Personnel etc.

B: GALVANIZING:

Is there any facility for hot dip galvanizing of structures available at your works? If yes then furnish the following information:

- a) The galvanizing plant is coal fired or oil fired.
- b) The dimensions of the galvanizing tank to assess the maximum size of the members that can be galvanized.
- c) Facilities for management and control of temperature of zinc during galvanizing process.
- d) Test facilities available for thickness of the coating of zinc on members.
- e) Test facilities to check gm/sq.m coating of zinc on members.
- f) Availability of various IS codes pertaining to galvanizing at the test laboratory.
- g) Minimum and maximum percentage increase in weight of galvanized structure compares to their black weight.
- h) Quantity of zinc required per MT of black weight of steel structure.



1.0 <u>STANDARDS</u>

The supply of items covered by this specification shall comply with the latest editions of the Indian Standards / IEC and codes of practice. Some of the applicable standards are given below.

Sl. No.	Indian Standards	Title	International Standards
1.	IS:209	Specification for Zinc Aluminium	BS:343
2.	IS:398	Conductor for overhead purposes.	IEC:209
	(Part – 11)	Aluminium conductors,	
		Galvanised Steel	
	(Dort V)	Aluminium Conductor	
	(rall - v)	Galvanised Steel	
		Reinforced (Moose)	
3	18.617	Aluminium and Aluminium allow	
5	15.017	ingots and castings for general	
		engineering nurnoses	
4.	IS:731	Porcelain insulators for Overhead	BS 137(Part 2)
	101/01	power lines with a nominal	22 10 ((1 2)
		voltage greater than 1000 V.	
5	IS:731	Wrought aluminium and	
		aluminium alloy drawn tube for	
		general engineering purposes.	
6.	IS:1327	Method of determination of mass	
		of tin coating on tin plate.	
7.	IS:1521	Method of tensile testing of steel	
		wire.	
8.	IS:1548	Manual on basic principles of lot	
		sampling.	
9.	IS:1573	Electroplated coatings of Zinc on	
		iron and steel.	
10.	IS:2004	Specification for carbon steel	
		forgings for general engineering	
11	10.2107	purposes.	
11.	18:2107	white Heart Malleable from	
12	10.2100	Casung.	
12.	15:2108	Black Heart Maneable Iron	
13	18.2121	Specification for conductors and	BS-3788
15.	15.2121	earth wire accessories for	D 5.5200
		overhead power lines	
	Part (I)	Armour rods, binding wires and	
	(-)	tapes for conductors.	
		1	

	Part (II)	Mid span joints and repair sleeves for conductor.	
14.	Part (III) IS:2486	Accessories for earth wire Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000 V.	
	Part (I) Part (II)	General requirements and Tests Dimensional requirements	IEC-120 IEC – 120
15	Part (111) IS:2629	Locking devices Recommended practice for hot	
10.	15.202)	dip galvanising of Iron and steel.	
16.	IS:2633	Method for testing uniformity of Zinc coating on Zinc coated articles.	
17.	IS:3063	Single coil rectangular section spring washers for bolts, nuts and screw.	
18.	IS 3138	Hexagonal Bolts and Nuts.	ISO/R947 & ISO/R272.
19.	IS:4218	Metric Screw threads	ISO/R68 ISO/R261 ISO/R262 ISO/R965
20.	IS:1826	Galvanised coating on round steel wires.	ASTMA:272-72a BS-443
21.	IS:6745	Methods for determination of weight of Zinc coating on Zinc coated Iron and steel articles.	
22.	IS:9708	Specification for stock bridge"vibration Damper" for overhead power lines.	
23.	IS:10162	Specifications for spacers and spacer dampers for twin Horizontal Bundle conductors	BS:1473 BS:1490 BS:1452
24.	IS:8263	Method for radio interference tests on high voltage insulators.	NEMA :107 CISPR . IEC:437
25.	IS : 5561	Electric Power Connector.	,
26.	IS:5082	Wrought Aluminium and aluminium alloys, bars, rods, tubes and section for electrical purposes.	
27.	IS:6639	Hexagonal bolts for steel structures.	
28.		Thermal Mechanical performance test and mechanical performance test on string insulator units.	IEC-575

2.0 PRINCIPAL PARAMETERS

- 2.1.1 The surface of the equipment shall be smooth and free from sharp edges, burrs and other projections, which may be a cause for increasing corona losses and radio interference above acceptable levels.
- 2.1.2 All castings shall be free from blow holes, surface blisters, cracks or any other casting defects. All sharp edges and corners shall be blurred and rounded off.
- 2.1.3 All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 2.1.4 Clamps and connectors shall be designed for corona control.
- 2.1.5 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 or connector is designed with respect to the specified reference ambient temperature shall also be indelibly marked on each component of the clamp and connector except on the hardware.
- 2.1.6 No part of a clamp or connector shall be less than 10 mm. thick.
- 2.1.7 All items shall be designed to withstand the climatic conditions.
- 2.1.8 Size of the terminal/ conductor for which the clamp/ connector is suitable shall be embossed/punched (i.e. indelibly marked) on each components of the clamp/ connector, except on the hardware.

2.2.0 **INTERCHANGEABILITY :**

2.2.1 All similar parts, particularly the removable ones shall be interchangeable with one another. All bolts and nuts have the same standard wit-worth threads throughout where required, and nuts shall be locked in an approved manner.

2.3.0 INSULATOR FITTINGS (HARDWARE FITTINGS):

- 2.3.1 Insulator fitting assembly normally consists of : I) Clamp (ii) Yoke plate (iii) Corona control rings (wherever required) (iv) Shackles (v) turn buckles (wherever required) (vi) Required no. of nuts & bolts (vii) Any other item if required.
- 2.3.2 Insulator fittings components other than plates, angles and flats, shall be of forged steel. Malleable cast iron components shall not be accepted.
- 2.3.3 Insulator hardware assembly shall be designed for a 4000 kg. Tensile load per string for the switchyard with a factor of safety two (2).
- 2.3.4 The insulators fitting shall have to be matched with the insulators. P.G. clamps shall be suitably designed according to requirements.

2.4.0 GALVANISING:

- 2.4.1 All ferrous parts including bolts and nuts shall be hot dip galvanized and shall be evenly and uniformly coated with zinc complying with IS: 2629. The uniformity of zinc coating shall be tested as per IS: 2633. The zinc coating shall be uniform; adherent, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust, stains, bulky white deposits and blisters. The zinc used for galvanizing will have to be arranged by the fabricator and purity shall be of grade Zn 99.5 as per IS: 209.
- 2.4.2 All ferrous parts including structural steel works and single pipe. supports shall also be galvanized after fabrication.
- 2.4.3 All bolts, nuts, locknuts, washers etc. shall be hot dip galvanized. Excess spelter from bolts, nuts etc. shall be removed by centrifugal spinning. From bolt or nut. Threading after galvanizing, shall not be permitted. Nuts, however, may be tapped, but not to cause appreciable racking of the nuts on the bolts. Springs washers shall be electro-galvanized.

3.0 TECHNICAL PARTICULARS:

3.1.1	Material	<u>220 Kv</u>	<u>132 Kv</u>
		Mild steel forged steel etc.	Mild steel forged steel etc.
3.1.2	Suitable for	(a)I)ACSR Zebra conductor	(a)I) AAC Tarantulla conductor
		II) AAC Tarantulla conductor	II) ACSR Zebra
			III) ACSR Panther Conductor
		b) Fog type	b)Fog type
		disc insulator (280x146 mm)	disc insulator (280x146 mm)
3.1.3	Tensile strength	7000kg(70 Kn)	7000kg(70 Kn)
3.1.4	i)Maximum current	1250 A	1250 A
	ii) Fault current level	40 Ka	31.5 Ka

3.1 INSULATORS FITTINGS :

3.15 General criteria for using the conductor : refer clause 4.02 of "Technical specification for Handling, Erection, testing and commissioning."

3.2 DOUBLE TENSION INSULATORS FITTINGS FOR TWIN MOOSE BUNDLE CONDUCTOR WITH BOLTED TYPE TENSION CLAMP.

Suitably designed insulator fitting with bolted type tension clamp shall be offered. The clamp should be suitable for two point anchoring. The fitting should normally have following components. The tension clamp shall be suitably designed to take a static tension of 4000kg. The clevis, ball and socket for the disk insulators shall be as per I.E.C. specification 16 mm type. The material of construction shall be as under:

a) Shackles, Link socket -Forged steel clevis

b)	Yoke plate	- Mild steel	
c)	Angle plate	-do-	
d)	Corona control rings	- Mild steel tube or Al. tube	(Minimum thickness 1.6 mm) (Minimum thickness 2.5 mm)
e)	Turn buckle	- Forged steel	
f)	Tension clamp	- Aluminum Alloy	

3.3 SINGLE TENSION & SUSPENSION (STRING) FITTINGS FOR MOOSE , PANTHER, ZEBRA ANDTARANTULLA CONDUCTORS

The material i.e. mild steel forged steel or malleable iron for these fittings shall be such that it gives the required mechanical strength. The clamps should be of Aluminum Alloy and shall be designed to carry the same current as the conductor. All forging and casting shall be of good finish and free from flaws and other defects. The edges on the outside of fittings shall be rounded. All ferrous fittings and the parts other than those of stainless steel shall be galvanised. Spring washers' nuts etc. may be electro-galvanised. All parts of different fittings which are provided for interconnection shall be made such that sufficient clearance is provided at the connection joints to ensure free movement and suspension of spring insulator assembly.

Suspension clamps shall be so designed that the effects of vibration both on the conductor and fittings itself are minimized. The clamps shall permit the conductor to slip before the failure of the conductor occurs. The fittings shall have sufficient contact surface to minimize damage due to fault currents. All nuts shall be made in accordance of IS-1367 or equivalent. Pins shall be made of forged steel and security dips shall be of phosphor bronze or brass. These tension and suspension fittings should meet the requirement of IS-2486 parts I & II or equivalent. The size of ball and clevis and socket shall be of 16 mm as per IS / IEC specification.

3.4 CLAMPS AND CONNECTORS PARAMETERS:

Bus-Post clamps, P.G.clamps, shall be suitably designed according to requirements.

3.4.1		Material	220/132/33 KV
	a)	For connecting ACSR/ AAC conductor	Aluminum alloy casting conforming to designation A6 of IS:617 and shall be tested for all tests as per IS:617
	b)	For connecting equipment terminals made of copper or ACSR conductor	Bimetallic connectors made from aluminum alloy casting conforming to designation A6 IS : 617 with 4mm thick cast copper lines and shall be tested as per IS:617

	c)	For connecting G.I. Shield w	vire	Malleable iron casting.	
	d)	Bolts, nuts and plain washers	5.	Hot dip galvanising mild steel	
	e)	Spring washers for items 'a'	to 'c'	Electro galvanised-suitable for at least 3 service conditions as per IS:3063 & IS:1573	
	f)	Misc.		Mild steel.	
3.4.2	Co	rona Extinction voltage	220kV min156 kV lir to ground.	132 kV ne	
3.4.3	Faı	ılt current level	40kA	31.5 kA	
3.4.4	Mi of o	nimum thickness of any part clamp or connector	10 mm	10 mm	
3.4.5	Otł	ner Details			
	1)	For bimetallic clamp and co mm shall be cast integral v	nnectors, copper with aluminum a	r alloy liner of minimum thickness alloy.	2
	2)	Flexible connector braids or sheets or aluminum laminate	laminated straps	s shall be made from tinned copper the clamp. The terminal clamps fo	r

- bus posts shall be suitable for the type of conductor used.
 3) Size of the terminal / conductor for which the clamp/connector is suitable shall be embossed / punched (indelibly marked) on each component of the
- 4) 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 one clamp / connector except on the insulator fittings.

4.0 **TYPE AND ROUTINE TESTS:**

clamp/connector except on hardware.

4.1 Clamps & Connectors

The type tests shall include the following but shall not be limited to the following and shall be carried out on clamps and fittings without any extra cost to the Purchaser.

i) Test for corona inception and extinction voltages with and without corona rings to be performed on completely assembled strings.

- ii) Radio Interference voltage test.
- iii) Corrosion and Galvanising test.
- iv) Dynamic High current withstand test.
- v) Tension Test.
- vi) Slip Test

4.3

- vii) Electrical Resistance test.
- viii) Heating cycle test.

4.2 The reports of following type tests, on the complete insulators string with hardware fitting, shall need to be furnished.

a)	Power frequency voltage withstand test with corona control rings and arcing horns (I) dry (ii) wet.	BS:137
b)	Power frequency voltage flashover test with corona control rings and arcing horns (I) dry (ii) wet.	BS:137
c)	Power frequency voltage flashover test without corona control rings and arcing horns (I). Dry (ii). Wet.	As per clause 7.0
d)	Switching surge voltage withstand (wet) test.	IEC-383
e)	Impulse voltage withstand test.)
f)	Impulse voltage flashover test.)
g)	Voltage distribution test.)As per clause7.0
h)	Corona and RIV test.)
i)	Mechanical strength test.)
j)	Vibration test.)
J I	6,	
c))
a) b)	Visual Examination (A))
a) b) c)	Visual Examination (A) Verification of dimensions (A) Electrical Presistance test for tension clamp)))IS:2486
a) b) c) d)	Visual Examination (A) Verification of dimensions (A) Electrical Resistance test for tension clamp.)))IS:2486
a) b) c) d) e)	Visual Examination (A) Verification of dimensions (A) Electrical Resistance test for tension clamp. Heating cycle test on tension clamps. Magnetic Power Loss for suspension assembly)))IS:2486) As per clause 7.0
a) b) c) d) e) f)	Visual Examination (A) Verification of dimensions (A) Electrical Resistance test for tension clamp. Heating cycle test on tension clamps. Magnetic Power Loss for suspension assembly.))IS:2486) As per clause 7.0 As per clause 7.0
 a) b) c) d) e) f) g) 	Visual Examination (A) Verification of dimensions (A) Electrical Resistance test for tension clamp. Heating cycle test on tension clamps. Magnetic Power Loss for suspension assembly. Corona Extinction Voltage RIV performance test)))IS:2486) As per clause 7.0 As per clause 7.0 IS:8263
 a) b) c) d) e) f) g) h) 	 Visual Examination (A) Verification of dimensions (A) Electrical Resistance test for tension clamp. Heating cycle test on tension clamps. Magnetic Power Loss for suspension assembly. Corona Extinction Voltage RIV performance test. Slin Strength test for suspension and tension assembly.)))IS:2486) As per clause 7.0 As per clause 7.0 IS:8263 IS:2486
 a) b) c) d) e) f) g) h) i) 	 Visual Examination (A) Verification of dimensions (A) Electrical Resistance test for tension clamp. Heating cycle test on tension clamps. Magnetic Power Loss for suspension assembly. Corona Extinction Voltage RIV performance test. Slip Strength test for suspension and tension assembly. Microscopic test for grain size of forgings (A)))IS:2486) As per clause 7.0 As per clause 7.0 IS:8263 IS:2486 IS:4748
 a) b) c) d) e) f) g) h) i) j) 	 Visual Examination (A) Verification of dimensions (A) Electrical Resistance test for tension clamp. Heating cycle test on tension clamps. Magnetic Power Loss for suspension assembly. Corona Extinction Voltage RIV performance test. Slip Strength test for suspension and tension assembly. Microscopic test for grain size of forgings (A). Tensile strength test of components (A)))IS:2486) As per clause 7.0 As per clause 7.0 IS:8263 IS:2486 IS:4748 As per clause 7.0
 a) b) c) d) e) f) g) h) i) j) k) 	 Visual Examination (A) Verification of dimensions (A) Electrical Resistance test for tension clamp. Heating cycle test on tension clamps. Magnetic Power Loss for suspension assembly. Corona Extinction Voltage RIV performance test. Slip Strength test for suspension and tension assembly. Microscopic test for grain size of forgings (A). Tensile strength test of components. (A). Magnetic particle inspection for forgings (A).))IS:2486) As per clause 7.0 As per clause 7.0 IS:8263 IS:2486 IS:4748 As per clause 7.0 IS:3703& IS:7743
 a) b) c) d) e) f) g) h) i) j) k) l) 	 Visual Examination (A) Verification of dimensions (A) Electrical Resistance test for tension clamp. Heating cycle test on tension clamps. Magnetic Power Loss for suspension assembly. Corona Extinction Voltage RIV performance test. Slip Strength test for suspension and tension assembly. Microscopic test for grain size of forgings (A). Tensile strength test of components. (A). Magnetic particle inspection for forgings (A). Tests on locking devices for ball and socket coupling.(A)))))IS:2486)) As per clause 7.0 As per clause 7.0 IS:8263 IS:2486 IS:4748 As per clause 7.0 IS:3703& IS:7743 IEC:372
 a) b) c) d) e) f) g) h) i) j) k) l) m) 	 Visual Examination (A) Verification of dimensions (A) Electrical Resistance test for tension clamp. Heating cycle test on tension clamps. Magnetic Power Loss for suspension assembly. Corona Extinction Voltage RIV performance test. Slip Strength test for suspension and tension assembly. Microscopic test for grain size of forgings (A). Tensile strength test of components. (A). Magnetic particle inspection for forgings (A). Tests on locking devices for ball and socket coupling.(A) Hardness Test. (A).))))IS:2486)) As per clause 7.0 As per clause 7.0 IS:8263 IS:2486 IS:4748 As per clause 7.0 IS:3703& IS:7743 IEC:372 IS:2108

n) Galvanizing (A).

4.4 Acceptance Tests

(A) marked tests shall be done as acceptance tests also.

5.0 <u>TESTING PROCEDURE</u>

5.1.0 INSULATORS AND HARDWARE FITTINGS :

5.1.1 Power frequency voltage flashover tests without corona control rings and arcing horns (I) Dry (ii) Wet The procedure for this test will be the same as specified in BS137 except that the insulator string shall be tested without the corona control rings and arcing horns.

5.1.2. Voltage distribution test :

The power frequency voltage distribution across the various discs in the insulators string consisting of 25 discs shall be measured using 25 mm diameter sphere with 1 mm gap between them. The flashover voltage of this gap, say, 'Vs' is pre-determined. The terminals of the sphere gap shall be connected to the metal fittings of a disc insulator in the string and the voltage across the entire insulator string shall be raised gradually until a flashover takes place across the sphere gap. The procedure shall be repeated with the sphere gap connected across all the discs in the string successfully. The values of the voltages $E_1, E_2, E_3, \dots, E_n$ across the entire string when the sphere gap is connected successively across the 1,2,3 nth disc shall be noted . The voltage 'V_n across the nth disc as a percentage of the voltage across the string is given by the relation.

 $V_n = V_s / E_n x 100 \text{ percent}$

Max. potential across any disc of the string shall not exceed 9% of the voltage applied across the string. The total of the voltage distribution of all discs so computed shall be within 95% and 105%. If not, the test shall be repeated. The proportionate correction shall be made on the value so as to give a total of 100% distribution.

In addition to above, voltage across the two max. stressed insulators so tested above, shall be rechecked by applying $242 \pm 5\%$ kV across the entire string and varying the sphere gap distance to determine the percentage voltage distribution.

5.1.6. Mechanical Strength Test of Each Component:

The load shall be so applied that the component is stressed in the same way as it would be in actual service and the procedure as given in clause no 7.1.5 above should be followed.

5.1.7. Chemical Analysis of Zinc Used for Galvanizing :

Samples taken from the zinc ingot shall be chemically analysed as per IS:209. The purity of zinc shall not be less than 99.5%

5.1.8. **Tests for Forgings :**

The chemical analysis hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognized procedures for these tests. The sample will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to the Contractor and owner in Quality Assurance Program.

5.1.9. Magnetic power loss test for suspension assembly :

Two aluminum tubes on 32mm, diameter shall be placed 450 mm apart. An alternating current over the range of 200 to 600 A shall be passed through each tube. The readings of the Wattmeter with and without two suspension assemblies along with the line side yoke plate, clevis eye shall be recorded . Not less than three suspension assembly shall be tested. The average power loss per suspension assembly shall be plotted for each value of current. The value of loss corresponding to 300 A shall be read from the graph.

TECHNICAL SPECIFICATION OF DISC INSULATORS AND CONDUCTORS ETC.

1.0 STANDARDS

The supply of accessory items covered by this specification shall comply with the latest editions of the Indian standards / IEC and codes of practice. Some of the applicable standards are given below :-

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2.0 PRINCIPAL PARAMETERS

2.1 GENERAL REQUIRMENT OF INSULATORS

- 2.2 The Porcelain shall be sound, free from defects, thoroughly verified smoothly glazed and have brown colour.
- 2.3 The design of the insulators shall be such that stresses due to expansion and contraction in any part of the Insulator shall not lead to deterioration. The porcelain shall not directly engage with hard metal.
- 2.4 Cement used in the construction of Insulators shall not cause fracture by expansion, or loosening by contraction, and proper care shall be taken to locate the individual parts correctly, during cementing. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.
- 2.5 The cap and pin used in the manufacture of insulators shall be of malleable iron, hot dip galvanized conforming to the latest IS specification.
- 2.6 The security clips shall be made of suitable material of copper alloy. The clips shall provide positive locking of the coupling.

2.7 REQUIREMENT OF ANTI-FOG TYPE DISC INSULATORS

A) 220 kV SWITCHYARD

- (i) Single suspension string shall be complete with 14 nos. anti-fog type disc insulators and without suspension clamps & fittings.
- (ii) Single strain string shall be complete with 16 nos. anti-fog type disc insulators and without strain clamps & fittings.

B) 132 kV SWITCHYARD (For 220 kV & 132 kV Substations)

- (i) Single suspension string shall be complete with 9 nos. anti-fog type disc insulators and without suspension clamps & fittings.
- (ii) Single strain string shall be complete with 10 nos. anti-fog type disc insulators & without strain clamps & fittings.

2.8 PARAMETERS OF DISC INSULATORS

These are required for 220 kV, 132 kV and 33 kV tension and suspension strings. The minimum guaranteed requirements of one unit of each type of insulators shall be as follows :

Anti-fog type insulators shall be of ball and socket type.

		For 220 kV & 132 kV Bus bar Strings
i)	Types of insulator	Anti-fog type
ii)	Electromechanical strength (kN)	70
iii)	Size of Insulator (mm)	280 x 146
iv)	Creepage distance	
	a) Total mmb) protected mm	430 290
v)	Power Frequency Flashover Voltage	
	a) Dry Kvb) Wet Kv	100 60
vii)	Power frequency with stand Test voltage	
	a) Dry kV.b) Wet kV.	85 50

vii)	50% Impulse 1.2/50 micro sec. Flashover voltage (dry)	
	a) Positive polarity / kV.b) Negative polarity/ kV.	175 170
viii)	Impulse 1.2 / 50 micro sec. withstand test voltage.	155
ix)	Power Frequency Puncture Voltage kV.	140
x)	Size of in ball shank in mm	16
xi)	Minimum corona extinction voltage kV. R.M.S.	18
xii)	Max. RIV at 10 kV. RMS.	50 micro Volt

3.0 BUS BAR CONDUCTORS

- 3.1 Aluminum strands for ACSR and all aluminum conductors shall be hard drawn from 99.5% pure electrolytic aluminum rods with 61% conductivity. The bidder shall specify the guaranteed minimum and average values of conductivity.
- 3.2 The steel wire for ACSR conductor shall be manufactured from high tensile steel of 134 to 143 kg. / Sq. mm. quality produced either by the acid or basic open hearth process or by electric process. It shall not contain sulphur or phosphorous exceeding 0.05 percent and total of sulphur or phosphorous shall not exceed 0.085 percent. No wires drawn from Bessemer process steel shall be used.
- 3.3 The surface of the conductor shall be clear and dry. The surface strands shall be smooth and free from burrs and other projections which may cause in creasing corona losses above those occurring on perfectly smooth conductor when used on extra high voltage lines. The successful bidder shall submit all relevant test certificates to the Purchaser.
- 3.4 General criteria for using the conductors shall be as per clause 4.02 of technical specifications for Handling, Erection, Testing and Commissioning.

4.0 GENERAL DESCRIPTION/ REQUIREMENT OF EARTH MAT

- 4.1 The earth mat required shall be laid at 700 /500 mm depth below ground level.
- 4.2 The earth resistivity of the soil will be intimated to the successful bidder who will lay the earth mats as per drawings duly approved by the Purchaser.
- 4.3 M.S. rods of 36/40 mm dia shall be used for the earth mat, to be laid in the total area of the switch yard and 3 metre long M.S electrodes of 36mm/40 mm dia

shall be fixed all along the boundary of the switch yard below the earth mat level.

4.4 The earthing of all the equipment/ structures placed in the switchyard will be done through suitable size riser of MS flats.

5.0 DRAWING AND DATA

The bidder shall finish all relevant drawings and descriptive/illustrative literature.

6.0 TESTS

All the equipment offered shall be fully Type tested by the bidder as per the relevant standards

All acceptance and routine test as stipulated in the relevant standards shall be carried out by the supplier in the presence of Purchaser's representative

TECHNICAL SPECIFICATION OF FIRE EXTINGUISHERS

A. <u>CARBON DIOXIDE TYPE – PORTABLE AND TROLLEY MOUNTED ISS :-</u>

IS – 2878/1986 (2nd Revision)

2. <u>SCOPE :-</u>

This specification covers the requirements regarding materials, shape, construction & performance test of carbon dioxide fire extinguishers, portable & trolley mounted of various capacities.

3. <u>CAPACITY :-</u>

- 1.1 Trolley Mounted: 11 Kg, 22.5 Kg. wall mounted 4.5 Hz
- 1.2 The capacity of extinguisher shall be the mass of carbon dioxide when it is filled in the container to the filling ratio of not more than 0.667.

4. <u>CONTENTS :-</u>

- 4.1 The Carbon di oxide gas shall confirm to IS 307/1996 (2nd Revision). The extinguisher should be cleared internally & be filled with liquefied carbon di oxide to the filling ratio of not more than 0.667.
- 4.2 The filling ratio is the ratio of mass of liquefied gas in the container to the mass of water required to fill the container at 15° C.

5. <u>CONSTRUCTION :-</u>

5.1 **Body :-**

The typical shape showing cylinder with other components shall be furnished by Tenderer with his bid. The extinguisher of capacity mentioned above shall have flat base.

5.2 Discharge Valve or Operating head

The valve shall be provided & it shall be squeeze grip type or wheel type.

5.3 <u>Discharge Fitting</u>

- 5.2.1 The nos. of not less than 100 mm dia shall be provided for 11 Kg. 22.5 Kg. Capacity extinguishers. The length of hose shall not be less than 2 m for 11 Kg. And 5 m for 22.5 Kg.
- 5.2.2 A discharge horn with suitable handle shall be provided.

5.2.3 Each extinguisher shall be provided with carrying handle

5.3 <u>Trolley :</u>

The trolley wheel shall be 300x50x25mm with rubber covered over it.

6. <u>PAINTING :-</u>

- 6.1 Each extinguisher shall be painted fire red confirming to shade No.536 of IS-5/1978 (3rd Rev.).
- 6.2 A picture showing operation of extinguisher in the correct manner shall be provided on the body of extinguishers.
- 6.3

The extinguisher shall be marked with letters 'B' & 'C' fires as laid down in IS : 2190/1979 (2nd Ref.). The letters 'B' & 'C' shall be 2.5 cm size, printed in white colour centrally contained in a square of 4 cm size and a circle of 2 cm respectively & shall be coloured black.

6.4 The paint shall confirm to is : $2932/1974 (1^{st} rev.)$

7. <u>PERFORMANCE REQUIREMENTS :-</u>

7.1 Discharge Duration :-

The design & construction of the extinguisher shall be such that when operated at an angle of not more than 45° C from vertical and at a temperature of $27^{\circ} + 2^{\circ}$ C it shall not less than 95% of the contents in the form of continuous discharge with in the following period from the time of operating the value.

Size of Extinguisher	Discharge Time, Sec.	
	Min.	Max.
11 Kg.	12	24
22.5 Kg.	20	60

7.2 Intermittent Operation :-

An extinguisher shall be capable of being operated intermittently without freeze up of the valve seat and causing any leak when conditioned at $27^{0}C + 2^{0}C$. The valve shall be opened for 3 sec. & closed for 10 sec. & the cycle shall be repeated & shall discharge at least 95% of the contents.

7.3 Leakage Test :-

The extinguisher without its attachment shall be shelved for 7 days after filling & shall be checked for weight at the end of the period. There shall be no loss of mass.

8. 8<u>MARKING :-</u>

- 8.1 Every extinguisher without its attachment shall be shelved for 7 days after filling & shall be checked for weight at the end of the period. There shall be no loss of mass.
- 8.1.1 The following information shall be marked on the extinguishers :

- (a) Manufacture's name & trade mark.
- (b) Method of operation in prominent letters.
- (c) The word "CARBON DI OXIDE TYPE" in prominent letters.
- (d) Capacity.
- (e) Years of manufacture and
- (f) Source, year of manufacture of the cylinder & its test pressure.
- 8.1.2 The following information of facilitate filling or recharging shall also be marked on the head of extinguisher or on the neck of the cylinder.
 - (a) Empty Wt. of Cylinder shown as EW and
 - (b) Filled Wt. of extinguisher shown ans FW.
- 8.1.3 The extinguisher may also be marked with the standard mark.

9. <u>TEST PRESSURE :-</u>

The pressure shall be 236 Kg.

(B) DRY CHEMICAL POWDER TYPE FIRE EXTINGUISHER 1. <u>ISS:</u>

2171/1985 (3rd Rev) Amendment No.1

2. <u>SCOPE :</u>

This specification covers the requirement regarding material shape, construction & performance test of Dry Chemical Powder (cartage) type.

3. <u>CAPACITY :-</u>

1X10 Kg. capacity extinguisher are in the form of portable (wall mounted) and 22.5 Kg. 45 Kg. Capacity extinguisher in trolley mounted.

Various composition of dry powder such as Sodium & Potassium carbonates and bicarbonates, chlorides Ammonium Phosphate & borates etc. The latest powder developed on a reaction product of urea & potassium bicarbonate. The gas cartridge shall confirm to IS 4947/1977.

5. <u>PRINCIPAL :-</u>

The dry chemical powder extinguisher extinguishes fire by beating displacement of air and decomposition of dry powder in to carbonate dioxide.

6. <u>CONSTRUCTION :</u>-

Body :

The typical shape showing cylinder with other components in shown in the fig. 3 enclosed. The extinguisher mentioned above shall have flat base. The outer cylinder dia shall be 175+5mm.

6.1 Discharge Vave :

The valve shall be either queez grip type or wheel type.

6.2 <u>Discharge Fitting :</u>

- 6.3.1 The neck ring dia of 75mm & length 16mm shall be provided.
- 6.3.2 Syphon tube of 1 mm thick & 16mm dia shall be provided.
- 6.3.3 Cartridge holder shall have female left handed threads corresponding to those of cartridge, with port holes.
- 6.3.4 Each extinguisher shall be provided with carrying handle.

6.4 <u>Trolley :-</u>

The details of trolley shall be submitted by the Tenderer with his bid. The trolley wheel shall be 300x50x25mm with rubber covered over it.

7. <u>MATERIAL:-</u>

Following material is to be used for construction fire extinguisher.

<u>Sl.No</u> .	<u>Component</u>	<u>Material</u>
1	Body	Mild steel sheet 1.25mm thick
2	Inner Container	Brass sheet.
3	Neck Ring	Liquid Tin Bronze
4	Syphon tube	Brass, Copper, Aluminium, 16mdia 71mm thick.
5	Hose	The minimum bursting pressure shall be 50 Kg/Cm^2
6	Piercer/Spindle	Steel
7	Spring	Steel (Plated)

8. <u>PAINTING :-</u>

- 8.1 Each extinguisher shall be painted fire red confirming to shade No.536 of IS-5/1978 (3rd Rev.).
- 8.2 A picture showing operation of extinguisher in the correct manner shall be provided on the body of extinguishers.
- 8.3 The extinguisher shall be marked with letters 'B' & 'C' indicating their suitability for respective classes of fires as laid down in IS: 2190/1979 (2nd Rev.) The letters 'B' & 'C' shall be 2.5 cm size printed in white colour centrally contained in a square of 4 cm size and a circle of 2 cm respectively & shall be coloured black.
- 8.4 The paint confirm to IS $2932/1974 91^{st}$ Rev.)

9. <u>EXPANSION SPACE :-</u>

An air space shall be provided in the body above the specified liquid level & shall be of sufficient volume to ensure that when the discharge nozzle is temporarily closed and the extinguisher is put in to separation at a temp of $(27^0 + 5^0$ C, the pressure exerted shall not exceed 1.5MN/M (15 Kgs/Cm)².

10. <u>ANTI CORROSION TREATMENT :-</u>

The body shall have all the internal surfaces completely coated with lead tin alloy having tin not less than 10% applied by hot dipping process. The external surface shall be subjected to this anti corrosive treatment which shall be applied to a uniform thickness.

11. <u>TEST REQUIREMENT :-</u>

- 11.1 Under normal condition operation $(27^0 + 5^0C)$, the jet should maintain a flow of 4m for 5 Kg Capacity & 6m for 10 kg capacity) extinguisher.
- 11.2 There should be 85% discharge with in a maximum period of 22 Sec. For 5 Kg. Capacity & 30 sec. For 10 Kgs. Capacity 45 Sec. for 25 Kgs.
- 11.3 In case of hydraulic burst test, mechanical failure should not occur at a pressure not less then 4.5 MN/M^2 (45Kg/Cm^2).
- 11.4 The extinguisher body & the cap assembly shall be tested to an internal hydraulic test pressure of $3 \text{ MN/M}^2 (30 \text{Kg/Cm}^2)$.
- 11.4 The expansion space static pressure shall be $1.5 \text{ MN/M}^2 (15 \text{Kg/Cm}^2)$.

12. MARKING :

The following marking shall be marked on the extinguisher

- 12.1 Method of operation in prominent letters.
- 12.2 The word "DRY CHEMICAL POWDER" in prominent letters.
- 12.3 Manufacture's name or trade mark.
- 12.4 Year of manufacture.
- 12.5 Test pressure & capacity in Kg.

TECHNICAL SPECIFICATION OF FIRE BUCKETS

1. <u>STANDARD</u>

ISS shall confirm to IS 2546/1974 1st Revision amendment No.1 Galvanized mild steel fire bucket.

2 <u>MATERIAL</u>

Galvanized mild steel shall be used.

3 <u>CONSTRUCTION</u>

The fire bucket shall be round type i.e. its bottom portion shall be round & not flat type as in case of ordinary bucket. The upper diameter & length shall be 250mm & 300mm respectively.

4 <u>PAINTING</u>

The bucket shall be first painted with one coat of red Oxide primer and then with two coats of synthetic enamelled post office red paint from outside. Inside partition shall be painted with two coats of synthetic enamelled white paint. The handle and outside bottom portion shall be painted with black paint Only BRITISH, ASIAN, SHALIMAR paint shall be used.

1.1 <u>FIRE:-</u>

On one side the **"FIRE**" in 100mm height shall be written & on other side the word आग in same height, shall be written. The thickness of each alphabet in English as well as in Hindi shall be 050mm. Only Capital letters shall be used.

TECHNICAL SPECIFICATIONS OF LIGHTING

1.0 SCOPE

- 1.1 Periphery lighting by erection of steel tubular pole of 9 meter long and fixing light fixtures on these.
- 1.2 Electrification of switchyard by fixing light fixtures on 220/132/33 KV Columns.
- 1.3 Electrification of Control Room building and Store building.
- 1.4 Electrification of Lawn in front of Control Room by grouting 2.5 meter long GI pole and all other associated work.
- 1.5 Laying & termination of cables for all the above work
- 1.6 Painting of light pole.
- 1.7 Supply of all the required equipments/ material and any other work required to complete the work satisfactorily.
- 1.8 The quantities of various items specified in Schedule of Quantities and prices are tentative. The detailed layout & drawings for lighting work shall be issued by Executive Engineer of concerned Electricity Transmission Division and the quantities shall be finalized & paid for accordingly.

TECHNICAL SPECIFICATIONS OF OUTDOOR LIGHTING

1.0 STEEL TUBULAR POLE

- 1.1 The Steel tubular pole shall conform to IS-2713
- 1.2 It shall be 9M long in 3 portions.
 Bottom portion having dia 139.7mm, thickness 5.4mm & length 5M,
 Middle portion having dia 114mm, thickness 45 mm & length 2.0M,
 Top portion having dia 88.9mm, thickness 3.25mm & length 2.0M.
- 1.3 M.S. Pipe of 60mm dia having suitable cap welded at one end at angle of 30 deg from horizontal shall be fabricated which should exactly fit over the top portion of the pole.

2.0 LAWN LIGHT POLE

This shall be made of G.I. pipe of 'B' class of 50mm outer dia & 4mm thick. The length shall be 2500mm with top end having a thread of 75mm long and bottom end having a M.S. plate of 150x 150x4mm welded. A hole of 19mm dia shall be made in the pipe at a height of 1175mm from the bottom (without taking the thickness of plate). After welding of plate at bottom the same (plate) shall be painted with red oxide primer. A nut bolt of suitable size should also be welded with pipe for earthing purpose at a place near the hole at same height.

2.1 G.I BEND FOR LIGHT FITTING

This will be made of G.I. pipe bend of 'B' class of 50mm dia and the total length of pipe shall be 1500mm. One end of pipe shall have bend of 30° of radius 100mm such that the bended length is 200mm.

The bend should be smooth and the pipe in no case develop crack. In case of any crack, the same shall be rejected.

3. G.I. BEND FOR CABLE FOR LAWN LIGHTING

This will be made of 25mm dia GI pipe of 'B' class having total length of 600mm with bend at 200mm at 30° and other end threaded & fitted with a chuck nut.

4. G.I. BEND FOR STEEL TUBULAR POLE

This will be made of 35mm dia G.I. pipe of 'B' class length being 2.5M with bend at one end at 30° in 0.5 m length & other end having thread & fitted with a chuck nut for taking cable to junction box fitted on steel tubular pole for periphery lighting.

5. G.I. BEND FOR JUNCTION BOX FITTED ON COLUMN

This will be made of 35mm dia GI pipe of B' class length being 2.0M with bend at one end at 30° of 0.5m length & other end threaded & fitted with a chuck nut for fixing it with Junction box fitted on 220/132/33 KV columns for yard lighting.

6. JUNCTION BOX (JB)

- 6.1 The Junction boxes shall be of size 180x150x100mm & 280x225x150mm and shall contain all required terminal blocks, fuses etc ..
- 6.2 The Junction box shall be finished with smoke gray paint shade 631-ISS.
- 6.3 The door complete with rubber gasket shall be hinged type provided with 2 No. fixed screws .
- 6.4 Arrangement shall be made in JB for it's mounting on pole.
- 6.5 Earthed stud shall be provided on side of JB, earthing shall be done by 8 SWG G.I. pipe.
- 6.6 Hole marking of 25mm dia 2 No. in 180x150x100mm & 35m dia in 280x225x150 shall be made in bottom of JB..

6.7 One hole of 19mm dia marking shall also be done on the inside plate just above the HRC fuses to facilitate the entry of cable from light luminaries to JB.

7 CONCRETING

- 7.1 Steel Tubular Pole shall be grouted in 1:4:8 ratio with cement, coarse sand & 40mm brick ballast in size 450x450x 190mm.
- 7.2 The Plinth shall be 300mm above ground level and shall be properly plastered in1:4 cement concrete ratio and shall be tapered from all four corners in 75mm.
- 7.3 The light pole of 2.5m long shall be grouted in 1:2:4 cement sand coarse sand and 20mm granite with 225mm plinth above ground.
- 7.4 The Junction Box for Lawn Light shall be embedded in the Plinth above ground level with top surface of JB in level with plinth well.
- 7.5 GI pipe for cable entry shall also be fitted with Light Pole before concreting is done.
- 7.6 Junction Box on steel Tubular Pole shall be fitted at 1.5M height from ground level.

8 CABLE LAYING & TERMINATIONS

- 8.1 The cable shall be laid 500mm below the ground in excavated trenches.
- 8.2 75mm thick ganga sand shall be laid first as pad for laying of cable over it.
- 8.3 Bricks on it's 75mm edge shall be laid continuously on both side of excavated trench after ganga sand is placed 75mm thick over the excavated trench. Then cable shall be laid over the sand bed between bricks and filled with sand and then brick in placed on its 125mm surface. Thereafter the earth is filled in layer of 20cm. and properly rammed and finally levelled.
- 8.4 When more than one cable is running in same trench then each cable shall be segregated with ganga sand filled between two cables.
- 8.5 All termination of cable & connection shall be done strictly as per drawing.
- 8.6 Only AI. lug of Dowell or Jainson make shall be used for termination.
- 8.7 Crimping of Al lug shall be done with the help of hydraulic crimping tool suitable for lug. Size.

- 8.8 Any civil work damaged by the Contractor during the course of cable laying shall be made good.
- 8.9 No wastage is allowed in cable length only length required for termination & that too bare minimum required is allowed as wastage. The cable drum should not be damaged.

9. PAINTING

- 9.1 3 Nos.450mm strips of Post Office red colour shall be made in 9M long street light pole with one strip of white colour in between.
- 9.2 In 2.5M long pole, strip length shall be 75mm.
- 9.3 For painting of plinth snowcem of colour as approved by the Engineer shall be applied in two coats.
- 9.4 Pole Number shall also be painted on the steel Tubular Pole.
- 9.5 Strict cleanliness of the work site shall be observed during the erection work.:-

(B) TECHNICAL SPECIFICATION FOR INTERNAL ELECTRIC WIRING

- 1. These specifications cover the requirements for internal wiring work.
- 2. Definition of point-A "point" shall include complete wiring from branch distribution board to the outlet via the switch. The outlet shall be a ceiling rose in case of ceiling and exhaust fan points, light points for fluorescent tube fittings and pendant fittings etc. excluding rod pendant and socket outlet in case of plug points.
- 3. Type of Wiring: The wiring shall be carried out in conduit on surface with P.V.C. insulated wire.

The wiring whether concealed or on surface, shall be easily accessible for inspection. The wiring shall be done 225mm below the ceiling as possible and shall be straight. Open type wiring shall not be done in air conditioned space and above the false ceiling or lofts under any circumstances.

4. Layout of Wiring: The wiring shall be done on distribution system with main and branch distribution boards at convenient physical and electrical load centre and without isolated fuses.

"Power" and "Heating" sub-circuits shall be kept separate and distinct from "Lighting" and "Fan" sub circuits.

"Lights" and "Fans" shall be wired on separate circuits.

- 5. Medium pressure wiring and associated apparatus shall comply, in all respects, with the requirements of latest version of Rules 50, 51, 61, and 61-A of Indian Electricity Rules, 1956.
- 6. Position of wiring run and points: The position of runs of wiring and the exact positions of all points and switch boxes shall be marked on the building plan or the building itself and approved by the Engineer-Incharge.
- 7. Voltage and Frequency of Supply : All current consuming devices shall be suitable for the voltage and frequency of the supply to which these are to be connected.
- 8. Cables and Flexible Cords: The conductors of cables, except flexible cables or cords, shall be of copper or aluminium as specified. The minimum cross-sectional area of conductor for final sub-circuit and for light and fan sub-circuit shall be 1.50 sq.mm aluminium. The cross-sectional area of conductor for the

wiring of high pressure mercury/sodium vapour lamp and exhaust fan shall be 2.5sq.mm aluminium. The minimum cross-sectional area of conductor for power wiring shall be 4 sq.mm. aluminium or 2.5 sq.mm copper.

- 9. Rating of lamps and Fans: As far as possible, actual current carried by any conductor should be estimated. Unless the actual value of load is known, a light point shall be rated at 100 W in non-residential buildings and 60 W in residential buildings table fans and ceilings fans at 60 W, 5 A socket outlet at 60 W and 15 A power outlet at 100 W. Exhaust fans shall be rated according to their capacity.
- 10. Looping back : The wiring shall be done in looping back system without any connector or junction box on the line. The looping back of phase or live conductor shall be done at the switch box and that of neutral at the light, fan or socket outlet. In no case, joint shall be made bare or by twisting the conductors in through runs of cables. If the length of final sub-circuit, sub~main or main is more than the length of standard coil and joint becomes unavoidable, such joints shall be made by means of proper connector. No junction box shall be provided specific difficulties should be referred to Engineer-In-charge for decision.
- 11. Control at a point of commencement of supply : A circuit breaker or a linked main switch with fuse on each live conductor shall be provided at the point of entry at an accessible place, as near as practicable to the termination of service line. There shall be no break on the neutral wire except at the switch gear. No fuse shall be provided in the earthed neutral conductor. The neural shall be distinctly marked.
- 12. Metal Boxes: Metal boxes made of cast iron shall be 3mm thick. The sheet steel boxes shall be made of 1.5mm (16 SWG) thick mild steel sheet. These boxes shall have not less than four screwed holes for fixing the top cover and a earthing stud. These boxes shall be provided with a cover of phenolic laminated sheet, not less than 3 mm thick, fastened to the box with not less than four number brass screws and washers. These boxes shall be painted both inside and outside, with two coats of antirust paint.
- 13. Fixing of fittings and accessories: In case of conduit wiring, all accessories like switches sockets, call bell pushes regulators etc. shall be of piano type. These shall be mounted on phenolic laminated cover fixed on cast iron or mild steel box of suitable size. The accessories and regulators shall be mounted in flush type pattern or as directed by Engineer-in-charge.
- 14. Conduit Wiring System: This type of wiring can be used both for low voltage and medium voltage installation. Single core PVC insulated (without sheath) cable shall be used. This cable shall be drawn in heavy gauge rigid steel conduit. The conduits shall be fixed on surface.

(I) Surface conduit wiring system – Heavy gauge rigid steel conduit, solid drawn or lapwelded, with galvanized or stove enamelled surface, not less than 19mm in diameter, shall be used. The gauge of conduits shall be not less than 1.5mm (16

SWG). for conduit of size upto 32mm diameter and not less than 2mm (14 SWG) for conduit of size above 32mm diameter. Only threaded type conduit accessories shall be used. Pin grip or clamp type accessories shall not be used under any circumstances. The maximum number of PVC insulated 1100 volt grade aluminium conductor cables that can be drawn in conduit shall be specified.

In case of cables carrying alternating current the outgoing and return cables shall be drawn in the same conduit.

The conduit pipe shall be joined by means of screwed socket, couples, or accessories only. Inspection boxes and inspection type couplers shall be provided at intervals not exceeding 6meters. Threads on the conduit pipe shall be long enough to accommodate the pipe to full threaded portion of the couplers and accessories. No burrs or sharp edges shall be left at the curt end of the conduit pipes to avoid damages to the insulation of the conductors while pulling.

The layout of the conduit shall be such that condensation or sweating inside the conduit, if occurs, is drained out. In order to minimize it all outlets of the conduit system shall be ventilated, keeping covers of the inspection boxes exposed but flushed in level.

The conduit pipe for each circuit shall be erected before any cable is drawn in. The conduit pipes shall be fixed by heavy gauge steel saddles, secured over 12mm thick spacers of well seasoned teakwood/approved MDF, at intervals not exceeding 60cm. The spacer shall be fixed to wall plug by flat headed wood screws. A saddle shall be fixed within 10cm. on both sides of couplers, bends or similar other fittings. The saddle shall be not less than 24 gauge thick for conduit pipe up to 15mm diameter and not less than 10 gauge thick for conduits of larger diameter.

When conduits have to be attached to irons or steel joints or pillars, suitable girder clips at intervals of 60cm shall be secured by means of ordinary clips or girders clips, as required. Where it is not possible to drill holes, suitable clamps with bolts and nuts shall be linked. The clips shall be not less than 19mm wide and 0.90mm thick for conduit pipe up to 25mm diameter. For all sizes of clamping rod shall be 4.45 mm (7SWG) diameter).

All necessary bends in the system including diversion shall be done by bending pipe, or by inserting suitable solid inspection type normal bends, elbows or similar fittings or by fixing cast iron or sheet inspection boxes as directed by Engineer-Incharge. Conduit fittings shall be avoided, as far as possible, on conduit system exposed to weather, where necessary, solid type fittings shall be used, radius of such bends in conduit pipes shall be not less than 7.5cm. No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.

The conduit of each circuit or section shall be completed before conductors are drawn in. The entire conduit system shall be electrically and mechanically continuous and shall be tested for the same. The entire system shall be permanently connected to earth in general conformity to the requirement of earthing G.I. earth continuity wire of 8SWG size shall run along the full-length of

the conduit and shall be fastened, to conduit between each wire and conduit, and terminated in the box with stud. Gas or water pipes shall not be used as earthing medium. If conduit pipes are liable to mechanical damage, they shall be adequately protected. When passing through walls or floors, conduit pipes shall be continuous. The metal box shall be efficiently earthed with the conduit by means of approved couplers. Only a portion of the box shall be sunk in the wall, the remaining portion shall project out of entry of conduit pipe into the box. The clear depth of the box shall be not less than 6cm. Where fan regulator is also be accommodated, the depth shall be increased to accommodate the fan regulator in flush pattern. Standard conductors shall be preferred in conduit wiring.

After completion of erection, the portion of the building damaged during the erection of the installation shall be repaired properly to meet the original finish and colour of the walls and ceiling etc.

15. Capacity of Sub-Circuits: Light and fans shall be wired on separate sub-circuits. Not more than a total often light plug points or four to six fan points shall be provided in a sub-circuit. The load on a sub-circuit shall be restricted to 800 watts.

The power sub-circuit shall be designed according to the said requirement of the subcircuit.

16. Passing through walls and floors : (I) When the conductors pass through walls, they shall be taken through one piece of heavy gauge rigid steel conduit or porcelain pipe or corrugated or solid P.V.C. pipe extending through the whole thickness of the wall. The ends shall be bushed properly. the pipe or conduit shall be of adequate six so that the wires pass through a straight line without any twist of cross in wires.

(II) When the pipe extends outside the building, the portion exposed to weather shall be well mouthed, turned downwards and properly bushed on the open ends.

17. Fittings and accessories: (I) Ceiling roses and similar attachments: A ceiling rose shall not embody fuse terminals as integral part of it. A ceiling rose or similar attachments shall be used in low voltage installations only. (II) Socket outlet and plugs: Every socket outlet shall be controlled by a switch which shall be on the live side of the line and shall preferably by located immediately adjacent there to or combined therewith. A socket outlet shall not embody fuse terminal as an integral part of it but the fuse may be embodied in plug.

In an earthed system of supply, three pin type socket outlet, with the third pin connected to earth, shall be used. The connection from such outlet to any current consuming device shall be done by means of 3 core flexible cords, one end of the earthing core of which shall be connected to the earthing pin and the other to earthing point of the current consuming device. Every plug containing a fuse shall be nonreversible and shall be so arranged and connected that the fuse controls an outer phase conductor or the non-earthed conductor of the circuit.

18. Main switches and switch boards : (1) All main switchgears shall be metal clad and shall be installed in dry situation, as near as practicable to the point of supply.

- 18.1 The main switch will have a fuse on each live conductor of supply mains. No fuse shall be provided in the earthed neutral. The neutral wire shall be continuous except at the linked switch gear.
- 18.2 The bottom of switch board shall be more than 1.25 metres above the floor level unless the front of switch board is completely enclosed by a door or the switch board is located in a position to which only authorized persons have access.
- 18.3 Equipments which are on the front of a switch board shall be so arranged that inadvertent personal contact with live part is avoided during the maintenance of switch gear changing of fuse or like operations.
- 18.4 The switches shall be so arranged that fuses are not "alive" when the switch is in the ... OFF position.
- 18.5 A danger notice plate shall be provided on switch boards connected to medium voltage supply and above.
- 19. Main and branch distribution Boards:
- 19.1 The main and branch distribution fuse boards shall be of metalclad type. These shall be of weather proof type for exposed to whether or damp situation and flame proof type for situations exposed to explosive dust, vapour or gas.
- 19.2 Main distribution boards shall be controlled either by a linked switch fuse or circuit breaker. Each outgoing circuit shall be provided with a fuse on the phase or live conductor.
- 19.3 Branch distribution boards shall be controlled by a linked switch fuse or circuit breaker. Each outgoing circuits of the branch distribution board shall be provided with a fuse on the phase or live conductor. The earthed neutral conductor shall be connected to a common link and be capable of being disconnected individually for testing purpose. At least one spare circuit of the same capacity shall be provided on each distribution board.

20. Wiring of distribution boards

- 20.1 The load coming on the distribution board shall be divided as far as possible, evenly between the number of ways of the boards. One spare circuit should be left for future extension.
- 20.2 All connections between pieces of apparatus or between apparatus and terminals on a board shall be neatly arranged in a definite sequence following the arrangements of the apparatus mounted thereon, avoiding unnecessary crossings.
- 20.3 Cables should be connected to terminals only by soldered lugs crimped lugs or clamped securely without cutting away the cable strands.
- 20.4 All the conductors shall be rigidly fixed in such a manner that clearance of at least 25mm is maintained between conductors of opposite polarity or phases and between the conductors and any other materials other than insulating material.

- 20.5 The incoming and outgoing cables shall be neatly bunched and fixed properly permitting the board to swing back fully.
- 20.6 The current rating of fuse shall not exceed the current rating of the fuse carrier or the current rating of the smallest cable in the circuit protected by the fuse.
- 20.7 Boards for mounting switch gear: One of the following types of boards shall be used for mounting metal clad switch gear.
- 20.8 Hinged type metal boards: These types of boards shall be used for low voltage installation for mounting metal clad switchgear consisting of not more than one switch fuse and one single phase and neutral distribution fuse board. These boards shall consist of a box made of sheet steel not less than 3mm thick. Alternatively, a frame of angle iron of minimum size 35mm x 6mm or channel of minimum size 35mm X 25mm X 6mm for these boards shall be made and mild steel plate of 3mm thickness mounted on the front and 1.6mm thickness on the back. The joints shall be substantially welded. The boards shall be provided with locking arrangement and earthing stud. If so required in any work atleast 6mm thick wooden board of well seasoned polished M.D.F. exterior grades board shall be provided at the back. There shall be a clearance of 30mm minimum between the front and back covers.

No apparatus shall project beyond the edge of the board. No fuse shall be mounted within 5mm of the board edge.

The boards shall be painted with synthetic enamel paint over anti-rust priming coat.

The boards shall be securely fixed to the wall by means of rag bolts or wood plugs.

21 Lighting fittings

Lights, fans and socket outlets shall be so located as to provide, maximum comfort to the occupant and to enable him to utilize the electricity in the most economical manner. Every fitting shall be controlled by a switch which shall be in live conductor of the circuit. Where control of the fitting at more than one point is necessary .it shall be done by as many two way and intermediate switches as there are control points.

Fittings Wire: These wires shall be of copper and shall be used only for internal wiring of fittings and shall be carried up to the termination of the light point.

Fluorescent tube fittings: These fittings shall be high power factor type i.e. shall consist of necessary power factor improvement capacitor. The capacitor shall be of 2.4 MFD for fittings suitable for single tube and 3.15 mfd. for fittings suitable for double tubes. The fittings shall be of standard models complete with necessary number of tubes and not economical models. These shall be complete with all components supplied as original components with standard models and shall be assembled and wired by the manufactures at the factory. The fluorescent

tube shall be of the same make as the fitting. In cases where tubes are not manufactured by the fittings manufacturers the fluorescent tube of any approved make as directed by the Engineer In charge shall be used.

Lamp Holders: All lamp holders shall be bayonet cap type and shall be provided with shade carrier.

Height of fittings : Unless desired otherwise, all wall mounting and pendent fittings inside the building shall be kept at a height of 2.5 metres above the floor level. All fittings outside the building and on roads shall be fixed at the height as directed by the Engineer-in charge.

Rod pendent fittings shall be suspended with heavy gauge rigid steel conduit pipe duly painted of appropriate size electroplated steel chains of required length as directed by the Engineer in charge.

22 EARTHING

General-Earthing shall confirm to the following specifications. For other details not covered in these specifications, relevant Indian Standards shall be referred to I.S.: 3043,1965 (Code of Practice for Earthing).

Earthing shall generally be carried out in accordance with the requirements of Indian Electricity Rules, 1956 as amended from time to time and the relevant regulations of the Electricity supply authority concerned. The following clauses of the Indian Electricity Rules, 1956 are particularly applicable 32, 51, 61, 61 A, 62, 67,69,88(2) & 90.

All earth connections shall be visible for inspection.

All materials, fittings etc. used in earthing shall confirm to the Indian standards specifications wherever these exist. In the case of materials for which I.S.S. do not exist, the same will be approved by the Engineer-in-charge

No earth electrode shall have a ohmic resistance greater than five ohms as measured by an approved earth testing apparatus. In rocky soils, the resistance may be upto eight ohms.

Normally, an earth electrode shall not be situated less than 1.5m away from any building.

The location of the earth electrode will be such where the soil has reasonable chance of remaining moist, as far as possible. Entrances, pavements and roadways, are to be definitely avoided for location of the earth electrode.

TYPE OF EARTH ELECTRODES

a) Pipe earth electrode.

G.I. pipe shall be of 40mm dia 4.5 metres in length. Galvanising of the pipe shall conform to relevant Indian Standards. The pipe shall have a clean surface, not

covered by paint, enamel or poorly conducting material. The pipe shall be of one piece. G.I. pipe electrode shall be compared at the bottom and provided with holes of 12 mm dia drilled and spaced 75mm from each other up to 2 metres of length from bottom. The electrode shall be buried in the ground vertical with it's top not less than 20 cm below ground level.

Watering arrangement:- In the case of pipe electrode a 40mm x 20mm reducer shall be used for fixing the funnel. The watering funnel attachment shall be housed in masonary, enclosure not less than 300mm deep. A 300mm x 300mm cast iron cover frame with hinged cover having locking arrangement shall be suitably embedded in the masonary enclosure.

b) Artificial treatment of soil

The electrode shall be surrounded by charcoal/coke and salt in alternate layers not less than 150rnm thick.

c) Earthing lead:

Main earthing lead: The main earthing lead shall be of G.I. wire or G.I. strip in case of G.I. plate earth electrode. -

For all electrical installations, except sub-stations and generating stations, the earthing lead shall be not less than one-half of cross-sectional area of the largest conductor to be protected. A conductor larger than 100sq.rnm nominal cross-sectional area (2/0 SWG) in case of copper conductor and 150 sq.mm in case of G.I. conductor need not be used.

The minimum size of main earthing, lead shall not be less than 8 SWG copper or G.I. wire, or 12mm x 3mm copper or G.I. strip.

d) Earth continuity conductor: The nominal cross sectional area of an earth continuity conductor not contained within a cable or flexible cord shall be 14 SWG copper or 12SWG G.I. or 4 sqmm aluminium wire.

The earthing lead in the case of pipe earth electrode, shall be connected by means of a through G.I. bolts, nuts and washers and cable sockets as indicated in the drawing. All material used for connection the earth lead with electrode shall be of GI in case of G.I. pipe. The earthing lead shall be securely connected at the other end to the main board.

Loop earthing shall be provided for all mounting. Protection of earthing lead. The earthing of main board and other metal clad switches and distribution fuse boards with not less than 14 SWG copper or 12 SWG GI or 4sqmm aluminium wire lead from electrode onwards shall be suitably

protected from mechanical injury by a 15mm dia G.I. pipe in case of wire.

23. COMPLETION REPORT

After completion of the installation the test results and completion report of the installation work shall be submitted.

24. TESTING OF INSTALLATION:

24.1 General

The following tests in sequence shall be carried out on completion and the defects revealed shall be made good:

Polarity test.

Insulation resistance test. Earth continuity test.

Earth electrode resistance test.

Where ever any addition is made to the fixed wiring of an earthing installation, both the addition and that part of existing installation relating thereto should be tested. Polarity test of non-linked single pole switch

In a low voltage installation a test shall be made to that all non-linked, single pole switches have been in the same conductor throughout and that such conductor has been connected to an outer or phase conductor or conductor or to the non-earthed conductor of the.....

Insulation resistance test : (1) The insulation resistance shall be measured by applying between earth and the whole of conductor or any section thereof with all fuses and all switches closed and except in earthed electric wiring, all lamps in position or both poles of installation otherwise electrically connected together a voltage of not less than twice the working voltage. It shall not exceed 500 volts for medium circuit.

Insulation resistance in meg-ohms of an installation (1) shall be not less than 50 divided by number of points on the circuit, provided that the installation need not be required to have insulation greater than one meg-ohm.

Insulation of an electric installation (or an extension installation) a certificate shall be furnished by Contractor, countersigned by the certified supervisor, in direct supervision of whom the installation was carried. The certificate shall be in a prescribed form as specified by the local electric supply authority

Earth continuity path : The earth continuity of metal conduits and metallic envelopes of cables shall be tested for electric continuity and resistance of the same along with earthing including any added resistance or earth leakage measured from, the connection with the earth at any point in the earth continuity conductor in the installation shall not exceed 10 ohm.

TS-19

TECHNICAL SPECIFICATIONS FOR 63KVA DIESEL GENERATOR

The scope of work includes the supply and installation of 1x 63kVA Diesel Generator (DG) set mounted inside the Substation generator room and associated works. The outgoing cables shall be sized to suit the DG output.

1.0 GENRAL

This specification covers the turnkey installation of 1 x 63kVA standby diesel generating system covering the diesel engine, alternator, engine control panel, associated accessories, cooling system, ventilation system, fuel and exhaust system, acoustic enclosure and switchgear etc.

The contractor shall assume full responsibility of co-coordinating the work with various subvendors and other contracting agencies at site and execute the work to the total satisfaction of the clients and statutory agencies.

2.0 SITE CONDITIONS:

Location	: Various substation in Uttar Pradesh
Design Maximum Ambient Temperature	: 50 deg C
Minimum Ambient Air Temperature in shad	$e : 0 \deg C$
Relative Humidity	: 100% Max.
Wind Load	: 195 Kg/sq.m.
Slismic Level	: 0.3g
Isoceraunic Level	: 50 days/Year
Average Annual Rainfall	: 1200mm
Altitude	: Not exceeding 1000 m.
Hot and humid tropical climate conductive to	o rust and fungus growth.

3.0 ELECTRICAL SUPPLY SPECIFICATIONS

Nominal voltage	: 415V ±10%
No. of Phases	: 3 + Neutral
Frequency	: $50Hz \pm 5\%$
Neutral earthing	: Solidly Grounded
Control supply	: 12 / 24V, 2-wire DC

4.0 SCOPE OF WORK & EXCLUSIONS

The scope of work shall include but not be limited to the supply, installation, testing and commissioning of the following items. The supplier shall study the requirements stipulated in the specification and also to suit the site conditions and offer a complete system with guaranteed performance under the severest operating conditions specified.

a. 415V, 3-phase + Neutral, 63kVA 1500 RPM, DG set with accessories as specified.

b. Set mounted microprocessor based engine control panel.

c. Radiator cooling system.

d.Exhaust piping including supports.

e.Thermal insulation for exhaust piping.

f. Exhaust stacks with steel supporting system.

g. Preparation of related schematic and GA drawings for DG installation, exhaust piping, ventilation system, etc.

h. Obtaining Diesel Engine manufacturer's approval of the installation with specific emphasis on alignment, exhaust & fuel piping and ventilation before commissioning.

i. Testing and commissioning of the installation.

j. House keeping during the installation work and removal of debris and unwanted materials on a day to day basis and clearing the site on completion.

k.Any related work covering supply of installation materials, consumables, etc. whether specified for not, to render the system fully functional and conforming to the best engineering standards. This shall include battery charging.

5.0 DIESEL ENGINE & ACCESSORIES

5.1 ENGINE

- a. The diesel engines shall be of approved make, direct injection, four stroke, multi cylinder, water cooled radiator type, turbo charged, operating at a nominal speed of 1500 R.P.M and capable of developing requisite Brake Horse Power (BHP).
- b. The engine and the governing system shall be suitable for standby and Automatic Mains Failure (AMF) duty power generating application and shall conform to BS5514 / relevant ISS / IEC / ISO3046. The unit shall be suitable for operation on high speed diesel oil available in the Indian market.
- c. The engine shall be electric start and shall be suitable for battery assisted manual / auto starting.
- d. The governing system of the engine shall be electronic type and suitable to control frequency variation within \pm 5% whenever the load is switched in or thrown off.
- e. The engine fittings shall include but not be limited to the following:
 - i) Closed coupling and flywheel with guard.
 - ii) Dry type air filter with clogged condition indicator.
 - iii) Cooling radiator.
 - iv) Fuel pump.
 - v) Electronic governor.
 - vi) Dual fuel filter with online filter changing provision.
 - vii) Lube oil pump, oil cooler and filter.

viii) Turbo charger.

- ix) 12 / 24V DC starter & battery charging alternator.
- x) Engine mounted microprocessor based control panel to display the following minimum engine and electrical parameters:
 - a. Lube oil pressure indicator and temperature gauge.
 - b. Tacho meter for speed indication with hour meter.
 - c. Battery charging Ammeter.
 - d. Starting switch with key.
 - e. Over speed stop switch with contacts.
 - f. Low lube oil pressure switch.
g. High water temperature alarm & trip

xi) Wiring harness using temperature resistant insulation and flexible copper conductor wires. The wiring should be clamped at regular intervals and terminated using lugs and terminals.

xii) Stainless steel flexible for engine exhaust.

xiii) Stop solenoid.

- f. The engine speed shall be regulated through an electronic governing system which shall also provide the over speed protection. The governor shall ensure that the speed of the set is regulated within 1% of the nominal speed under normal operating conditions.
- h. The DG set shall be capable of handling step load up to 70% of the capacity without dropping other loads due to voltage dips. Further the engine shall be capable of taking full load within 10 seconds of starting.
- i. All moving parts of the engine and other associated equipment shall be provided with guards to prevent accidental contact. The guard shall be designed to facilitate easy removal and reinstallation.
- j. The engine supplied with first filling of oil of required quantity as recommended by the manufacture

5.2 ACCESSORIES

The following accessories shall be supplied with the DG set.

- a. Common base frame for the engine and alternator.
- b. Antivibration mounts of requisite capacity.
- c. Residential silencer.
- d. Protective guards for all rotating parts.
- e. Electric driven lube oil priming pump complete with hosepipes and couplers.

f. Diesel tank with capacity to last 12 hours on 100% load. Capacity fabricated out of 1.5-3mm thick sheet steel including first filling of diesel. The tank shall be further complete with overflow pipe, drain pipe, fuel level indicator, valves, low level contact and alarm.

g. Galvanized sheet steel trays beneath the engine and day tank to collect the leakage oil.

h. Batteries

The batteries shall be of heavy duty, high performance lead acid type of Exide make or equivalent. Each battery shall be rated 12/24V. The number and AH capacity shall be selected to suit the engine requirements.

Battery shall be suitable for six successive starting attempts each of 10 seconds duration with a gap of 5 seconds between successive starts. The battery shall be supplied complete with electrolyte and accessories. The accessories shall include battery stand, battery leads with terminal Tends acrylic top cover and inter battery connectors. The charger shall allow the battery to be charged when the set is not running. The charger shall get disconnected from the mains when the generator set is running.

i. Control Panel

The DG shall be supplied with an engine mounted Microprocessor based control panel. The control panel shall display all the engine, alternator & battery parameters. It shall not only display faults but also keep a record of faults. An emergency stop push button will be provided to stop the DG during emergency. For Engine faults, the set will be stopped in emergency mode & for electrical faults it shall be stopped with a time delay for cooling down. An audible alarm shall be provided in the main panel to announce tripping of DG. j. Alarms: The following alarms shall be provided in the DG control Panel to indicate & protect against abnormal operations.

Condition Status Function Low Oil Pressure 2 stage Alarm Engine Stop High Water Temperature 2 stage Alarm Engine Stop Over Speed Alarm Engine Stop Low Fuel Level Day tank Alarm High Fuel Level Day tank Alarm Earth fault on Alternator Alarm Engine Stop Fail to start Alarm Battery charger fault Alarm

6.0 ALTERNATOR

1500 RPM, 415V, 3-Phase, 75 kVA, star-connected, 50Hz, 0.8 P.F, horizontal foot mounted, double bearing, self excited, self-regulated, brushless, screen protected drip proof, continuous duty alternator with class TH. insulation in IP22 enclosure incorporating the following.

- a. Continuous damper winding.
- b. One anti-condensation heater wired to a separate terminal box.
- c. Pilot exciter.
- d. 3 Phase sensing AVR with + 0.5% voltage regulation.
- e. A neutral CT of adequate ratio and class for REF relay for DG Protection.
- 6.1 The Alternator shall further meet the following specifications:

a. The alternator shall conform to BS2613.

- b. The alternator shall be suitable for 20% over speed for two minutes.
- c. The alternator shall be capable of carrying 50% overload for a duration of one minute.

d. The alternator shall be capable of carrying 10% overloading for one hour Tin any period of 12 hrs running.

e.The inertia constant shall be 0.26 second or above.

f.The alternator terminal voltage for any load variation should be maintained within + 5%. g.The prime mover response should be such that with 150kW load throw TOFF / ON for the generator both transient and steady state frequency variation should be within + 3%. The generator terminal voltage for this load variation should be maintained with + 5%. h.The field coil terminals shall be wired to terminal box for external speed control.

i.Both ends of each phase winding shall be brought to the terminal box.

j.The alternator shall withstand a 3-phase short circuit at the terminals for a period of 3 seconds.

k.The total harmonic distortion shall not exceed 3% and the design shall permit up to 30% unbalance between phases while in operation

6.2 Performance

Under normal operating conditions, the sound pressure levels when measured Tat a distance of one (1) metre outside the DG building shall be not more than 70 dB.

6.3 Painting'

The entire system shall be coated with grey oxide paint.

After erection rust preventive painting must be essential.

After erection one coat of Dark Green color synthetic enamel must be applied.

7.0 **DIMENSIONS**

As per drawing of Generator room to be developed by tenerder

8.0 SPARES

The DG set will be supplied with the following spares, which shall be handed over at the time of commissioning.

2 sets of renewable parts of oil, fuel & air filters 2 Nos. fan belts 5 Nos. spare fuses of each type & size used 5 spare relays of each type 1 set of fuel injectors 1 No. Operators manual 1 No. Service manual.

9.0 INSTALLATION

The bidder shall undertake the installation work at site. The general scope of installation work shall include but not be limited to the following:

9.1 Diesel Generator Set

a. The assembled DG set shall be installed on anti-vibration mounts. The unit shall be visually inspected for any transit damage.

b. The contractor shall arrange for the inspection of the set by the diesel engine manufacturer.s authorized representative and obtain This approval before rolling the set.

- c. The fuel oil day tank shall be installed over the drip tray at the location indicated.
- d. The batteries shall be fully charged, installed, and connected.
- e. The battery charger shall be heavy duty.

9.2 Exhaust Piping'

a. The exhaust piping shall be fabricated from 1.5-3mm thick mild steel T-pipes.

b. The exhaust piping and the silencers shall be insulated using 50mm thick mineral wool inside the container &up to the exhaust stack. The insulation shall be cladded with 24G aluminium sheet.

c. The exhaust pipe shall be supported using spring suspension supports.

d. The shipping sections of the stack shall be welded at site and erected over the mild steel frame work. The entire length including flanges, bolts and washers shall be aluminised inside and outside to inhibit corrosion. A weather cowl shall be provided on top.

e . All tools and tackles used for the erection shall have valid safety certification.

9.3 Electrical Installation

a. The electrical power cabling from alternator to the panel will be carried out by the Ministry of Health (MOH) personnel. However the DG control cabling from the DG to the DG Panel will be carried out by the DG vendor.

b. The contractor shall appoint an experienced full time engineer throughout the installation period till the set is handed over. Three month maintenance from the date of commissioning shall be carried out by the DG vender.

c. The contractor shall carry out the control cabling from the engine control panel to the breakers in the main panel.

d. Connecting block with wiring diagram shall be provided in the DG Panel for integrating with local LT system

10.0 TESTING

10.1 At Manufacturer.s works the routine tests and full load test on Engine, and Alternator shall be carried out at the manufacturer.s work in accordance with applicable Indian standards.

The following tests shall be conducted:

a. Full load testing for 8 hours with load bank.

b. Overload testing at 10% overload for one hour immediately after the full load test.

c. Operation of protective devices.

10.2 Site Testing'

Following tests shall be conducted at site in the presence of the MOH.s representative before energization. The contractor shall provide all testing equipment, labour and consumables required for the testing.

a. Checking the alignment by engine manufacturer.s representative and obtaining approval.

b. Insulation resistance test on alternator, control panel and cabling / bus bar trunking.

c. Checking the Automatic Mains Failure (AMF) operation both on auto and manual mode.

- d. Checking the engine safeties for satisfactory operation.
- e. Checking vibration levels.

f. Testing of individual protective devices on engine and alternator and ensuring that the wiring is carried out properly.

g. Full load running for 8 hours continuously. All the readings shall be logged to evaluate the fuel consumption, lube oil pressure, water & oil temperature vis-à-vis the electrical load.

h. One hour overload testing at 110% load shall be carried out at the end of the full load trial. i. The guaranteed specific fuel consumption shall not exceed 150 grams / BHP. HR with a tolerance of + 2.5 %. The same shall be proved during the load trial.

j. The noise level at 1m from the enclosure and the temperature rise inside the enclosure shall be measured.

k. Any deviation from the guaranteed parameters shall be made good and these performance parameters should be measured once again till the required results are achieved.

1. The DG set shall be deemed to be commissioned after satisfactory performance of all associated equipment.

11.0 GUARANTEE

11.1 Diesel Generator Set

The DG set and accessories shall be guaranteed for satisfactory operation for a period of 24 months from the date of commissioning or 5000 running hours from the date of supply whichever is earlier. Any defects noticed during this period shall be rectified free of cost. The supplier shall indicate the type of records to be maintained so that the warranty claims if any are honoured by the manufacturer.

12.0 MAINTENANCE

The bidder shall be required to maintain the installation at no extra cost to the owner for a period of two year from the date of commissioning. During this period, the contractor shall make good any defects caused due to faulty design, bad workmanship and poor quality of materials.

13.0 DOCUMENTATION

As a part of the equipment supply, following documentation shall be furnished

- a. General arrangement plan of DG set.
- b. Exhaust fabrication drawing.
- c. Layout of exhaust piping.
- d .Engine wiring diagram.
- e. Test certificate for engine and alternator.

f. Installation, operation and maintenance instructions for diesel engine and alternator.

g. Spare parts list.

14.0 SCHEDULE OF TECHNICAL PARTICULARS

All the installation shall fully conform to the requirement stipulated and the tests shall be carried out as stipulated. Deviations if any, shall be clearly brought out in the tender.

15.0 STANDARDS

IS: 9537 – 1981 Rigid Steel Conduits for electrical wiring (Second Revisions)

IS : 10810 – 1988 Methods of test for cables.

IS : 13947 - 1993 Degree of protection provided by enclosures for LV switchgear and control gear.

IS : 13947 – 1993 General requirement for switchgear and control gear for voltage not exceeding 1000 Volts.

IEC60034 BS - 5000 Alternator

IS : 694 -1990 PVC insulated Electric cable for working voltage upto and including 1100 volts.

IS: 732-1989 Code of practice for electrical wiring and installation

IS : 1554 -1988 (Part PVC insulated (Heavy Duty) electric cables for working voltages-I) upto and including 1100 volts.

IS: 1651 & 1652 – 1991 Stationary cell & batteries, lead acid type.

IS: 1885 – 1971 Glossary of items for electrical cables and conductors

IS : 2551-1982 Danger notice plates.

IS: 3043 – 1987 Code of practice for earthing.

IS : 3480 -1966 Flexible steel conduits for electrical wiring.

IS: 5133 – 1969 (Part –I) Boxes for the enclosure of electrical accessories.

IS: 5578 & 1984 Guide for marking of insulated conductors

IS: 8130 -1984 Conductors for insulated electric cables and flexible cords

Technical Specification for Thermal Hand Held Infrared Imaging Camera

Sl.	Description	Specification
No.	E1	
1	requirement	The infrared thermal imaging camera should be fully automated and shall be useful for thermo-vision scanning, having capability to identify hot spots and loose connections in sub-stations and transmission lines upto 765KV. The camera shall have the laser pointing facility and shall have built in high resolution color screen (LCD min 3.5" size). The instrument shall be portable and battery operated.
		The infrared thermal imaging and measurement system should be based on un-cooled focal plane array (UFPA) technology. It shall also have a built in digital color visual camera of minimum 5 Mega Pixels, thus creating a color visual image of corresponding thermal image. It should be possible to store the thermal and visual image together (thermal fusion-merging visual & thermal images). It should be suitable for following measurements:
		a) The absolute value of Hot spot temperature. b) Color thermal as well as visual image of focused object
		c) Display/ Define isotherm
		d) Measurement of object temperature.
2	Thermal imaging	The thermal detector of the thermo-vision camera should be based on the
	performance	Focal Plane Array, Un-cooled micro-bolometer technology with minimum
		384 x 288 pixels.
		It should have thermal sensitivity of the order of 0.05° or better at 30°C.
		Image frequency should be such that the buffering effect shall not come on
		uisplay. The spectral range should be of the order of 8 to 14 um or better
		The thermo-vision camera shall be supplied with the standard lens and an
		additional telescopic Zoom lens.
		The minimum focus distance of the camera for the standard lens &
		telescopic Zoom lens shall be such that it does not affect measurement in
		switchyard & transmission lines.
		The thermo-vision camera shall have manual focus through focus dial.
	a) Spatial	Standard lens: 1.1 milli radians or less
	resolution	Telescopic lens: 0.55 milli radians or less
	(Horizontal IFOV)	
	b) Lens	Standard lens: $24^{\circ} \times 18^{\circ}$
	(Horizontal FOV)	Lelescopic Zoom lens: 12 x 9° Minimum focus distance 0.1 mt. or better
3	Temperature	$\frac{1}{10000000000000000000000000000000000$
5	measurement range & Accuracy	10000 C (minimum), with accuracy of $\pm 2\%$ of reading of $\pm 2 \text{ C}$
4	Emissivity	The camera shall have automatic temperature correction facility for
	Correction	emissivity (emissivity range 0.1 to 1).
5	LCD & Indications	The system shall have a tiltable (min 90°) 3.5 inches color LCD display
		with capacitive touch screen for control & programming. Display shall be
		properly visible in sunlight. Camera shall also have status indications to
6	Dhygiaal	view the status of battery / power mode indication etc.
0	Characteristics	filed replaceable battery. The thermo vision camera shall also operate on
		230V AC supply + 10% and camera battery shall also get charged with this
		while the camera is in operation. Separate battery charger and spare battery
		shall also be provided. The equipment shall be well balanced for one hand

		operation. Hand/neck straps should be provided for safety of camera while using in field.
7	Battery Operation time	Camera battery (Li-ion) shall have sufficient power for 4 hours of continuous operation with LDC display ON.
8	Video Output	The camera shall have video output. (PAL/NTSC).
9	Voice recording/	The system shall have the voice annotation (voice recording) facility for
	Text annotation	upto 60 seconds per image and voice recording shall be tagged to particular
		image of the system. It shall have provision to attach pre-defined text in
		each image file during measurement. Infrared image alongwith
		corresponding visual image and voice recording or text annotation shall be linked together.
10	Image storage	The system shall be supplied with minimum of removable 16GB
	capacity	SD card (maximum 32GB)
11	Image storage	The camera should store the image in full radiometric JPEG format, with
	facility	date and time stamping alongwith all technical parameters and atmospheric
		conditions corresponding to image, in addition to visual image, voice /text
		annotation. If required, operator shall have the facility to recall, analyse,
		save and delete the images in the field including the replay and edit of its
		images/recalled images details
		Camera shall have the facility to freeze/hold the image and store a single
		image or multiple of images either continuously or periodically. While
		saving the image, the camera shall automatically prompt for saving of voice
		or text annotation and visual image. It shall also be possible to store only IR
		images with or without voice/text annotation or IR image.
12	Measurement	The thermo vision camera shall measure absolute temperature of hotspots
	function	and have auto spot function (auto placement of cursor at min or max
		temperature). It shall be possible to create movable cross-hairs/spots (with
		temperature) in the live/freeze image. It shall be possible to create different
		areas with continuously adjustable dimensions and position in as image
		shall be moveble and shall give maximum and minimum temperature value
		and its position within the area. It shall be possible to manually adjust
		emissivity (preferably with an online help table) reflected temperature
		distance for individual spot as well as for individual area.
		The laser locator shall be active in IR mode with push button. The camera
		should have all the required standard palettes/color schemes (minimum 4
		pallets).
13	Software	The analyzing software (to be provided alongwith the camera) shall be
		windows based, simple to operate, compatible to IR and visual camera
		images and capable of providing comprehensive report generation facility in
		addition to image analysis and post processing. It should also be possible to
		insert a visual image (photo) as well as text object in the report. The
14	Accessories	All the required accessories like PC/video interface cables, power supply
14	Accessories	cables battery battery charger (in addition to the AC adopter) standby
		battery set. Bluetooth voice recording device. Memory card 16GR or more
		operating manual, original CD and software, application CD, hard carrying
		case etc should be provided.
15	Operating	Shall operate at Temperature o to 50° C, RH:10 to 90% non-condensing.
	conditions (with all	
	accessories)	
16	Safety standards	Thermo vision camera shall have minimum protection grade of IP-54. The
		unit shall meet all EMC emission, immunity standards as per IEC/EN
		61000-4-4, IEC/EN 61000-4-2 and IEC/EN 61000-4-8 respectively with CE

-		
		marking to work in EHV areas without any interference. Copy of relevant certificates shall be furnished alongwith the bid.
17	Demonstration	The acceptance of the instrument shall be subjected to the successful
		demonstration by supplier to the satisfaction of UPPTCL at prescribed site.
		During the demonstration, if the instrument is found not upto the mark/ not
		meeting working requirements of UPPTCL, the same shall be summarily
		rejected and repeated attempts shall not be permitted.
18	Guarantee	Kit shall be guaranteed for minimum 3 years. If the kit needs to be shifted
		to suppliers works for repairs during warranty period, supplier will have to
		bear the cost of spares, software, 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.
19	Calibration	Calibration certificate from/traceable to NABL accredited lab or
	certificate	internationally reputed lab, shall be submitted. Date of calibration shall not
		be older than one month from the date of supply of Kit.
20	Services after sale	Bidder will have to submit the documentary evidences of having established
		mechanism for prompt service chart alongwith bid.
21	Commissioning,	Successful bidder will have to commission the instrument to be satisfaction
	Training and	of UPPCL. The instrument failed during the demo shall be rejected and no
	Handing over of	repairs are allowed.
	the instrument	

TECHNICAL SPECIFICATIONS FOR AUTOMATIC TRANSFORMER OIL BDV TEST SET

		BB (IESI SEI
Sr. No	Item	Description
1.	Functional Requirement	The Automatic transformer oil BDV test kit is intended to be
		used for testing of Break down value of insulating oil used in
		power transformers, CTs, PTs etc. The oil test set should have
		minimum 50 Test result storage capacity. The Test results can
		be recalled and printed. The set should be fully automatic type.
2.	Applicable standards	IEC 156 / IS 6792
3.	Input Voltage	240V, Single phase, 15 Hz AC
4.	Output Voltage	0-100 kV, (Rate of rise: 2KV/Sec, <u>+</u> 10%), continuously variable
5.	Accuracy	± 2%
6.	Resolution	0.1 KV
7.	Switch off Time	≤ 0.01sec
8.	Stirrer	Magnetic type stirrer to be provided
9.	Display/	Backlit, Alphanumeric LCD Display
	Control	Soft Keypads.
10.	Printer	Inbuilt Printer
11.	Measurement	Fully Automatic Pre-programmed Test Sequences as per latest
	Programmes	IEC & IS 6792.
		In addition Custom test sequence should also be possible
12.	Test Lead/ Accessories	HV test unit, control unit, test vessel, electrodes (mushroom and spherical), oil test vessel, digital volt meter and other
		indicating lamps etc.
		A hard carrying case (which should be robust/rugged enough)
		for ensuring proper safety of the kit during transportation shall have to provided.
13.	Design/Engg.	The complete equipment along with complete accessories must

		be designed/engineered by Original Equipment Manufacturer.
14.	Operating Temperature	0 to +50 deg C
15.	Protection/ Control	Against short circuit, over load, transient surges etc. Also the instrument should have facility of stopping automatically on power failure. Also the kit should have facility of HV chamber interlocking as well as zero start interlocking. A Safety interlock has to be there, which prevents access to the high voltage terminals during testing. The design should ensure a high level of safety for the operator. The high voltage chamber is to be covered by a polycarbonate door.
16.	Portability	Compact in size and light in weight. The size should not exceed 500x500x500mm
17.	Calibration Certificate	Unit shall be duly calibrated before supply and the date of calibration shall not be older than two month from the date of supply of Kit.
18.	Services after Sale	The supplier shall have to submit the documentary evidences of having established mechanism for prompt services as and when required. Also the Supplier must be manufacturer or authorised distributor of the manufacturer.
19.	Commissioning, Training and Handing Over of the Instrument	The supplier will have to demonstrate the instrument to UPPTCL at the substation.
20.	Packing and transport cases	The kit and accessories shall be robust and rugged enough, so that it can be transported safely at different locations. The transportation case and packing of the kit shall be such that the transportation from one station to other will not affect the performance and accuracy of measurement of kit.

Technical Specifications for Supply of earthing equipment kit

1. General information

The items covered under this specification shall be used for temporary earthing during operation and maintenance of EHV transmission lines and sub-stations under induced voltage conditions. The items shall be PRIMARLY used for maintenance of double circuit transmission lines on de-energized / dead circuit while other circuit on the same tower remains charged, besides its use on other maintenance works on single circuit lines and sub - stations.

2. Scope

This specification covers the design, manufacturing, testing, inspection, supply and field demonstration of Earthing Equipment suitable for temporary earthing of EHV transmission lines and substations along with all associated components and fittings. The items covered under this specification shall be complete in all respect including all components, fittings and accessories which are necessary or usual for their efficient performance and satisfactory maintenance under the various operating and atmospheric conditions. All such items shall be deemed to be within the scope of the conditions, whether specifically included or not in the specification. The items are as under:-

(a) Earth Clamp:

Clamp for attachment to tower structure of lines and Earth strip at sub - stations. This clamp shall also be used for Earth bonding scheme, i.e. to bond various EHV transmission line tools and plants with steel angle sections of tower. The short circuit rating shall be minimum 8 KA for 1 sec. and 25 KA for 1 sec. for Earthing cable / lead with cross sectional area of 35 sq. mm and 95 sq. mm of copper respectively.

(b) Line Clamp:

Clamp for attachment to line conductor, Bus bar or other current carrying conductor. The clamp shall be suitable for Panther/Zebra/Moose ACSR and ACAR/ Marcella/ Tarantula conductors (conductor diameter 20 mm to 40 mm.) The short circuit current rating shall be minimum 8 KA for 1 sec. and 25 KA for 1 sec. for Earthing cable / lead with cross sectional area of 35 sq. mm and 95 sq. mm of copper respectively.

(c) Earthing Pole:

Light weight detachable type insulating pole equipped with a detachable coupling for line clamp and conductive cable/ lead.

(d) Earthing Cable/ Lead with lug:

Required size of Copper stranded flexible cable/lead, including terminations lugs, suitable for short circuit current rating of 8 KA for 1 sec. & 25 KA for 1 sec. shall be used. However, the minimum size of Copper cable shall not be less than 35 sq. mm & 95 sq. mm for 8 KA & 25 KA current rating respectively. Required copper equivalent size of Aluminium stranded flexible cable/lead shall be used.

The cable/lead of 25 KA for 1 sec. rating shall be used in Sub-stations as Primary Earths and the same of 8 KA for 1 sec. rating shall be used for applications in transmission lines and sub - stations as Additional Earths.

3. General Requirement :

- (a) The climatic conditions for normal use shall be under temperature range from -5 0 C to + 50 0 C ambient temperatures (Max. Temperature of Conductor may be 70 0 C on account of radiation from Sun and Conductor heating).
- (b) Earthing device shall permit safe earthing and short circuiting of electrical installations. The fault current level of Earthing devices shall be minimum 8 KA for 1 sec. and 25 KA for 1 sec. with cable / lead of minimum 35 sq. mm and 95 sq. mm of Copper cable respectively.
- (c) The Earthing Device shall be in general conform to IEC:1230:1993, IEC:855:1985 and IEC:1235:1993.

4. DETAILS OF COMPONENTS OF EARTHING DEVICE :-

Clamp for attachment to tower structure of transmission lines and Earth strip at sub-stations (Earth Clamp).

The earth clamp shall be suitable for application by hand to tower structure/ Earth strip/ bonding to tools and plants under any natural condition. The large thumb screw of this clamp shall have pointed end, which can penetrate through the painted / galvanized surface into steel parts or large flat surface ensuring a strong and efficient connection to the structure/Earth/strip/tools and plants. The clamp shall be suitable for connection to structure / Earth strip/tools and plants up to 25 mm thickness. The normal tightening torque shall be max 1.5 Kg-m and such that it shall not cause damage to clamps or connection points. The clamp shall withstand minimum pull force as per the requirement of IEC-1230 (350 kg for 35 sq. mm flexible lead) during attachment to tower/Earth strip/tools and plans. The Earth clamp shall also be equipped with a permanent or detachable coupling for connecting the Earthing cable/lead.

4.2 Clamp for Attachment to Conductor of Line / Sub-station (Line Clamp)

The line clamp shall be suitable for application by means of an operating socket attached to an "insulated glass fiber telescopic Earthing Pole" in either upward or downward directions. For such applications "spring loaded jaws" shall be required to enable the clamp easily slip over the conductor and retain the clamp in position while operating screw is being tightened / loosened. The clamp shall provide reliable contact performance and withstand the thermal and mechanical stresses produced by rated short circuit current. The normal tightening torque shall be 1.5 kg.m. and shall be designed such that no failure occurs up to tightening torque of 4.5 kg.m. The clamp shall withstand minimum pull force as per the requirement of IEC-1230 (350 kg for 35 sq. mm flexible lead) during attachment to conductor. The clamp shall be suitable for conductor diameters ranging from 20 mm to 40 mm.

The clamps without the provision of "Spring loaded jaws" shall also be acceptable, provided that the same can be fixed on the conductor from downward as well as upward side through detachable Earthing Poles.

4.3 Light weight Detachable Type Earthing Pole including socket for fixing Conductor Clamps (Earthing Pole).

The glass fiber insulated detachable type Earthing Pole shall have a overall length of approximately 5 (five) meters. The same shall consist of three equal detachable pieces, the length of each piece being approximately 1.7 meters. The three pieces shall have arrangements for easy connection/detachment with each other with suitable over lapping. When the three pieces are connected together it shall form a single stable and sturdy pole. The top part of the pole shall be provided with a metallic socket for holding the line-end clamp and for easy and smooth fixing of the line-end clamp to the conductor and also for removing the same (line-end clamp) from the conductor. The Earthing Pole shall be capable of being easily removed after fixing the Line Clamp to the conductor. The glass fiber insulated detachable type Earthing Pole shall be of Reinforced Category as per IEC -1235 or the pole shall be as per IEC - 855. "Carrying slings" for Earthing Poles shall also be provided. The carrying sling shall be made of nylon and shall not interfere with the operation of the pole. The Earthing pole and its couplings shall withstand the bending force and torsion stresses produced by the load of flexible earthing lead and tightening forces. The deflection shall be minimized to avoid uncontrollable movements. The limiting value of deflection shall be as per the requirements of IEC – 1235 for Reinforced Category or as per IEC- 855.

Detachable coupling between an Earthing pole and conductor clamp shall allow fixing of the Line Clamp and removal of the Earthing Pole without using pulling

or pushing forces exceeding 10 kg. If the Earthing pole can be detached by pulling and pushing only, the release force shall not be less than 5 kg.

Operating socket shall have provision of natural "Spring loaded plunger" which will maintain grip pressure on the operating screw, holding both socket and line clamp rigidly while being directed into position. This operating socket shall form a part earthing pole. Alternatively operating socket without provision of "spring loaded plunger" shall also be acceptable, provided that the line clamp can be easily fixed and removed and also Earthing Pole can be easily removed after fixing the line clamp to the conductor.

4.4 Stranded Flexible Cable / Lead including Terminations lugs: Standard length of cable / lead shall be 10 meters.

4.4.1 Copper Lead/Cable:

"Flexible Stranded Cable / Lead" of copper of suitable size required for short circuiting current rating of 8 KA for 1 sec & of 25 KA for 1 sec, as the case may be, for connection between Line clamp and Earth clamp shall be used.

This flexible stranded cable or lead shall have a transparent / opaque insulated covering of bright colour (Red or Orange) to increase visibility of the strands and shall have approx. 2.0 mm thickness. The insulated covering shall be either PVC or Silicon sheath which shall withstand 50 V r.m.s. and variation from -5^{0} C to $+50^{0}$ C of ambient temperatures (Max Temperature of conductor may be 70^{0} C on account radiation from Sun and Conductor heating).

4.4.2 Termination Lugs:

The cable / lead shall be connected to Earth Clamp and Line clamp by means of lugs with large contact areas having double crimping and shall have the required electrical,

mechanical and sealing qualities. In case of Copper lead, the termination lugs should be of waterproof type and prevent oxidation for long life.

5. Details of Materials :

Basic materials to be used for various components of the Earthing device shall be as per the Table -I. However an alternative material giving equivalent or better performance may also be used. The parties shall indicate the materials proposed to be used for all components of the "Earthing Device" stating the class, grade or alloy designation of the material, manufacturing reference standard etc.

6.0 Requirement of Tests :

Following tests shall be conducted on "Earthing Device". UPPTCL reserves the right to add or delete any test. These tests shall be conducted at manufacturers' works or at other standard laboratories of repute. However, UPPTCL reserves the right to get all or some of the tests to be conducted again, if felt necessary, in a laboratory of its choice and in presence of UPPTCL representative.

6.1. Type Tests :

These tests shall be conducted on samples manufactured / dealt by the bidder. The bidder is required to furnish copies of recent Type Test Certificates for the offered items, along with the offer. The test procedure shall be in accordance with IEC:855:1985, IEC:1230:1993 and IEC:1235:1993. The following type tests are to be conducted:-

- a) Fatigue test on cable/ lead with end fittings in accordance with IEC 1230,1993.
- b) Humidity penetration test on devices with copper cables in accordance with IEC 1230.1993.
- c) Pull test on cable / lead with clamps in accordance with IEC 1230,1993.
- d) Suitability of line clamp (Manual Checking) in accordance with IEC 1230. 1993.
- e) Tests on clamps, fixed connection points and connection within the device with respect to the ability to withstand the connecting forces in accordance with IEC:1230:1993.
- f) Short circuit current test for Flexible Cable / Lead with Earth Clamp, Line Clamp and accessories in accordance with IEC 1230,1993. This Type Test certificate shall be accompanied by a clear designation of the device tested, test results, a description of the test arrangement with photographs and/or diagram and an oscillogram with time trace and scales for test voltage and test current.
- g) Dielectric tests of Earthing Poles in accordance with IEC: 855:1985 or IEC:1235:1993. This Type Test certificate shall clearly mention the designation of the device tested, a description of the test arrangement with photographs and/or diagram and test results.
- h) Testing durability of marking.
- i) Visual inspection and dimensional check of earthing poles.
- j) Bending and crushing test of Earthing pole accordance with IEC :855:1985 or IEC:1235:1993.
- k) Torsion test of Earthing pole with couplings in accordance with IEC :855:1985 or IEC:1235:1993.
- 1)

6.2 Routine Tests :

These tests shall be carried out by the successful bidder during the course of and after completion of manufacturing of the Earthing Devices. The tests to be carried out are as given below:-

- m) Tests for Flexible cable / lead, Earth Clamp, Line Clamp and accessories shall be all those tests as given in Table 3 of IEC:1230:1993 under routine test category.
- n) Tests for Earthing Poles shall be those as given at clause no. -12 of IEC:1235:1993 for Insulating Hollow Tubes or as given at clause no. 11 of IEC:855:1985 for Insulating Foam Filled Tubes.

The successful bidder shall submit appropriate test certificates in support of successful completion of all the above tests against the batch of Earthing Devices to be supplied by them.

6.3. Acceptance Test:

After completion of manufacturing and prior to delivery, the successful bidder shall arrange these tests to be carried out in presence of POWERGRID representative. The following Acceptance Tests shall be carried out :-

- a) Fatigue test on cable / lead with end fittings in accordance with IEC 1230,1993.
- b) Humidity penetration test on copper cable / lead with end fittings in accordance with IEC 1230,1993.
- c) Pull test on cable /lead with clamps in accordance with IEC 1230,1993.
- d) Testing durability of marking in accordance with IEC 1230,1993.
- e) Bending test on Earthing pole in accordance with IEC:1235:1993 or IEC:855:1985.
- f) Torsion test on Earthing pole with couplings in accordance with IEC : 1235:1993 or IEC:855:1985.
- g) Dielectric tests of Earthing Poles in accordance with IEC :855:1985 (Clause 11) or IEC:1235:1993 (Clause 12), as the case may be.

Description of the Item	Sample size	Acceptance number of defects	Rejection number of defects
Earthing cable / lead with end fittings.	10% of the total ordered quantity subject to minimum five and maximum ten number of samples.	 Nil for sample size up to five nos. One for sample size between six and ten nos. 	 One no. for sample size up to five nos. Two nos. for sample size up to ten nos.
Earthing Pole.	 For total batch length of tube up to 13,500 meters – 05 nos. of samples. For total batch length of tube from 13,500 meters to 75,000 meters – 08 nos. of samples. 	 One for sample size up to five nos. Two for sample size up to eight nos. 	 Two nos. for sample size up to five nos. Three nos. for sample size up to eight nos.

Sampling, acceptance and rejection criteria shall be as per the following table:-

Samples which are subjected to tests of destructive nature are to be destroyed and made good with fresh products.

No material shall be delivered to UPPTCL before successful completion of all the Acceptance Tests in presence of UPPTCL representative and obtaining appropriate certificate thereof.

7. Association of Sub – Vendors:

Main vendor can associate sub – venders for supply of component/parts of Earthing device, However, all such sub vendors shall be approved by UPPTCL before commencement of manufacturing in order to maintain quality of product.

8. Applicable Standards :

a)	IEC 1230 – 1993 - 08 Live	Working – Portable equipments for
		earthing or earthing and short circuiting.
b)	IEC 1138 – 1994 – 04	Cable for portable Earthing and short circuiting equipment.
c)	IEC: 855 – 1985	Insulating foam filled tubs and solid rods for live working.
d)	IEC : 1235 – 1993 - 08	Live working : Insulating hollow tubes for electrical
		purposes.
e)	IS : 617	Specification for Aluminum and Aluminum Alloy ingots and casting for general engineering purposes.
f)	IS : 228	Method or Chemical analysis of steel.
g)	IS :8130	Sp. for conductor for insulated electric cables & flexible cords.
h)	IS : 5831	Sp. for PVC insulation and sheath.
i)	IS : 8309	Sp. for compression type tubular in line connector for aluminum conductor of insulated cables.
j)	IS : 694	PVC instated cables for working voltage up to and including 1100 Volt.

9. Marking :

Marking shall be clearly legible. Marking letter shall be at least 3 mm high and durable. The marking shall contain manufacturer's name or trade mark and item reference of the device. The cable lead shall also have marking of cross-sectional area in mm² & of material. The marking on the Earthing pole and lead shall not affect its performance.

10. Packing & Delivery:

All the Earthing devices shall be delivered in light yellow water proof canvas carrying bag with a reinforced base, two handles having a sealing strip and a shoulder strap. The bag shall contain two external pockets, one pocket shall be used for keeping "instructions for use" and other pocket shall be used for item reference.

One bag should be able to contain / store one set of Earthing devices. The Earthing pole shall be supplied in a long bag having three parts for keeping 3 nos. poles. These bags will also have two handless and a sealing strip in the center.

For the purpose of transportation of Earthing devices from manufacturer works to Purchaser, the above bags shall be packed in wooden crates. These wooden crates shall not have any nails protruding outside the wood.

11. Guarantee :

THE EARTHING EQUIPMENT TO BE SUPPLIED BY THE SUCCESSFUL BIDDER SHALL BE GUARANTEED FOR A PERIOD TWENTY FOUR MONTHS FROM THE DATE OF SUPPLY.

SI No	Name of the Item	Materials	Reference Standard IEC/IS
01	Earth Clamp Clamp for tower structure/ Earth strip/Tools& plants	High strength Aluminum Alloy or Bronze	IS – 617, IS – 228
02	Line Clamp Clamp for conductor	do	do
03	Earthing Pole a) Detachable type pole	Epoxy rod/Glass fiber (Reinforced)	IEC 855,IEC 1235
	b) Operating Socket	High strength Aluminum alloy or Bronze	IS - 617 IS - 228
04	Lead/Cable		
	a) Flexible conductor strands (Cu)	Copper	IEC –1138, IS – 8130, IS – 694
	b) Protective sheath	PVC / Silicon sheath	IEC – 1138 IS – 694, IS – 6831
	c) Cable / lead terminations Lugs (AI) (Cu)	High strength Aluminum Alloy, Electroplated copper	IEC – 1138 IS – 617 IS - 8309

Details of Materials

<u>TS-23</u>

TECHNICAL SPECIFICATION FOR MULSIFYRE SYSTEM

TECHNICAL SPECIFICATION OF MULSIFYRE SYSTEM

CLAUSE	DETAILS	PAGE NO.
1.0.0	Scope	2
2.0.0	Standards	2
3.0.0	General Information	3
4.0.0	Protection Scheme	3
5.0.0	Scope of Supply	6
6.0.0	Design and Construction	7
	Features of Equipment	
7.0.0	Scope of Erection Work	24
8.0.0	Tests	25
9.0.0	Drawing and Data	26
10.0.0	Technical Requirement for Fire Protection and Alarm System	27
11.0.0	Schedule of Quantities and Prices	47

TECHNICAL SPECIFICATION FOR DESIGN, SUPPLY, ERECTION AND COMMISSIONING OF SPRINKLER DETECTOR TYPE AUTOMATIC FIRE PROTECTION SYSTEM

1.0.0 **SCOPE:**

- 1.1.0 This specification covers design, engineering, manufacture, assembly, stage testing, inspection, testing before supply, packing, forwarding, delivery at site, of erection and commissioning of water emulsification type automatic fire protection system for 220 kV Substation. The specific requirement of the equipment and the scope of work is defined in the subsequent clauses. A tentative layout of above the ground water piping route and a flow diagram of mulsifyre system are to be enclosed alongwith the bid for guidance purpose.
- 1.2.0 Mulsification type fire protection system shall comprise of fire pumping sets, MS pipes and fittings with anti corrosive treatment deluge values, high velocity water projectors, detectors, alarm panel etc. and all other items to complete the scheme for the following equipments:-

160 MVA 220/132 kV TRANSFORMERS 02 Nos.

2.0.0 **STANDARD:**

2.10 The equipments and its installation of Mulsifyre system shall conform to the latest revision with amendments available of relevant standards, rules and codes, some of which are listed herein for ready reference.

SI.No	. Standard	Title
1.	Tariff Advisory Committee	Fire Protection Manual
2.	National Fire Protection Association	Fire Protection Manual for
		equipments of mulsifyre system system
3.	Fire Officers Committee, London	Water Projectors, Control Valves,
		Deluge Valves, Quartozoid Bulb, Detector etc.

4.	Underwriter Laboratories Inc. USA	Fire Protection Manual
5.	IS : 1363	Bolts and Nuts
6.	IS : 226	Material of Flanges
7.	IS : 1538/76	Filling used in underground
8.	IS : 1239	Pipe for sprinkler fire protection system
9.	IS : 780/1967 he	Isolating valves on water eader for Size 75 cm and above
10.	IS : 2208	Fuses
11.	IS : 2959	Contactors
12.	IS 2147-1962	Enclosure of switchgear
13.	IS : 1232	Motor terminal box
14.	IS : 318	Material of impeller of pump.
15.	BS : 970	Material of impeller of shaft.

3.0.0 **GENERAL INFORMATION:**

A general drawing for piping and instrumentation diagram for fire protection system is to be enclosed by the bidders. The drawing shall only be indicative for guide line for design system, layout of equipment and other relevant data for the purpose of evaluation. Bidders shall submit drawings with bid according to its recommended scheme. Successful bidder shall however be required to prepare detailed drawings on the basis of above drawing and also as per the rules laid out by Fire Insurance Authorities.

4.0.0 **PROTECTION SCHEME:**

4.1.0 The aim of emulsification type fire protection system is to extinguish the oil fire on the equipment to be protected instantaneously. For this the system shall supply water through projectors in the form of conical spray, to cover the entire volume of equipments to be protected, consisting of droplets of water travelling at high velocity and these droplets of water bombarded to the surface of oil to form an emulsion of oil and water that will not support combustion. This emulsion of water and oil shall not be of a stable character but the oil will start to separate out from the water, which shall be drained away after few minutes of shutting off the water.

4.2.0 FOR 220 kV SUBSTATION:

In the substation the proposed fire protection scheme shall in general comprise of the following:

- 1) Two pumping units, one electric motor driven set as the main unit and one diesel engine driven set as the 100% stand by unit, for supplying the water requirement for the proposed fire protection system.
- 2) Provision of future extension of this fire protection system shall be provided if required.
- 3) The scheme of fire protection shall be so designed that it will cater for effective fire protection in case of simultaneous fire in both 220/132 kV Transformers.
- 4) The entire scheme when fully executed shall have to protect completely any one set of the equipments as described above. Bidder will give complete, calculations to justify the hydraulic design and selection of pipe dimension and other equipments of the above scheme. For this scheme it is envisaged that pump house shall in general comprise of the followings:

- a) One electric motor driven pump set (main)
- b) One diesel engine driven fire pump set (100% stand by)
- c) One package air compressor unit
- d) One package air compressor unit (100% stand by)

The pump capacities on the drawings are to be mentioned and bidders are requested to quote also for any other capacity to meet the above duty justified by adequate calculations.

- 5) The bidder may also give any other alternative scheme to the above which they feel/ recommend best to suit, giving the requirements as per the details of equipments as shown in the drawings. The offer for this alternative shall be complete with details of technical reasons for recommending of the same, calculations, drawings price of supply and erection and split up prices of main equipments.
- 6) The emulsification type automatic fire protection system shall comprise water projectors to be erected about to command plant as required, and the surrounding floor area. The fire protection system shall be so designed as to envelope the equipment to be protected completely without leaving any gap. The water flow through the projectors about each equipment shall be controlled by separate automatic deluge valves. The deluge valves shall be pneumatically operated and shall be controlled by high expansion liquid filled bulb type detectors. The detector pipe work system shall be charged with compressed air at a suitable pressure. In the event of fire taking place, one or more of the detector bulbs will collapse due to heat allowing release of air through them. This will cause fall in air pressure in detector system, thereby opening the respective pneumatically actuated deluge valve and thus bringing all the water projectors into action simultaneously. As the water spray starts the water pressure in the supply header shall actuate the fall in hydraulic diaphragm of the starter controlling the electric motor driven pump for fire protection system bringing the same into operation automatically to supply water to the fire protection system. In the event of electric motor driven fire protection pump failing to start the header water pressure will fall further and actuate the pressure switch controlling the starting equipment of the Diesel Engine driven pumping set bringing it into operation automatically through the interconnection. The above operation shall not require human assistance of any sort whatsoever. Shutting down of the pumps will be manual. Provision shall be kept for alternative manual starting of the pumps. The individual pressure settings for starting pumps shall be kept quite close.
- 7) The fire protection system shall comprise of pressurised water tank, jockey pump of adequate capacity in order to compensate any loss of pressure in water pipe due to leakage etc.

- 8) The jockey pump be connected to the fire protection system after the pump house control valve and will maintain the water pressure in the headers not less than (70 mtr. head) 7×10^4 Kg/cm. The vessels shall be kept charged with sufficient water. The purpose of jockey pump is to avoid frequent starting and stopping of fire pumps in case of slight leakage from the water pipe line which is to be maintained at a constant pressure.
- 9) The bidder shall specify the minimum clearance to be kept between the sprinkler pipe work and the live parts of the protected equipment. This shall be in accordance with the standard practices for high voltage substations and recommended by National Fire Authorities. The bidder shall give the reference of the source from which the value is chosen by him. The B.I.L. rating of high voltage equipment and the system is 1050 kV.

5.0.0 SCOPE OF SUPPLY:

- 5.1.0. The scope of supply under this specification shall include but not limited to the following.
- 5.1.1 One (1) Diesel Engine driven pumping set.
- 5.1.2 One (1)—Automatic Starting Control Panel for the diesel pump including Automatic Battery Charging Equipment.
- 5.1.3 One (1) set of spare parts for Diesel Engine as per recommendations of Fire Protection Authorities
- 5.1.4 One (1) Electric Motor Driven Pumping Set.
- 5.1.5 One (1) set Automatic Starting Switchgears.
- 5.1.6 Necessary Nos. of water projectors, bulb detectors alongwith their supporting structures etc.
- 5.1.7 Two (2) Package Air Compressor Unit with receiver of adequate capacity for detector system.
- 5.1.8 Automatic Starting Control Panel for the above air compressor unit.
- 5.1.9 Jockey Pump of pressurisation of fire protection system.
 - One (1) Priming Tank of suitable capacity.
- 5.1.10 One (1) set of pump house main control valve assembly complete with strainer, alarm gong isolating valves etc.
- 5.1.11 Required nos. of automatic Deluge Valve assemblies complete with alarm and all accessories.
- 5.1.12 Pipings for above the ground water supply, compressed air, drain, vent etc. strainers, valves, bends, tees, counter flanges, expanders/ reducers, bolts, nuts, washers, gaskets expansion joints, controls, control accessories, gauges and all other fittings as required for equipments inside and outside the pump house and for the entire fire protection scheme. All terminal points will be provided with counter flanges, bolts, nuts, washers, gaskets etc.
- 5.1.13 All foundation frames, base plates, anchor plates, onsets, anchor bolts, nuts washers, gaskets, packing pipe hangers and supports including structural

supports and anchoring material as required for complete erection and commissioning of the entire fire protection system.

- 5.1.14 415V, 3 phase, 50 c/s AC switchboard of suitable ampere rating complete with two numbers incomers, incoming switch fuse units, volts meters, ammeters and switch fuse units for the outlet feeders. There shall be indication lamps for indicating 'ON' 'OFF' of incomers and supply of the outlet feeders.
- 5.1.15 Necessary power and control cabling from the above switch board to all electrical equipment for fire protection system.
- 5.1.16 One set of alarm and annunciator panel for the system to be provided in the main control room of the substation.
- 5.1.17 The bidder shall indicate the details of items and quantities required for mulsifyre system for the various equipments to be protected against fire for the purpose of bid evaluation.
- 5.1.18 The contractor shall include in his bid any/ all other additional equipment, fittings and accessories as may be necessary to meet the approved requirements of Fire Insurance Authorities and to complete envisaged plant and system to accrue benefit to purchaser. Omission of specific reference of any particular equipments, accessories and fittings in this specification shall not relieve the contractor from supplying such equipment fittings and accessories that may be necessary for making the system safe and compete, without any extra cost to the purchaser. Reference of all such equipments, accessories etc. shall be made in their bid.
- 5.1.19 All consumable materials required for complete erection of the whole plant under this specification.
- 5.1.20 Supply of recommended spare parts for two years trouble free operation of the equipment (complete item wise list of spare parts to be furnished by the bidder)
- 5.1.21 Supply of special tools and tackles as required for erection of the plant and maintenance of the main equipments under this specification.
- 5.1.22 Supply of various drawings, data sheets, test reports and certificates, operation and maintenance manuals etc. as required and as specified under the applicable clause of this specification.

6.0.0 DESIGN AND CONSTRUCTION FEATURES OF EQUIPMENT TO BE SUPPLIED UNDER THIS SPECIFICATION:

6.1.0 **FIRE PUMPING SETS:**

The design and construction of the fire water pumps with either electric motor or diesel engine drive shall meet the recommendations of National Fire Protection Association USA or any other international relevant standards.

Each firewater pump shall be horizontal centrifugal type with end suction and vertically split casing. Both the pumps shall operate under flooded suction conditions and shall have fully automatic priming arrangement and the priming arrangement shall be such that pump will start even if there is interruption in priming water supply or leak through foot valve, thus making failure of priming arrangement virtually impossible.

The pumps should have best efficiency at specified duty point, they shall have a continuously rising head capacity characteristic without any zone of instability. At 150% of rated capacity the total head should not be less than 65% of the rated head. Also with line pump operating rated speed and discharge valve closed the total head of the pump should not exceed 120% of rated head at 100% capacity in case of horizontal pumps.

The pump impeller shall have non overloading characteristics during single pump operation. The pumps shall have internal/ external flow recirculation. The magnitude of peak to peak vibration at shop shall be limited to 75 microns at the bearing housing. After installation at site the magnitude of vibration shall be limited to 50 microns. The pump should start automatically and stop manually. The pumps shall be designed in a way that they are suitable for 2.0 meter suction lift.

The pumps shall meet the following performance requirements:

- a) Rated capacity : 210 M³/H
- b) Total dynamic head : 70 meters

at rated capacity

The generated head of pump shown above is only indicative. The bidders shall choose the appropriate value and the discharge capacity of the pumps for the fire protection system according to his calculations justifying that it matches with the duty requirement as mentioned on clause 4.2.0 above and also with the characteristics of projectors quoted by them. It shall also be ensured by them that the projectors at further point shall work satisfactorily with the chosen generated head of pump.

6.1.0 **REQUIRED CHARACTERSTICS:**

Consistent with good operating characteristics and high efficiency, both the pumps should have continuously rising characteristics from operating to shunt off point. Both the pumps shall have similar characteristics to be able to operate in parallel satisfactorily. The chosen characteristics shall be fully compatible with complete system design.

6.1.1 **IMPELLERS:**

The impeller shall be keyed to the shaft and locked in position between shaft sleeves. The rotor assembly shall be dynamically balanced before incorporation in the pump. Impeller shall be at least 5% and preferably 10% smaller in diameter than the maximum that can be incorporated in the casing.

6.1.2 **WEARING RINGS:**

Renewable wearing rings shall be provided on both impeller and casing.

6.1.3 SHAFT AND SHAFT SLEEVES:

The shaft shall be round and polished to final dimension and of ample size to withstand all stresses resulting from rotor weight, hydraulic loads and high starting and accelerating torque. Renewable shaft sleeves shall be provided to protect the shaft from wear.

6.1.4 **STUFFING BOXES:**

Packed type stuffing boxes shall be provided to prevent leakage. Seal and or cooling water if necessary shall be taken from pump discharge.

6.1.5 **COUPLING:**

The coupling between pump and motor/ diesel engine shall be flexible type of suitable design. Suitable guard shall be provided.

6.1.6 **PUMP CASING:**

The pumps casing shall be of closed grained cast iron and equipped with priming connection, air release valves and drain plugs.

6.1.7 **BASE PLATE:**

The pumps and drive shall have common base plate. The base plate shall be of rigid construction and properly ribbed as needed. Suitable drip tip with drain top shall be provided as required.

6.1.8 **BEARINGS:**

Each pump shall be furnished with heavy duty ball or roller bearings to provide smooth operation and to absorb any unbalanced forces including thrusts during all service conditions. Thrust bearing discs, cellars etc. shall be furnished as per standard of the manufacturer for this service.

6.1.9 **MINIMUM FLOW RECIRCULATOR:**

Each fire pump shall be provided with a bypass or re-circulator system for maintaining automatically a limited rate of water flow through the pump when the pump is in operation with delivery closed.

6.1.10 **MATERIAL OF CONSTRUCTION:**

The material construction of the pumps shall be as follows:

a.	Impeller	:	Leaded Gun Metal IS 318 Gr. V
b.	Shaft	:	Hardened Carbon Steel BS970, EN 8
C.	Casing	:	Closed Grain Case Iron
d.	Shaft sleeves	:	Leaded Gun Metal IS 318
e.	Wearing rings	:	Bronze
f.	Gland	:	Bronze
g.	Base plate	:	Fabricated Steel
h.	Gland packing	:	Graphite Impregnated Asbestos

All material shall conform to IS, BS or equivalent.

6.2.0 ELECTRIC MOTOR DRIVE:

6.2.0 The motor driven fire water pump and the air compressor shall be driven by horizontal TEFC Squirrel Cage Induction motors of proper horse power rating and shall be suitable for use on a nominal voltage of 415V, 3 phase, 50 cycles, neutral grounded system.

6.2.1 **DRIVE EQUIPMENT:**

This specification forms part of the driven equipment specification. Informations not available in the following paragraphs shall be governed by the driven equipment specification.

Motors shall be capable of satisfactory operation for the application and duty as specified and as required by the driven equipment.

6.2.2 **TYPE AND RATING:**

- a) Motor shall be constant speed squirrel cage, 3-phase induction type.
- b) Motor shall be capable of continuous operation at full load in a hot humid and tropical atmosphere with an ambient temperature of at least 50°C.
- c) Motor output shall preferably be in kW and shall be chosen so as to provide a minimum 15% spare margin over the maximum power requirement of the driven equipment.
- d) Motors upto 150 kW shall be rated for use on a nominal 415 Volts, 3 phase, 50 c/s grounded system.

6.2.3 **PERFORMANCE:**

- a) Motor characterstics such as speed, torque, acceleration time, etc. shall be properly coordinated with the requirement of the driven equipment.
- b) Motor shall be capable of giving rated output without reduction in the expected life span when operated continuously under either of the following supply condition:
- i) Voltage : $\pm 10\%$
- ii) Frequency : $\pm 5\%$
- iii) Combined Voltage : $\pm 10\%$
- c) Motor shall be suitable for direct on line starting at full voltage, starting current at rated voltage shall be limited to 6 times full load current.
- d) The motor shall be capable of starting and accelerating the driven equipment with 80% rated voltage at motor terminals

- e) Motor shall be capable operating satisfactorily at full load for 5 minutes without injurious heating with 80% rated voltage at motor terminals.
- f) Motor shall be capable of three equally spread starts per hour. Under normal condition two starts in quick succession with cold machine at room temperature and one restart from hot conditions.
- g) The motor shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage, in either direction of rotation.
- h) The motor vibration shall be within the limit specified in the applicable standard unless otherwise specified for the driven equipment.

6.2.4 **ENCLOSURE:**

- a) Indoor motors shall be totally enclosed fan cooled type.
- b) The winding shall be impregnated to make them non-hygroscopic and oil resistant.

Temperature Measurement	Insulation Class	Maximum Temp. rise for all type of enclosure
Thermometer method	E	55°C
	В	60°C
Winding Resistance	E	75°C
Methods	В	70°C

6.2.5 **BEARING:**

- a) Motor shall be provided with greased ball, roller or sleeve bearing depending upon size and particular application.
- b) Special bearing may be used subject to approval of the purchaser.
- c) Bearing shall be designed for positive lubrication with a drain to guard against over lubrication.
- d) Bearing shall be properly shielded to prevent leakage of lubricant or entrance of foreign matters along the shaft.
- e) The bearing shall permit running of the motor in either direction of rotation.

6.2.6 **TERMINAL BOX:**

a) Motor terminal box shall be detachable type and located in accordance with IS:1232 or equivalent, the box shall be suitable for top and bottom entry of cable.

- b) Terminal box shall be of plate steel construction, robust, dust and water proof.
- c) The terminals shall be of the stud type with necessary plain washers, spring washers an check nuts. They shall be substantially designed for the current carrying capacity and shall ensure ample phase to phase and phase to ground clearance and shall be thoroughly insulted from the frame.
- d) The terminals shall be clearly marked A.B.C. and corresponding rotation for this connection shall be indicated.
- e) The terminal box shall be furnished complete with cable lugs and compression glands for termination and connection of cables.
- f) The terminal box and its arrangement is subject to approval by the purchaser.

6.2.7 **GROUNDING PAD:**

- a) Provision of two separate and distinct ground connection shall be provided on each motor.
- b) The ground provision shall include either two cleaned and buffed metal surfaces on the frame or two flat steel pads welded to the frame.
- c) Each ground pad shall be provided with tapped holes bolts and washers.

6.2.8 **TROPICAL PROTECTION:**

- a) All motors shall have fungus protection involving special treatment for insulation and metal against fungus insects and corrosion.
- b) Space heater shall be provided for all motors above 75 kW to maintain the internal motor temperature above dew point when motor is idle. When provided the operation of this should be most soliable and should have protections against any malfunction of its operation.
- c) Space heaters shall be rated 240 Volts, single phase, 50 cycles.
- d) Heater shall be located to provide uniform heating and to permit easy removal or replacement of the heater element.

6.2.9 **ACCESSORIES:**

- a) Bearing or stator temperature detector shall be furnished according to the recommendations of the manufacturer.
- b) The terminals of individual RTDs shall be brought out separately to outside terminals without any internal shorting.

- c) All accessories, such as stator temperature detectors and space heater shall be wired upto and terminated cable terminal box.
- d) Each terminal shall be identified with suitable marking.
- e) All meters shall be provided with suitable lifting attachment.

6.2.10 **PAINT AND FINISH:**

- a) Motor external parts shall be finished and painted to produce a neat durable surface which would prevent rusting and corrosion. The equipment shall throughly degreased, all rust sharp edges and scale removed and treated with one coat of primer and finished with two coats of grey enamel paint.
- b) The motor fan shall also be painted to withstand corrosion.

6.3.0 **DIESEL ENGINE DRIVE:**

6.3.1 The standby fire water pump shall be driven by a direct injection, multicylinder, water cooled, four stroke cycle diesel engine. The engine, after the corrections for altitude and ambient temperature specified, shall have a break horse power rating not less than 20% greater than the maximum horse power required at the pump shaft at rated speed and output. The diesel engine rating should be in accordance with clause 7.4.5.2.3 of TAC Manual (Hydrant system part I).

Since the fire pumping unit is not required to run continuously for long period and operation will not be very frequent. Proper measures shall be built into the engine to allow it to start instantaneously against full load even if it has remained idle for several weeks or months.

6.3.2 **AUTOMATIC STARTING ARRANGEMENT:**

The engine shall be able to start and accept full load within 15 sec. from receipt of signals to start. The starting system shall include a DC motor having high starting torque to overcome full engine compression. The engine shall be provided with two sets of 24V lead acid batteries. Each set shall be enclosed in a hard rubber container and shall be of heavy duty traction type, with ample capacity to start the engine several times in succession. One set of battery is for automatic starting of the engine and the other provided for manual starting. A selector switch shall be provided at the automatic starting control to select any of the two sets of battery for manual auto-starting of the engine.

The automatic starting arrangement shall include as a safeguard "Repeat Start" feature as that if the pinion of the starting motor does not engage the engine fly wheel at the first attempt, it is automatically retrace and after a short pause again advanced towards the fly wheel. This repeat start cycle will continue untill starter motor pinion engages with the starting ring on the fly wheel and cranks the engine.

6.3.3 BATTERY CHARGING EQUIPMENT:

The diesel engine shall be provided with a wall mounted automatic battery charger complete with air cooled transformer, full wave bridge connected rectifier suitable for operation on single phase AC supply to charge lead acid cells at natural falling rate of 10 to 6 amps. or to trickle charge. The automatic battery charger must be capable of charging to two set of 24V batteries simultaneously.

6.3.4 **ENGINE LUBRICATION SYSTEM:**

The engine shall have an integral positive displacement pump for providing normal pressure lubrication to the engine bearings, cylinders, big end bearings and valve gear etc. The pump shall be driven by main engine cum shaft. Additional splash lubrication shall be provided to protect the cylinder walls when engine will start after an idle period. The oil used shall have necessary lubricating property at ⁰C and at the maximum operating temperature.

6.3.5 **SPEED GOVERNOR:**

The engine shall be provided with suitable speed governor capable of regulating the engine speed within a range of 10% between no load and maximum load condition of the pump and shall be set to maintain the rated speed at rated load.

6.3.6 ENGINE COOLING ARRANGEMENT:

The engine jacket cooling system must comply with either one of the following arrangement:

(a) The engine cooling water shall be obtained from the discharge of the fire pump, taken off prior to the pump discharge valve. The water after passing though the engine jacket should be discharged to waste through a pipe placed well above the top of the engine water jacket or above the level of the top of the pump priming tank where one is fitted.

N.B. The terms-Syphon System of cooling shall not be used.

(b) Cooling Circulation:

The engine cooling system shall be the closed circuit type, including a circulating pump driven by the engine, a heat exchanger and a reliable engine jacket temperature regulating device. An opening shall be provided in the circuit for filling the system, checking level, and adding make up water when required.

N.B. if the auxiliary pump (to circulate water in the closed circuit) is belt driven from the engine, there must be multiple belts such that should half the belts break the remaining belts must be capable of driving the pump.

(i) Exchange Water-Supply:

The cooling water supply for the heat exchanger shall be from the discharge of the fire pump, taken off prior to the pump discharge valve. Threaded rigid piping shall be used for this connection. The pipe connection shall include a manual shut off valve, an approved flushing type strainer in addition to the one that may be part of the pressure regulating valve, a pressure regulating valve and a second manual shut off valve in the approved order. A pressure gauge shall be installed in the cooling water supply system on the engine side of the inlet manual valve. A by-pass connection with a wheel valve and a strainer shall also be provided.

(ii) Water outlet:

An outlet shall be provided for the waste water line from the heat exchanger and the discharge line shall not be less that one size larger than the inlet line. The outlet line shall be short, shall provide discharge into a visible open waste cone and shall have no valves in it.

6.3.7 ENGINE FUEL TANK:

The fuel storage tank for the diesel engine shall be lead coated steel having sufficient capacity to run the engine at full load for a minimum period of six hours. The tank shall be fitted with magnetic level indicator of most reliable type.

All piping, valves, fittings, filters etc. shall be included in the offer by the bidder.

6.3.8 **AUTOMATIC STARTING CONTROL PANEL FOR DIESEL ENGINE DRIVE:**

The control panel shall house the necessary gears required for auto starting of the Diesel Engine when the header pressure falls. Push button for manual starting of the engine shall be provided on this panel to select any of the two sets of battery for manual/ auto starting of the engine. It shall be fabricated from sheet metal of minimum 16 gauge thickness and the panel shall be dust and vermin proof. It shall be provided with a hinge door to give an access to the internal equipment.

6.3.9 **DRIVEN EQUIPMENT:**

Informations not available in the above paragraphs shall be governed by driven equipment specifications.

6.4.0 SWITCHGEARS AND ACCESSORY EQUIPMENT:

6.4.1 Automatic Switchgear for Electric Motor

The automatic switchgear for the fire pump motor shall comprise a hydraulic pressure controlled disphargm type direct on line starter and isolator. The unit shall be mounted on a stand for use with horizontal pumping sets. The switch shall not be fitted with any 'No Volt' protection or any single phasing preventer or any other relays except for HRC fuses. The front of the switch casing shall be removable allowing easy access to the working parts. The isolator is to be provided to cut off electric supply to the automatic switch on the motor to permit safe periodical clearing and inspection. The enclosure of the switchgear shall be provided with a degree of protection not less than IP 54 as per IS: 2147-1962.

6.4.1.1 Power & Control Supplies:

Power and control supplies will be provided by purchaser at the voltages specified below. If voltages other than these indicated are required by the contractor, then necessary arrangement shall be made by the contractor within the control cabinet to obtain the desired voltage(s) by providing step down transformers and inverter/ converter etc.

- 1. Power Devices: 415V, 3ϕ , 50Hz
- 2. Space Heater/ Lighting supply voltage: 240V, 1 Ph, 50Hz.

Each supply shall be controlled within the cabinet by adequately rated heavy duty, load break isolator and HRC fuses.

6.4.2 **POWER CONNECTION:**

The purchaser's external power cable connections to the switchgear cabinet of the motor will be carried out using 1100 Volt grade 3½ core 3.5 mm² PVC cables. All necessary cable terminating accessories such as packing glands, crimping type copper lugs, supporting clamps and brackets etc. required for the termination of these cables shall be included in the contractors scope of supply.

6.4.3 **ISOLATING SWITCHES:**

The switch control gear shall be provided with 3 pole isolating switch, HRC fuses and other equipments required for satisfactory control of the motor. The isolating switch shall be rated at least 20% more than the connected motor full load current.

Isolating switches shall be hand operated, air break, heavy duty, quick make, quick break type conforming to IS: 4047 or equivalent.

The incoming power supply isolating switch operating handle shall be interlocked with the control cabinet door so as to prevent opening of the door when the switch is closed and to prevent closing of contacts when the door is open. Device for bypassing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.
6.4.4 **CONTACTORS:**

Contactor type motor starters shall be of the full voltage, direction-line, air break, single throw, electromagnetic type conforming to IS: 2959 or equivalent.

6.4.5 **FUSES:**

All fuses shall be of the HRC cartridge type, conforming to IS:2208 or equivalent mounted on plug-in type fuse bases having prospective current rating of adequate capacity. Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded, and it shall be possible to change fuses with the circuit alive, without danger of contact with live metal. Isolator fuse pulling handle shall be supplied with each control cabinet.

6.5.0 **ALARM PANELS:**

Annunciators of facia type having translucent window of 35mm x 50mm (minimum) size engraved with appropriate function in Block Letters for each alarm point shall be provided on the annunciator panel to be erected inside the main control room of the substation. Annunciators shall be suitable for operation on the voltage specified and shall have single alarm buzzer common to all points. Three push buttons for buzzer alarm reset, trouble lamp reset and hooter alarm reset with appropriate name plates shall be provided common to all alarm points. Annunciators shall be suitable for operation with both normally open and normally close alarm contacts. All relays necessary for the annunciation system shall be supplied and mounted within the cabinet.

On receiving an alarm impulse, even if momentary, the appropriate alarm shall pick up, energizing the corresponding visible (flickering light indication) and audible alarm units. It shall be possible for the operator to reset the audible alarms even if the 'alarm' (fault) conditions persists. However visible alarm shall not reset unless the alarm condition has disappeared and operator presses the lamp reset push button. Annunciator shall be provided with lamp indication and audible alarm shall be ready to operate for any new alarm conditions immediately after the alarm is reset for a previous alarm condition. Annunciators shall operate satisfactorily between 80% and 110% of rated supply voltage.

6.5.2 The following annunciations shall be provided on the panel :

- a) Low air pressure in the detector pipe shall have separate windows. Additional windows shall also be provided on the panel for future extension of the fire protection system.
- b) Low water pressure after main control valve.
- c) Low water level in the storage reservoir.
- d) Fire in 220/132 kV Transformers.
- e) Fire protection system operating
- f) Electric motor driven pump fails to start when system operates
- g) Electric motor driven pump running
- h) Stand by Diesel Pump start
- i) Stand by Diesel Pump fails to start
- j) Battery for Diesel Engine
- k) Pressurised water tank level
- I) Air compressor running in the event of low air pressure
- m) Low Air pressure in detector pipe

All the above annunciations shall be both audio and visual on the panel. The audio indication shall be by means of buzzer alarm and the visual will be through flickering light indication on the respective facia plates. The hooter alarm shall operate only at the indication of FIRE.

6.5.3 **PUSH BUTTON:**

All push button shall be of push to actuate type having 2 'NO' & 2 'NC self reset contacts. They shall be provided with integral escutcheon plates, engraved with their functions. Push button contacts shall be rated for 5 Amps. of 415V AC and lamp inductive breaking at 250V AC

6.5.4. **INDICATING LAMPS:**

Indicating lamps shall be of the filament type having double contact bayonet caps and low watt consumption. Lamps shall be provided with series resistors to prevent short circuiting of control supply on filament fusing.

6.5.5 **SPACE HEATER:**

Strip type space heaters of adequate capacity shall be provided inside each cabinet to prevent moisture condensation. Space heaters shall be rated for 240

V, 1-phase, 50 Hz supply. Heaters shall be complete with rotary type 'ON – OFF' switch, HRC Fuse on phase, link on the neutral and a thermostat to control switching of the heater.

6.5.6 **INTERIOR LIGHTING AND RECEPTACLE:**

Control cabinet shall be provided with 240V, 1-phase, 50Hz, 40W preferable fluorescent lighting fixture for interior illumination controlled by a 'ON-OFF' switch and 240V, 1-Phase, 5 Amp, 3 pin receptacle.

6.6.0 **DETECTORS**:

Thermostat bulb type detector actuators having necessary sensitivity for the purpose intended shall be made of suitable material preferably quartz. These shall be fitted to the detector pipe work system around the equipment to be protected for detecting and actuating the system in case of genuine fire. The detectors shall be mounted on this pipe work in positions carefully selected to ensure the rapid detection of fire. When the fire occurs, the resulting heat shall chatter the bulbs into small pieces ensuring prompt and free opening of the automatic deluge valve by releasing the compressed air in the detector pipe work around the particular equipment involved in fire. The bulbs shall have a suitable temperature rating considering the coldest as well as the hottest climates. The detectors shall have the temperature rating marked on them and the colored liquid filling accordingly. The bulb and its filling shall be of a permanent and unchanging nature uninfluenced by the passage of time or by atmospheric conditions. The metallic parts of the detectors (Body and Yoke) shall be provided with corrosion resistant coating of approved type for long life under outdoor conditions. The detectors shall be well protected from any mechanical injury and will be definitely placed at positions where the chances of occurrence of the fire are more.

The offered bulb detectors should be fully tested and approved by appropriate authorities as mentioned in clause 2.0.0 and clause 10.0.0 of technical specification. Non compliance to this shall make the bidder liable to be rejected.

6.7.0 **WATER PROJECTORS:**

The water projectors (the nozzles for high velocity water supply spray system) shall be adequately designed and installed to discharge water in the form of an expanding cone of evenly distributed broken stream which strike the burning surface with sufficient impact to ensure the formation of emulsion. The projector orifice shall be properly selected so as to achieve wide coverage with economical

water discharge. The bidders shall furnish the characteristics of the quoted projectors and clearly mention in their bid the minimum pressure of water at the projector required for maintaining characteristics of the projectors so that the water envelope formed by the projector discharge angle shall not reduce at this minimum pressure. The bidders shall also state in their bids the minimum pressure of water at which the projectors shall start dripping. Each projector shall be complete with integral perforated copper plate strainer or thimble strainer to arrest oversize foreign matters which will not pass through the projectors.

The projectors shall be made up of durable material and shall be coated with corrosion resistant coating. The number of projector which the bidder recommends according to his experience for ensuring that the spray completely impinges on and envelopes the risk and adjacent floor area will be clearly mentioned by him and he shall also furnish full justification together with the criteria of selection of the number of projectors chosen and offered in his bid.

6.8.0 **AUTOMATIC DELUGE VALVE:**

The deluge valve shall operate to bring a large number of water projectors simultaneously into operation. The connection to the water distributor shall lead from the outlet of the valve to the distribution pipe work which shall be suitably graded in diameter to carry adequate supply of water to all points of distribution projectors. The distribution pipe work shall remain empty until the deluge valve opens.

The detector pipe work charged with compressed air shall be connected to the diaphragm unit of the deluge valve. A detector pipe work pressure gauge shall be fitted. The water supply connection shall be coupled to the inlet of the valve and a water supply pressure gauge shall be fitted.

The deluge valve shall operate only through the differential pressure between the detector circuit pressure on the operating diaphragms and water pressure at the valve inlet. It will be of completely fail safe and proven design fully tested for head loss.

Among the other thing it shall generally be provided with the following:

- a) Water inlet side 'Locked Open' isolating valve alongwith padlock and strap.
- b) Alarm valve alongwith alarm motor and gong complete with inlet water strainer.

- c) Differential air valve.
- d) Test cum drain valve and other drain valves.
- e) Vent valve or plug.
- f) Accelerator valve, chamber complete with Accelerate Isolating valve, test valve.
- g) Water inlet pressure gauge.
- h) All piping and connections for the deluge valve assembly.

The automatic deluge valve shall have the cast iron body and internals as per standard of the manufacture. The pneumatic actuation shall be of rubber diaphragm or equivalent. The deluge valve should be TAC/FOC approved, FM/UL listed.

6.9.0 MAIN CONTROL VALVE:

This valve shall be located in the pump house. It shall be of adequate size and capacity required for this purpose and shall be of proven design. The water pressure beyond this valve in the main water header and up to the deluge shall be maintained at a pressure not less than 7.5×10^4 Kg/m² and this value shall automatically actuate the pumps etc. in case the water pressure in the header falls below this level. It shall essentially have a water operated alarm which will send alarm only when there is flow of water through the valve. Among other things the control valve shall generally be provided with the following:

- a) Water inlet side `Locked Open' insolating valve alongwith padlock and strap.
- b) Water outlet side `Locked Open' isolating value alongwith padlock and strap.
- c) One complete strainer at the outlet.
- d) Alarm valve alongwith alarm motor and gong complete with inlet water strainer.
- e) Drain and test valve.
- f) Drip plug.
- g) Water inlet pressure gauge.
- h) Installation pressure gauge.
- i) All piping and connection for the valve assembly.
- j) A hydraulic disphragm switch arrangement for instantaneous automatic starting of fire water pumps due to fall in water pressure.
- k) Water inlet side 'Normally Closed' locked with padlock and strap isolating valve.
- I) Non return valve of adequate size.
- m) Water outlet side isolating valve.

The control valve shall have cast iron body and internals as pet standard of the manufacturer.

6.10.0 AIR COMPRESSOR AND DRIVES:

Two package air compressor with receiver of adequate capacity shall be provided for the detector system in order to restore automatically any loss of pressure which may result from leakages through pipe work. The receiver shall be complete with pressure gauge, drain valve, relief valve etc.

The compressor motor shall be provided with adequate automatic starter with all safeguards alongwith the control panel and cabling from the panel upto the compressor and shall be installed in the pump house.

6.11.0 VALVES, GAUGES, PIPING, FITTINGS, JOINTINGS ETC.

All valves to be clearly shown in drawings by the Contractor.

6.11.1 VALVES ON WATER LINE HEADERS:

6.11.2 The isolating valves on water line header for size 75 mm and above shall be of cast iron body flanged and bronze internal as per IS: 780/1967 or equivalent for sizes below 75 mm the valve body shall be of gun metal with screwed ends and bronze internals as per IS: 77 or equivalent.

For flanged valves, the gaskets at counter flanges shall be 3 mm thick made from Indian rubber sheet or equivalent.

6.11.3 VALVES ON COMPRESSED AIR LINE:

Compressor air line valves shall be brass body with bronze trim. The bidder may also offer lubricated plug type valves with iron body and bronze plug.

6.11.4 **PRESSURE GAUGES AND PRESSURE SWITCHES:**

The pressure gauges and pressure switches shall be of proven design for outdoor installation. The pressure gauge dial size shall be of 150 mm and shall have smallest division of unit. They shall correspond to relevant ISS, BSS, IEC or other equivalent specification.

6.11.5 SIZING OF WATER HEADERS AND HYDRAULIC CALCULATINGS:

The bidder shall furnish full justification supported by calculations for the various sizes of pipes for the system.

The hydraulic losses due to friction in the pipes, deluge, valve and main control valve shall be taken into account.

The pressure and flow required at the valves to supply the most un-favorable and the most favorable areas of operation shall be calculated and shall include the demand to any individual low level protection to vessels, drums, steel of operation. The shops of the assumed areas of operation shall correspond with the predicted shape of the fire areas most favorable and un-favorable demand.

The bidder shall furnish his criteria for selecting the various locations of the projectors. The hydraulic system losses etc. under the worst conditions are to be so chosen that the pressure available under required flow conditions at the highest projector is sufficient. This shall be proved thorough calculations submitted alongwith the bid. All sizing of headers etc. as recommended shall be fully backed by calculations.

6.11.6 **PIPING AND FITTINGS:**

The water pipes under scope of this specifications shall be quoted by the bidder according to their calculations and conforming to preferred engineering practice. The size of main water pipe line from the pump house upto deluge valve positions shall be chosen considering the full discharge of motor driven pump/ the diesel engine driven pump and the loss of water pressure in the water pipe line. All above the ground water piping shall be of MS with anticorrosive treatment. All the

fittings used in above the ground mains shall conform to IS:1538/ 76 heavy grade.

All mains which are erected above ground and also in trenches shall conform to IS:1239 or equivalent medium grade or equivalent.

All the pipes for sprinkler fire protection system above the automatic deluge valve shall be galvanized iron conforming to IS:1239 medium grade or equivalent.

All above ground pipes shall be painted in accordance with regulations of relevant fire protection authorities.

The following velocities in m/sec. of flow should be considered which deciding pipe size:-

Pipe Size	Below 50 mm	50 to 150 mm	200 mm to above
Pump suction	-	1.2-1.5	1.2-1.5
Pump discharge	1.2-1.8	1.82.4	2.1-2.5
Compressed air	16-20	2030	25-25

6.11.7 COMPRESSED AIR PIPING:

The compressed air detector pipe work shall be of 25 mm (1") size minimum and shall be galvanized iron as per applicable standard.

6.11.8 **JOINTING:**

Water piping shall have adequate number of flanged connections for easy dismantling during overhauling work on the transformers. Necessary flanged fittings with blind flanges shall be provided for future expansion. Flanges shall be made up of IS:226 steel or superior and shall be accordingly rated for maximum working pressure and rating shall be mentioned in the bid. All bolts and nuts shall be of steel and shall conform to IS:1363 or equivalent.

6.11.9 **EXPANSION JOINTS:**

Expansion joints shall be provided at appropriate places in the pipe work and close to the water pumping sets. The expansion joints shall be rubber type and shall be suitably rated for maximum operating pressure. The inner and the outer cover shall be made up of natural or synthetic rubber of adequate thickness. The carcass between the tube and the cover shall be made of high quality cotton having suitable number of plies and impregnated with rubber or synthetic compounds. Moreover, to ensure adequate strength reinforcement consisting of metal rings embeded in carcass shall be complete with split retaining ring of galvanized steel.

6.11.10 **INTERCONNECTION BETWEEN FIRE WATER PUMPS:**

The discharge piping and suction piping for the two fire water pumps shall be have interconnections shown in the attached drawing.

Different types of valves at appropriate places in the pipe line shall be provided in the fire protection system for satisfactory operation of the same. The bidder shall indicate the location of valves and type of valves clearly in the drawings submitted alongwith their bid. A main control valve consisting of strainer with all valve, pressure gauges, vents etc. shall be installed in the pump house in the main water supply line to the system for preventing entry into the projector installation pipe work of foreign matter of such size which could restrict flow and discharge or water through projector. The control valve shall have cast iron body with flanges, in which there is supported perforated copper cylinder held in position by cover place. The cylinder shall have perforation and the total from area for flow shall at the least 7 times the cross sectional area of the pipe to which it is fitted.

7.0.0 SCOPE OF ERECTION WORK:

7.1.0 All the equipments mentioned above shall be erected by the contractor at site. He shall, for this purpose, make all the necessary arrangement.

In addition the contractors scope of erection work shall include but not limited to the following:

a) The contractor shall carryout the excavation and back filling of the trenches for the laying of above the ground water header and the compressed air piping. The contractor shall take due care in laying the pipes providing adequate number of brick supports at intermediate places so that the pipe line do not sag in the long run. All the brick and sand etc. required for this purpose shall be supplied by the contractor. The jointing of the pipes shall be done carefully and thoroughly with quality material so that no leakage may result in the course of time. Before the trench is backfilled, the complete erected pipe line shall be charged with water and tested for any leakage at 18×10^4 Kg/m² (250 PSI). Any leakage noticed shall be immediately repaired by the contractor and the complete pipe line shall be tested again till the result is satisfactory.

- b) The mulsifyre piping and the detector pipe line to be erected around the equipment shall be carried out by the contractor as per the drawing dully approved by the purchaser. The recommendations of NFPA shall be followed in designing and erecting the system.
- c) The pump house equipment and other electrical equipments of the system shall be erected by the contractor as per the relevant Electricity rules and the relevant Indian Standard.
- d) Any other works as may become necessary for successful commissioning and trouble free operation of the mulsifyre system is deemed to be included in the contractors scope of work.
- e) All Electrical connections, require for the operation of the mulsifyre system shall be carried out. The contractor shall also provide the detailed wiring diagram alongwith the sizes and length of the cables required, to the purchaser and any other detail as he may ask for.

8.0.0 **TESTS:**

- 8.0.1 Complete and thorough testing of all equipments shall be the responsibility of the contractor. Testing shall be done as per the procedures and requirements laid down in the standards mentioned above. These tests shall be conducted by the manufacturer at his works, however, in case the full testing facilities not being available with the manufacturer, the contractor shall at his own expense get the testing done at some recognised institution or laboratory where the required testing facilities are available and furnish the test certificates for approval of the purchaser.
- 8.1.0 In pursuance to clause no. 6.0 of general condition following test report /characteristic as stipulated relevant standard shall be submitted by the Bidder along with the bid.
 - a. Performance characteristics of pumps, diesel engine and electric drive motor.
 - b. Performance characteristics of HVW spray and nozzles.
 - c. Temperature rating test of heat detectors.

8.2.0 **APPROVAL FROM TAC:**

The contractor shall do the needful and assist the purchaser for obtaining approval of the installation from Tariff Advisory Committee, India when so desired by the Purchaser. (All material to be used in the system should have approval of TAC).

8.3.0 ACCEPTANCE/ ROUTINE TESTS:

All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the supplier in the presence of purchasers representative.

The following acceptance tests shall be carried out at site after installation.

8.4.0 **LEAKAGE TEST IN CONTROL VALVE ASSEMBLY:**

With the control valve assemblies completely closed, and with the fire water mains upto the deluge valve maintained 7×10^4 Kg/m², no leakage should be noticed through the control valve assemblies.

All piping joints (above ground and underground) shall be tested to a minimum pressure equal to 1.5 times the pump operating pressure or the maximum head developed by the pump, whichever is higher, in the presence of purchasers' representative. Any leakage noticed at the time of testing shall be rectified at no extra cost to the purchaser and piping shall be tested to the pressure mentioned above till no leakage is noticed.

Shop hydrostatic tests for all cast iron and steel pipes and fittings and valves shall submitted to the purchaser for approval.

8.5.0 LEAKAGE TEST ON DETECTOR NETWORK:

The complete detector network shall be charged to the desired pressure and no leakage of air shall be noticed.

Operation of detectors, automatic deluge valve assemblies and different alarms. Automatic starting of both the pumps due to the operation of deluge valves. This can be carried out by closing the isolating valve downstream of deluge valves and opening the drain valve in the deluge valves.

All other tests to be done as per recommendation of the manufacturer for which list of details shall be furnished by the bidder.

8.6.0 **COMMISSIONING TEST:**

All commissioning tests shall be conducted which shall testify the operation of the whole system satisfactory when any of the detector actuates. It shall include simultaneously operation of alarm gongs, annunicator panels etc. any other circuit electrical or mechanical connected with the system. The bidder shall indicate in his bid the necessary commissioning tests to be performed. Non submission of this information may result in the offer to be treated as incomplete.

9.0.0 **DRAWINGS AND DATA:**

In addition to clause no. 5.0 of general description following drawings shall also be furnished by the bidder.

- 9.1.0 As part of the proposal, the bidder shall furnish relevant descriptive illustrative literature and the following drawings (in quadruplicate) for preliminary study:
 - a) Flow Diagram of complete protection system alongwith its scheme of automation.
 - b) Layout drawing of mulsifyre room.
 - c) Illustrative literature and pamphlets describing the equipments offered.
- 9.2 After receipt of a purchase order, the successful bidder will be required to furnish the following drawings for approval:
 - a) Final flow diagrams, showing the complete fire protection scheme with associated controls.
 - b) Electrical schematic diagram alongwith complete control schematics of all wiring, connector and interlock diagrams showing the points where connections have to be made by the purchaser.
 - c) Detailed dimensional drawing of the equipment and the associated piping.
 - d) Layout of mulsifyre room.

- e) Layout of water and compressed air piping.
- f) Characteristics curves of pumps, motor projectors and Diesel Engine.
- g) Details of automatic controls alongwith control schematics.
- h) Drawing of control panels and switchboard.
- All calculations, criteria of design, test reports backed up by testing procedures codes, approvals of equipments are required, erection criteria of number of projectors and detectors with their positioning in respect to each of the protected equipments and calculations of water requirement.
- j) Details of all control panels and switch board.
- k) Test certificates and reports on shop tests.
- I) Drawing submitted for approval shall be signed by the responsible representative of contractor and shall be in any one of the following sizes in accordance with Indian Standards, A1, A2, A3 or A4.
- m) Any other drawing to complete the scheme.



10.0.0 TECHNICAL REQUIREMENT FOR FIRE PROTECTION AND ALARM SYSTEM

1.00	Pipes:	
1.01	Manufacturer	Jindal Hissar / Star / Tata
1.02	Туре	M.S. Black Pipe
1.02.01	Service	Water for Fire Protection
1.02.02	Sizes:	
	(a) 150 mm and below	MS to IS: 1239
	(b) 200 mm and above	MS to IS: 3589
1.03	Ms Pipe Galvanised	
1.03.01	Service	Normally dry, spray system,
		down stream of deluge valve
1.03.02	Sizes:	
	(a) 150 mm and below	Galvanised MS to IS:1239
	(b) 200 mm and above	Galvanised MS to IS:3589
1.03.03	Type of pipe to pipe joint:	
	(a) 65mm and above	Butt welded
	(b) 50mm and below	Threaded / Butt welded
2.00	Complete piping, fittings, counter flanges and	Shall be furnished
	all other accessories.	
3.00	Coating & Wrapping of U/G Pipes	As per IS: 10221

Technical Requirement For Piping

1.00	Туре	Non Rising Type
1.01	Manufacturer	SIR / Zoloto
2.00	Specification for 50 mm to 300 mm & 350 mm and above	IS: 14846/2000
3.00	Valve rating	PN 1.6
4.00	Purpose / service	Isolation of fire water pipe
5.00	Hand wheel direction	Clockwise for closing
6.00	Material Specification:	
6.01	Body & Bonnet	Cast Iron IS: 210
6.02	(a) Body Seat Ring	Gun metal IS: 318, LTB-II
	(b) Wedge	Cast Iron IS: 210, Gr. FG-200
7.00	Stuffing Box	Cast Iron IS: 210
8.00	Test Pressure	
8.01	Body	15 Kg/cm^2
8.02	Seat & Back Seat Gland	10 Kg/cm^2
9.00	Quantity	Shall be as per approved drawing

Technical Requirement For Cast Iron Gate Valve

1.00	Particulars	
1.01	Manufacturer	Flameguard / New Age
1.02	Code / Standard	IS: 5290
1.03	Туре	Type – A
1.04	Location	Outdoor
2.00	Constructional Features:	
2.01	Bonnet	Screwed
2.02	Stem	Rising
2.03	Hand wheel movement to hydrant	Indicated on hand wheel to open
3.00	Material of Construction :	
3.01	Body Bonnet	
3.02	Trim	G.M. IS: 318, Gr. LTB-II
3.03	Instantaneous coupling	
3.04	Hand wheel	CI. to IS: 210 Gr. 200
3.05	Spring	Phosphor Bronze to IS: 7608
4.00	Service Conditions:	
4.01	Normal Pressure & Temperature	8 Kg/cm ² and ambient temperature
4.02	Hydrostatic Testing Pressure	14 Kg/cm ²
5.00	Approval by TAC & ISI marked	Yes/ No
6.00	Branch Pipe	GM IS: 318, LTB-II
7.00	Nozzle	GM IS: 318, LTB-II
8.00	ISI Marked	Yes

Technical Requirement For Hydrant Valve, Branch Pipe & Nozzle

1.00		
1.00	Standard Specification	As per IS: 636 Type – A
2.00	Material Specifications:	
2.01	Material	Reinforced Rubber line Canvas
2.02	Protection	
3.00	Length	15 Mtr.
4.00	Approval by TAC & ISI marked	Yes/ No
5.00	Hydrostatic Burst Pressure Test	35.7 Kg/cm^2
5.01	Hydrostatic Proof Pressure Test	21.4 kg/cm^2
	Instantaneous	Couplings
6.00	Туре	Instantaneous
7.00	Specific Code	As per IS: 903
8.00	Size	63 mm dia.
9.00	Quantity	Shall be as per approved drawing
10.00	Material of construction:	
10.01	Female half coupling	Gun-metal IS: 318, Gr. LTB-II
10.02	Male half coupling	Gun-metal IS: 318, Gr. LTB-II
10.03	Spring	Phospher Bronze to IS: 7608
10.04	Valve seat	Gun-metal IS: 318, Gr. LTB-II
10.05	Lug	Gun-metal IS: 318, Gr. LTB-II
11.00	Working Pressure	7 kg/cm ²
12.00	Tests	As per IS

Technical Requirement For Fire Hose Box, Hose & Couplings

1.00	Particulars	
1.01	Manufacturer	HD Fire Protect Pvt. Ltd. / Mather Platt
1.02	Туре	Quick opening flood valve
1.03	Model	Standard
1.04	Size	150 mm
1.05	Quantity	As per drawing
1.06	Type of actuation	Dry Pilot, Manual & Electrical
1.07	End Connection	Flanged as per IS: 1538
2.00	Material Of Construction:	
2.01	Body & Cover	Cast Iron to IS: 210 Gr. FG 200
2.02	Valve Seat	Gun Metal to IS: 318 LTB-II
2.03	Diaphragm rubber & seat seal	Natural Rubber
2.04	Studs	M.S.
3.00	Pressure Conditions:	
3.01	Max. working pressure	10 Kg/cm^2
3.02	Test Pressure (Hydro)	Body -15 Kg/cm ²
		Seat – 10 Kg/cm ²
4.00	Deluge valve complete with test valve,	Yes
5 .00	drain valve, priming valve ?	Vac
5.00	Whether water motor gong provided ?	
6.00	Whether manual actuation lever provided ?	Yes
7.00	Whether catalogue enclosed or not.	Yes

Technical Requirement For Deluge Valve

reemical requirement ror strainer

1.00	Туре	Ү-Туре
2.00	Quantity	As per drawing
3.00	Code / Standard	As per manufacturer's standard
4.00	Fluid handled	Water
5.00	Size	150 mm (as per approved drawing)
6.00	Working Pressure	7 kg/cm^2
7.00	Hydrostatic Test Pressure	15 kg/cm^2
8.00	Ratio of screen area to inlet pipe area	4:1 min.
9.00	Material of Construction:	
9.01	Body	MS to IS: 2062
9.02	Max. pressure drop through strainer at design flow, MVW	3 MWC
10.00	Whether adequate system is provided for the drainage of water line in the pump house for maintenance purpose?	Yes

1.01	Туре	Fixed Differential Type
1.02	Number & Location	As per approved Drawing
1.03	Set Point	Depends on location
1.04	Set point adjustable over range?	Yes. Range 1-10 kg/cm ²
1.05	Mounting Style	Vertical
1.06	Enclosure	Die cast aluminium weather proof as per IP
1.07	Process connection	1/4" NPT (F)
1.08	Electrical connection	3/4" ET (F)
1.09	Maximum Working Pressure	18 Kg/cm ²
1.10	Number of contacts NO & NC	2 NO & 2 NC
1.11	Accuracy	± 5% of FSR
1.12	Contact rating:	
1.12.01	AC	15A, 250V AC
1.12.02	DC	0.5 A @ 110/ 200 V & 10A @ 24V
1.13	Repeatability	± 0.5% FSR
1.14	Weight	600 gms (approx)

Technical Requirement For Pressure Switch

1.01	Туре	Bourdon Tube Type (Glycerine filled)
1.01.01	Code / Standard	IS: 3624
1.02	Number & Location	As per P & I Diagram
1.03	Accuracy, % FSD	± 5%
1.04	Size of dial, mm	150, White scale with black lettering
1.05	Range, Kg/cm ²	0-16 Kg/ cm ²
1.06	Protection against turbid water provided?	Yes, strainer provided in suction piping
1.07	Connection size	1/2" NPT
1.08	Case construction & material	Die cast Aluminium Stove Enamelled Screwed Inner Bazel, Anti Corrosive, Painting Weather proof as per NEMA
1.09	Measuring element type & material	Bourdon Tube AISI – 316 SS
1.09.01	Connection between sensing element & socket	Brazing
1.10	External Zero adjustment provided ?	Yes. micro meter type
1.11	Coating on movement material	Delrin Impregnated over Sector & Pin Bushing
1.12	Over range protection provided?	Provided
1.13	Provided complete with all accessories ?	Yes (3 Way Gauge cock 1/2" NPT)
1.14	Neoprene safety diaphragm on the back of the casing provided?	Provided
1.15	Upper range position limit provided?	Provided
1.16	Test Pressure	32 Kg/cm^2

Technical Requirement For Pressure Gauge

1.01	Туре	Quartzoid Bulb Type (Standard response)
1.02	Make	HD Fire Pvt. Ltd. / Tyco
1.03	Standard to which the detector corresponds	
1.04	Operating Temperature deg. C	79 °C
1.05	Method of actuation	To be mentioned
1.06	Number of heat detectors provided	As per approved drawing
1.07	Range covered by each detector	Max. spacing distance of 2.5 M between detectors
1.08	End connection	1/2" BSPT
1.09	M.O.C. (A) Housing (B) Bulb	Forged Brass Quartzoid Bulb filled with yellow liquid
1.10	Duration of sensing at rated temperature for actuation of the element	10 to 12 seconds
1.11	Pressure to be maintained in the detector system Kg/m ²	Kg/m ² (To be mentioned)
1.12	Low air pressure alarm setting Kg/m ²	Kg/m ² (To be mentioned)
1.13	Life of the element	Over 5 years
1.14	Whether the detector has undergone testing in authorised laboratory?	Yes

Technical Requirement For Detectors

Technical Requirement For Nozzles

1.01	Туре	High Velocity
1.02	Make	HD Fire Pvt. Ltd. / Tyco
2.00	Material of construction (Specify Standard / Code No.)	
2.01	Number of size of projectors provided?	As per approved drawing
2.02	Outside Body	Brass IS: 318 / Nickel Plated
2.03	Orifice	Brass IS: 318
3.00	Internal / External Deflectors	Brass IS: 318
4.00	Flow Capacity	Over 3 Kg/cm ²
5.00	Minimum required pressure at projector inlet for proper formation of spray Kg/cm ²	3.0 Kg/cm^2
6.00	K-Factor	17.5 – 18
7.00	Spray Core Angle	$60^{\circ} - 90^{\circ}$ as suitable

1.00	Air Compressor:	
1.01	Manufacturer	Ingersoll Rand / Comfos / ELGI
1.02	Type & Model No.	Air cooled
1.03	Standard to which corresponds	
1.04	Number furnished	One
1.05	Horse Power/ KW	
1.06	No. of cylinders	2 Nos.
1.07	No. of stages	2 Nos.
1.08	Delivery Pressure (Kg/cm ²)	Kg/cm ²
2.00	Receiver:	
2.01	Receiver capacity	150 Ltrs. & above
2.02	Pressure rating (Kg/cm ²)	10.0 Kg/cm ² minimum
2.03	Provided with V-Belt drive along with belt guard?	Yes
2.04	Provided with safety valve pressure?	Yes
3.00	Drive Motor:	
3.01	Manufacturer	KEC/Crompton/Havells
3.02	Туре	TEFC
3.03	Insulation class	To be mentioned
3.04	Power rating	3 HP
3.05	Full load current	To be mentioned
3.06	Speed	1440 RPM
3.07	Voltage, Phase & Frequency	415 V, 3 Ph, 50 Hz

Technical Requirement For Air Compressor

1.00	Туре	Swing Check Type (NRV Type)
2.00	Special features and details of operation	As per IS: 5312
3.00	Material used for Body, Cover, Disc	CI. to IS: 210 Gr. FG 200
4.00	Hinge Pin	HTB to IS: 320 HT-2
5.00	Inlet and outlet details	Flanges drilled to IS:1538
6.00	Hydraulic Test Pressure :	Upto 125mm NB 150mm NB & above
	(i) Body	$24 \text{ Kg/cm}^2 \qquad 15 \text{ Kg/cm}^2$
	(ii) Seat	16 Kg/cm^2 10 Kg/cm^2

Technical Requirement For Check Valves (Non Return Valves)

	•	1			
Sl.No.	Particulars	Motor runDieselMain pumpStandby Pump		Motor run Jockey Pump	
1.00	Manufacturer	KBL			
1.01	Type of Pump	H.S.C	End-su	iction	
1.02	Number of stages	1	1	1	
2.00	Performance characteristics:				
2.01	Rated capacity m ³ /hr.	210 m ³	210 m ³	10 m ³	
2.02	Design standards		As per IS: 5120 .		
2.03	Tolerance limit in pumps efficiency	N	o negative tolera	nce	
2.04	Speed of rotation (RPM) Nominal	1500	1500	2900	
2.05	Suction condition		Negative		
2.06	Rated output of motor, KW	75 KW		7.5 KW to 11.0 KW	
2.07	Rated output of design engine, HP		100 HP		
3.00	Guaranteed performance				
3.01	Guaranteed head in MLC at guaranteed rated capacity	70	70	88	
3.02	Guaranteed rated capacity in m ³ /hr	210	210	10	
4.00	Design & construction features :				
4.01	Pump duty (continuous/ intermittent)		Intermittent		
4.02	Location		Indoor		
4.03	Type & make of coupling between Pump and Motor	Split case pump coupling	with flexible	CPHM pump with flexible coupling	
5.00	Material of construction (indicate applicable code / standard)				
5.01	Casing	CI. IS: 210 FG	260	·	
5.02	Impeller	Leaded Tin Bro	onze to IS: 318 G	r. II	
5.03	Wearing Ring – Casing	Leaded Tin Bro	onze to IS: 318 G	r. II	
5.04	Base plate	MS fabricated			
5.05	Gland	2% Ni C.l.			

Technical Requirement For Pumps

5.06	Gland packing	Graphited asbestos
5.07	Mechanical Seal	N.A.
6.00	Accessories to be provided with each pump by the supplier	Common base plate, companion flanges, drain plug, vent, priming connections, coupling guard, eye bolts, lifting lungs, etc. complete in all respect.
6.01	Drive Motor Particulars:	
6.01.01	Туре	AC Squirrel Cage Induction Motor
6.01.02	Insulation Class	Class F with temp. rise limited to Class-B
6.01.03	Pump Operational Manual Copy attached ?	Yes

1.00	Driven equipment	Main Pump	Jockey Pump
1.01	Duty	S1	S1
1.02	Manufacturer	CGL / KBL	CGL / KBL
1.03	Туре	Three Phase squirrel cage induction Motor	Three Phase squirrel cage induction Motor
1.04	Output (KW)	75 KW	11 KW
1.05	Voltage (Volt)	415 ± 10%	415 ± 10%
1.06	Full Load Speed	1450 RPM	2920 RPM
1.07	Mounting	B3	B3
1.08	Insulation Class	F	F
1.09	Ambient Temperature °C	50	50
1.10	Temperature rise by resistance °C	75	75
1.11	Applicable Code/ Standard	IS: 325-1996/ IS: 1231- 1974 / IS: 900-1992	IS: 325-1996/ IS: 1231- 1974/IS: 900-1992
1.12	Starting torque % FLT	225	275
1.13	% Efficiency at 100% load	68	70
1.14	Rotation viewed from DE	BI-DIR	BI-DIR
1.15	Type of Lubrication	Lithum Soap Base Grease Grade 2	Lithum Soap Base Grease Grade 2
1.16	Coupling / Pulley	CI	CI
1.17	Net weight (Approx) Kg	1130	121
1.18	Phase / Connection / No. of Terminal	3 Phase	3 Phase
1.19	Frequency Hz	$50\pm 5\%$	$50\pm 5\%$

Technical Requirement For Pump Motors

1.00	General	
1.01	Manufacturer	Kirloskar / Cummins
1.02	Туре	Compression ignition, multi-cylinder, four stroke with mechanical fuel injection.
1.03	Capacity H.P.	To suit running of pump at 120% over load
1.04	Number of cylinder, bore & stroke (in mm)	Four
1.05	Rated R.P.M.	1500
1.06	Number offered	One
2.00	Performance Characteristics:	
2.01	BHP of engine at rated RPM	72/100 HP @ 1500 RPM
2.02	Percentage (%) overloading at the rated speed for one (1) hour in any period of (12) hours consecutive running	10%
2.03	Continuous hours of operation in full load of the engine, at the site elevation and design ambient temperature.	6 Hours
2.04	Speed governing system provided as per specifications ?	Yes
2.05	High water temperature shut done provided as per specification ?	Yes
3.00	Self Starting System:	
3.01	Method of starting	Both automatic & manual
3.02	Battery – voltage, capacity, type & make	Lead Acid type conforming to IS: 5154 Exide/Amaron/Equivalent 24V
3.03	Battery – number per engine	2 x 100% = Total 2 Nos.
3.04	Alternative manual starting arrangement provided ?	Yes
4.00	Battery Charging System:	
4.01	Make	Suchitra / Logicstat / Equivalent
4.02	Туре	Boost and trickle charge with manual selection for Booster / Trickle charge.
4.03	Capacity	24V/ 20 Amps. 150 AH (as specified by the manufacturer)
4.04	Number per engine	1 No.
4.05	Automatic controlling arrangement for rectifier type battery charger furnished?	Yes
5.00	Rectifier Type Battery Charger	

Technical Requirement For Diesel Engine

5.01	Type of semiconductor	Bridge of 4 diodes			
5.02	Supply voltage, phase and frequency	230 V, 1 Ph. 50 Hz			
5.03	Delivery current rating, Amps	20 Amps Boost (as per manufacturer specification)			
6.00	Fuel System:				
6.01	Gravity Tank Details :				
6.01.01	No. (for each engine)	1 No.			
6.01.02	Whether integral with engine?	No			
6.01.03	Capacity, Litres	200 Ltrs. Approx.			
6.01.04	Material	M.S. Sheet			
6.01.05	Time of continuous full load running with full capacity storage, hours	Not less than 6 hours at full load			
6.02	Engine fuel pump supplied	Yes			
6.03	All piping, valves, fitting, filters, etc. Supplied	Yes			
7.00	Cooling System:				
7.01	Direct cooling system provided?	Yes, H.E. cooled			
8.00	Level gauge for Fuel Oil Tank and Lubricating Oil Sump				
8.01	Make and type	Tube type	Dip stick		
8.02	Numbers	1 No.	1 No.		

Technical Requirement For Annunciation Panel

1.00	Control Panel Designation	24 window annunciation panel LOC: Fire Fighting Pump House				
1.01	Control Panel:					
1.01	General arrangement drawing complete with all dimensions and weight etc. furnished ?	Drawing to be furnished separately for approval				
1.02	Electrical Single Line Diagrams with all component along with relevant details furnished ?	Drawing to be furnished separately for approval				
1.03	Mounting Details	Floor / wall mounting				
1.04	Type of enclosure	Cubical with IP 52 protection				
1.05	Thickness of sheet (cold rolled) metal used, in mm for					
1.05.01	Door	1.6 mm				
1.05.02	Body	2.0 mm				
1.05.03	Panel frame (if any)	2.00 mm				
1.06	All instruments, motors, relay annunciation windows control and selector switches flush or semi-flush type ?	Flush type				
1.07	Mimic diagram included in the offer?	Yes / No				
1.08	Painting:	Inside Outside				
1.08.01	Colour	SyntheticSyntheticenamelenamel				
1.08.02	Finish	Glossy white Light grey shade 631 as per IS-5				
1.08.03	Details of painting procedure furnished ?	Yes				
1.09	Ground Bus:	Yes				
1.09.01	Material	Aluminium				
1.09.02	Size	25 x 6 mm				
1.09.03	Size of connector	8 mm nut bolt with nut & washer				
1.10	Internal Wiring:					
1.10.01	Voltage grade	1100 V				
1.10.02	Insulation	PVC				
1.10.03	Conductor material	Copper				
1.10.04	Size of					
(a)	Potential & Control circuit	1.5 mm^2				
(b)	Current circuit	2.5 mm ²				
1.10.05	H.V. withstand rating of control wiring volts	1.5 KV				
1.10.06	Colour	Control circuit -Grey with colour coded PVC Insulation				
2.00	Control Switch:					

2.01	Туре	Rotary type				
2.02	Catalogue number					
2.03	Key interlock furnished	Yes / No				
2.04	Contact rating:	Continuous				
2.04.01	240 V AC	16A				
2.04.02	220 V DC (Inductive)	Yes / No				
3.00	Push Button:					
3.01	Туре	Spring return	push to actuat	e		
3.02	Contact rating	Continuous				
3.02.01	240 V AC	10 Amp				
3.02.02	220 V D.C. (Inductive)	0.5 A				
3.03	No. of contact furnished	1 NO + 1 NC				
4.00	Lamps / Light Emitting Diode	Power supply on (Lamps)	Power Panel supply on (Lamps) Panel illumination fluorescent (Lamps)			
4.01	Туре	Filament Fluorescent		Solder type PCB mounted		
4.02	Rating	2 AMPS 20 Watts		10 mA		
4.03	Resistance value of external resistor	10 K Ohms	N.A.	220 Ohms		
4.04	Voltage	220 V DC	240 V AC	12 V DC		
5.00	Terminal Blocks:					
5.01	Voltage Grade, Volts	750 V Grade				
5.02	Current rating, Amps	10 Amps				
5.03	Туре	Clip on Type				
5.04	H.V. withstand of terminal blocks	1.5 KV for 1	Min.			
5.05	Suitable for copper cable size, mm ²	2.5 mm^2				
5.06	20% spare terminal furnished ?	Yes				
6.00	Annunciator:					
6.01	Туре	Micro alarm Fully programmable microprocessor based annunciator				
7.00	Indicating Instruments:					
7.01	Туре	Analogue				
7.02	Mounting Details	Flush				
7.03	Accuracy class	1.5				
7.04	Standard to which the equipment conforms	IS: 1248				

SCHEDULE OF QUANTITIES

Supply, installation, testing and commissioning of high velocity automatic water spraying system for 2x160 MVA Transformers with laying of fire detection and alarm system/ water pipe line, valves, quartz bulbs, HVWS nozzles including hydrant system alongwith all material, accessories relevant complete as per details below:-

S. No.	Name of work	Qty.		
1.	Supply, installation and commissioning of Kirloskar make 210 M ³ /hr, 70 M head, Automatic Electric Motor driven fire water pump of capacity 75 KWH/ 100 HP, 415 Volts, 1450 RPM, 3 Phase alongwith all required accessories, as per specification enclosed.	01 Set		
2.	Supply, installation and commissioning of Kirloskar make 210 M ³ /hr, 70 M head, Automatic Diesel Engine Motor driven fire water pump of capacity 105 BHP, 415 Volts, 1500 RPM, 3 Phase alongwith all required accessories, as per specification enclosed.	01 Set		
3.	Supply, installation and commissioning of Kirloskar make Jockey Pump, 70 meters head Automatic Electric Motor driven of capacity 11 KWH, 15 HP, 415 Volts, 2900 RPM, 3 Phase alongwith all required accessories, as per specification enclosed. (100% stand by)	02 Sets		
4.	Supply, installation and commissioning of ELGI / Ingersoll Rand make Air Compressor with single Stage delivery pressure 10 Kgs/, Automatic Electric Motor driven of capacity 415 Volts, 3 Phase alongwith air receiver and all required accessories, as per specification enclosed. (100% stand by)	02 Sets		
5.	Supply, installation and commissioning of Auto Power Supply Control Panel in pump house of capacity 315 Amp, 440 Volts AC, suitable for starting/ controlling all equipments provided for mulsifyre system with proper cable termination etc. alongwith all required accessories, as per specification enclosed.	01 Set		
6.	Supply, installation and commissioning of Annunciation Panel with hooter in the control room with single alarm connected to all points, fault condition, reset, accept push buttons, complete with wiring and cabling alongwith all required accessories, as per specification enclosed.	01 Set		
7.	Supply and laying of different sizes of GI Pipe Jindal / Tata make 'B' class for fire detection / water pipe line as per specification (IS: 1239) enclosed and as per drawing / site requirement, complete with elbow, tee, socket, reducer as per specification enclosed.			
(a)	80 NB	Mtr.		
(b)	65 NB	Mtr.	As per	
(c)	50 NB	Mtr.	requirement / approved	
(d)	40 NB	Mtr.	drawing	
(e)	25 NB	Mtr.		

11.0.0

8.	Supply, installation, testing & commissioning of quick opening flood, deluge valve of HD / Mather + Platt of 150 NB as per max. Working pressure 10 kg/cm ² as per specification enclosed.	02 Nos.		
9.	Supply, installation, testing & commissioning of high velocity water spray nozzles of HD make UL Listed Flow capacity 3.5 kg/cm ² . K18 and Spray Angle 80 with copper strainer as per specification enclosed.	Nos.	As per requirement / approved drawing	
10.	Supply, installation, testing & commissioning of Quartzoid bulb detectors (QBD) of HD make UL Listed operate at 79°C, sensing at rated temp. for actuation of the element 10-12 sec. K5.6 pendant chrome finish as per specification enclosed.	Nos.	As per requirement / approved drawing	
11.	Supply & laying of different sizes of MS Pipe of Jindal / Tata 'B' class for fire water pipe line/ support as per IS specification (IS: 1239) as per drawing/ site requirement, complete with elbow Tee, Socket reducer etc. with anticorrosive treatment.			
(a)	250 NB	Mtr		
(b)	200 NB	Mtr	As per	
(c)	150 NB	Mtr	requirement /	
(d)	100 NB	Mtr	drawing	
(e)	80 NB (Pipe line + Pylon support)	Mtr		
12.	Supply, installation & commissioning of gate valve (Sluice Valve/ Butterfly valve) (Zoloto/Kartar/Sir make) as per IS Specification (IS:14846) of			
(a)	200 NB	04 Nos.		
(b)	150 NB	04 Nos.	OR As per	
(c)	100 NB	01 No.	requirement / approved	
(d)	80 NB	01 No.	drawing	
(e)	50 NB	<mark>01 No.</mark>		
13.	Supply, installation, testing & commissioning of NRV (Kartar/Zoloto/Kalpana make) of working pressure 7Kg/cm ²			
(a)	200 Nb	02 Nos	OR As per	
(b)	80 Nb	01 Nos	requirement /	
(c)	50 Nb	03 Nos	drawing	
(d)	25 NB	02 Nos		
14.	(Kirloskar/Kalpana make) as per standard IS:4038 alongwith strainer			
(a)	250 NB	02 Nos		
(b)	100 NB	02 Nos		
15.	Supply, installation, testing & commissioning of fixed differential switch (Danfoss/Indfoss make) type pressure switch range 1-10 kg/cm ²	08 Nos		
16.	Pressure gauge as per IS specification IS Code 3624, accuracy -/+ 5%	10 Nos		

17	Supply, installation, testing & commissioning of 'Y' Type strainer (Kartar / Sir / Kalpana / Zoloto make) of			
	dia. working pressure 7 kg/cm ²			
	a) 150mm	02 Nos		
18	Supply & installation of flanges as per IS-1538 of different sizes as per drawing work include proper Butt welding with pipe & proper packing and coupling with Nut & Bolt (1 set = 2 No. flanges).			
	a) 250NB	01 Set		
(b) 200NB	04 Set		
	c) 150 NB	03 Set		
(d) 80NB	37 Set	Or as per	
	e) 65 NB	20 Set	requirement /	
	f) 50 NB	20 Set	drawing	
	g) 40 NB	01 Set	-	
	h) 25 NB	36 Set	-	
19	Supply & installation of MS Pipe supports, spacing between intermediate supports shall not be more than 5 metres, made of 'C' section angle of size 25x25x50mm suitable for different size of pipes with plinth, above ground level 300mm and below ground level 200mm with cement coarse sand and concrete/brick ballast as per specification in ratio 1:2:4	40 Set	Or as per requirement / approved drawing	
20	Supply, installation, testing & commissioning of fire hose boxes suitable for 15 mtr. long, 63 mm dia. reinforced, rubber lined fire hose pipe (as per IS-636) with nozzle (as per IS-903) and fire hydrant with Gunmetal lending valve of 63 mm dia (as per IS: 5290)	06 Set		
21	Pneumatic pressure controlling air vessel with return valve and pressure release safety mechanism, complete with all accessories.	02 Set		
22	Supply with laying of RCC hume pipe as per IS:458NP	25		
	3 class, 1000mm below the ground level of size 300 mm	Mtrs.		
23	Supply, installation, testing & commissioning of other Pump house equipments/ items like alarm gong assembly, various types of valves/ brass globe valves, back pressure cum alarm valves, hydraulic alarm motor, priming water tank etc. and other works necessary for completion of work. (detailed list of equipments/ items with their quantities be supplied)	01 Job		
BID SCHEDULES

SECTION-VII

BID SCHEDULES

INDEX

S.N. SCHEDULE

TITLE

1.	Schedule A		:	Bid Form
2.	Schedule B		:	Qualifying details in following schedules :
		B-1	:	Experience details of Equipments of manufacturers on whom the orders are placed by UPPTCL
		B-2	:	Experience details of Equipments of manufacturers on whom the orders have not been placed by UPPTCL
3.	Schedule C		:	Declaration
4.	Schedule D		:	Proforma for joint undertaking by the collaborator / associates with Bidder
5.	Schedule E		:	Schedule of General particulars
		E-1	:	For Bidder
		E-2	:	For Manufacturers
6.	Schedule F		:	Schedule of deviations from "Special Conditions of Specification"
7.	Schedule G		:	Schedule of deviations from "Technical Specifications"
8.	Schedule H		:	Schedule of deviations from "Instructions to Bidders"
9.	Schedule I		:	Schedule of deviations from General requirements of Specifications"
10.	Schedule J		:	Schedule of deviations from "General Condition of Contract" Form –"A"
11.	Schedule K		:	Deviation from Tech. Specn. for handling, testing & commissioning
12.	Schedule L		:	List of Recommended spare tools & tackles
13.	Schedule M		:	List of recommended test sets & testing instruments
14.	Schedule N			List of Recommended spare parts for five years & prices
15.	Schedule O		:	List of drawings/ literatures enclosed with the Bid
16.	Schedule P		:	Schedule of quoted guaranteed deliveries/ completion period
17.	Schedule Q		:	Schedule of offered quantities.
18.	Schedule R		:	Schedule of Guaranteed technical Particulars

SCHEDULE 'A'

BID FORM

FOR SUPPLY, ERECTION, COMMISSIONING & OPERATION OF EQUIPMENT FOR SUBSTATIONS

From:

To,

The Superintending Engineer Electricity Substation Design Circle-I Shakti Bhawan Extn., Lucknow.

Sir.

With reference to your invitation to Bid for the above I/We hereby offer to the Uttar Pradesh Power Transmission Corporation Ltd. Items in the schedule of prices and delivery annexed or such potion thereof as you determine in strict accordance with the annexed conditions of contract Form 'B'/'A', specifications and schedules of Rates to the Satisfaction of the Purchaser or in default thereof to forfeit and pay to the Uttar Pradesh Power Transmission Corporation Ltd. the sum of money mentioned in the said conditions.

The rates quoted are inclusive pro-rata and in full satisfaction of all claims.

l/We agree to abide by Bid for the period of six months from the date fixed for receiving of the same.

A sum Rs.....in the form of.....is herewith forwarded duly endorsed in favour of the......U.P. Power Transmission Corporation Ltd., Lucknow as earnest money.

I/We hereby undertake and agree to execute a contract in accordance with the conditions of the contract:

Encl.: As above

Yours faithfully

Witness:

(Signature of the Bidder in full)

SCHEDULE – B -1

DETAILS OF EQUIPMENTS OF SUCH MANUFACTURERS ON WHOM ORDER FOR RESPECTIVE EQUIPMENTS HAVE BEEN PLACED BY TENDERER

S1.	Equipment /	Name of	UPPTCL's	Qua	antity	Date of	Date of	Whether
No.	Material	Manufacturer	Order No.			Supply/	last	routine /
		(Make)	& date.	Order	Supp-	Commi-	type	acceptance test
			Designation	ed	lied	ssioning	test &	facilities are
			/ Address				Agency	available at
			of ordering					manufacturer's
			authorities					works or not
1	2	3	4	5	6	7	8	9
	Substation							
	Circuit							
	Breakers							
	Control & Relay Panels							
	Current Transformers							
	Potential Transformers							
	Lightening Arrestors							
	Isolators							
	Capacitor Bank							
	Battery,							
	Battery							
	Charger and							
	DCDB							
	Power &							
	control cable							
	ACDB							
<u> </u>	Lamps &				ĺ			
	Switches etc.							

Note: No supporting documents are required to be submitted with the offer in this case.

SCHEDULE – B 2

DETAILS OF EQUIPMENTS OF SUCH MANUFACTURES ON WHOM ORDER FOR RESPECTIVE EQUIPMENTS HAVE NOT BEEN PLACED BY UPPTCL WITH IN LAST FIVE YEARS

Sl. No.	Equipment / Material	Name of	Organizatio n and	Quantity		Date of Supply/	Date of last type	Whether routine / acceptance test
		Manufa cturer (Make)	Designation / Address of ordering authority with Order No. & date.	Orde red	Supp lied	Commi- ssioning	test & Agency	facilities are available at manufacturer's works or not
1	2	3	4	5	6	7	8	9
1.	SAS System conforming to IEC 61850 (i) BCUs (ii) BPUs (iii) IEDs (iv) Ethernet switches etc.							

Note- Supporting documents are to be enclosed with the offer.

SCHEDULE 'C'

DECLARATION

(To be executed on a non-judicial stamp paper of Rs.10/- with a revenue stamp of Re.1/- affixed)

Bid invited by	
Rid for	
Bid for	
Name of Bidder	
Specification No. and date of opening	

In Cosideration of of the U.P. Power Transmission Corporation Ltd., having treated the Bidder to be an eligible person whose Bid may be considered, the Bidder hereby agree to the condition that the proposal in response to the above invitation shall not be withdrawn within six months (or any extension thereof) from the date of opening of the Bid , also to the condition that if thereafter the Bidder does withdraw his proposal with the said period, the Earnest Money deposited by him may be forfeited to the U.P. Power Transmission Corporation Ltd. and at the descretion of the Purchaser, the Purchaser may debar the Bidder from the Bidding for minimum period of one year reckoned from the date of opening of the Bid.

Signed this	day of	
8	5	

Place.....Signed by....

Witness

Bidder

Full Signature.....

Name.....

Designation.....

SCHEDULE'D'

PROFORMA FOR JOINT UNDER TAKING BY THE COLLABORATOR/ASSOCIATE AND THE BIDDER

(To be stamped in accordance with U.P. State Act.)

To,

The Superintending Engineer ESDC-I, 13th Floor, Shakti Bhawan Extn., U. P.Power Transmission Corporation Ltd;, Lucknow. Dear Sir,

(In terms of "Instruction to Bidder" in the specification No..... for the design, manufacture, testing, delivery erection & commissioning (as specified), of

it is a condition that the Bidder as well as their collaborator/associate shall jointly and severally undertake the responsibility for the successful performance of the Contract (herein after referred to as Contract) which is qualified for the award on the basis of expertise of collaborator/ associate.

The Collaborator/Associate hereby agree to depute their technical experts from time to time to Bidder's works/project site as mutually agreed upon between the Purchaser and the Bidder's in order to discharge the Bidder's obligations as stipulated in the Contract. The Bidder and the Collaborator/Associate hereby agree that this undertaking shall be irrevocable and it shall form and integral part of the Contract.

In Witness thereof the Collaborator/Associate and the Bidder have through their authorised representative, set their hands and seal on this

......day of......201

WITNESS:

COLLABORATOR/ASSOCIATE

1	Full Signature
	Name
(Official Address)	Designation
Seal	Seal

WITNESS: BIDDER 1..... Full Signature..... Name...... (Official Address) Designation..... Seal Seal

<u>SCHEDULE – E1</u>

SCHEDULE OF GENERAL PARTICULARS FOR BIDDER

- Name of the Bidder.
 a) Registered office
 b) Postal address of Bidder.
 c) Telegraphic address.
- 2. Name and address of Local representative and his telephone number, if any.
- 3. Name and address of the officer of the Bidder / manufacturer to whom all reference shall be made for expeditious coordination.
- 4. Place from where service facility and spares are available (Give full address)
- 5. Earnest Money Deposit

 i)Earnest money deposited or not.
 ii)If yes, state amount of earnest money deposited.
 iii)No.& date of Bank guarantee/ Bank draft (for earnest money)

6. Validity of offer.(A minimum validity of 6 months from the date of Bid opening is required)

- 1% security deposit in terms of Form "A" is to be deposited within 15 days of placement of order. Whether or not willing to deposit if no, state reasons.
- 8. Whether agreeable to furnish 10% Yes/No. performance Bank guarantee or not if no state reason?
- 9. Whether ex-works prices quoted. Yes/No
- 10. Whether freight charges have been Yes/No quoted separately
- 11. Whether charges for transit insurance from warehouse to warehouse and

	storage erecting testing & commissioning insurance thereafter quoted separately.	Yes/No.
12.	Whether the quoted prices are also applicable for any reduced quantity order.	Yes/No
13.	Terms of payment as mentioned in relevant clause are acceptable or not .	Yes/No.
14.	State Trade/Sales Tax Number	
	i) Central ii) State	
15.	Income tax clearance certificate enclosed or not.	Yes/No
16.	Whether the Bidder is agreeable to supply the equipment ,in case of the deviations stipulated by him are not acceptable to the Corporation.	Yes/No.
17.	Have you noted that all the dispatches will be by Road Transport only.	Yes/No.
18.	GST	Applicable extra/Not applicable.
19.	Completion period	Given/not given
20.	Drawings (Schedule F)	Enclosed/Not enclosed.
21.	Whether the prices quoted are after taking ITC benefits.	Yes/No
	Whether the prices quoted are after taking ITC benefits.	Yes/No
Seal of C	ompany	

	Full Signature
	Name
	Designation
Date	-

SCHEDULE E2

<u>SCHEDULE OF GENERAL PARTICULARS FOR MANUFACTURERS</u> To be filled in for manufactures of transformers, circuit breakers, Instrument transformers, Isolators, Surge Arrestors, Control & Relay Panels, Capacitor Bank, SAS system and Energy Meters

	NAME OF EQUIPMENT	:
1	 Name of the manufacturer a) Registered Office b) Postal address c) Telegraphic address 	: : :
2.	Location and address of work	:
3.	Name and address of Local Representative and his telephone number, if any	:
4.	Name and address of the officer of the manufacturer to whom all references shall be made for expeditious coordination.	:
5.	Place from where service facility and spares are available (Give full address)	:
6.	Whether the manufactures is sole Proprietor / Partnership concern/ Pvt. Ltd. Company/ Public undertaking.	:
7.	Name of foreign collaborator, if any	:
8.	Whether the designs are their own or obtained from other sources. If from other sources, the same may be indicated.	:
9.	Name and address of sub-suppliers	:
10:	The Name, Designation, qualification and experience of the engineer employed by the manufacturer in design, development and manufacturing	:

of the quoted equipment

11.	Authorized capital of the compa	any	
12	Annual Turnover is Rs. per year	r :	
13.	Actual production per year of the equipment quoted.	ie :	
14.	Manufacturing capacity per mo the quoted equipment (item wis	nth of () e)	
15	State the name and designation Manufacturer's relative (s) if an working in corporation	of : y	
16.	Whether the offered equipment type tested or not with in 5 year preceding the date the Bid opening.	is : s	Tested/Not Tested
17.	Whether type test certificate of offered equipment are enclosed or not.	:	Enclosed/ Not Enclosed
18.	Whether Certificates for satisfac performance of offered equipme	ent :	Enclosed/ Not Enclosed
19.	Testing Facilities a) Type tests b) Routine tests		Available/ Not available Available/ Not available
20.	a) Manufacturing experience of guarda againment	of:	Enclosed/ Not Enclosed
	b) Evidence	:	Enclosed/ Not Enclosed
21.	Equipment quoted in service sir	ice	Given the year with evidence /Not Given
22.	Drawings	:	Enclosed/ Not Enclosed
23.	State Trade/Sales Tax Number i) Central ii) State		
24	ISI License No. date & validity	,	
Seal of C	Company	Full Signature Name Designation	

Date.....

DEVIATIONS FROM SPECIAL CONDITION OF SPECIFICATION &ITS PRICE INCIDENCE

(All deviations from the "Special condition of specification" shall be filled in this schedule, compliance with the Specifications will be taken as granted if the deviation are not specifically mentioned in this schedule. In case the Bidder is required to agree to the standard clause, then he may indicate the amount by which the Bided price will thereby be increased or decreased).

 Sl.
 Clause No.
 Deviation
 Price incidence (increase/decrease)

 No..

The Bidder hereby certifies that the above mentioned are the only deviations form the "Special Conditions of specification"

Full Signature	
Name	•
Designation	
Date	

SCHEDULE 'G'

DEVIATIONS FROM 'TECHNICAL SPECIFICATION' & ITS PRICE INCIDENCE.

(All deviations from the "Technical Specification" shall be filled in clause, in this schedule; compliance with the specification will be taken as granted if the deviation is not specifically mentioned in this schedule. In case the tenderer is required to agree to the standard clause, then he may indicate the amount by which the tenderered price will thereby be increased or decreased.

Sl. No. Clause No. Deviation Price incidence (Increase / Decrease)

The Tenderer hereby certifies that the above mentioned are the only deviations from the 'Technical Specification'.

Full Signature
Name
Designation
Date

SCHEDULE 'H'

DEVIATIONS FROM "INSTRUCTIONS TO BIDDERS" & ITS PRICE INCIDENCE

(All deviations from the "Instruction to Bidders" shall be filled in clause, in this schedule, compliance with the Specifications will be taken. as granted if the deviation are not specifically mentioned in this schedule. In case the Bidder is required to agree to the standard clause, then he may indicate the amount by which the Biddered price will thereby be increased or decreased).

SI.	Clause No.	Deviation	Price incidence (IncreaselDecrease)
No.			

The Bidder hereby certifies that the above mentioned are the only deviations from the "Instructions to Bidders"

•••
•••

DEVIATIONS FROM GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATION &ITS PRICE INCIDENCE

(All deviations from the General Technical Requirements Of Specification shall be filled in this schedule, compliance with the Specifications will be taken as granted if the deviation are not specifically mentioned in this schedule. In case the Bidder is required to agree to the standard clause, then he may indicate the amount by which the Bided price will thereby be increased or decreased).

Sl.No. Clause No. Deviation Price incidence (increase/decrease)

The Bidder hereby certifies that the above mentioned are the only deviations form the "General technical Requirements of specification"

Full Signature	
Name	
Designation	
Date	

SCHEDULE 'J'

DEVIATIONS FROM "GENERAL CONDITIONS OF CONTRACT FORM A/B" & ITS PRICE INCIDENCE

(All deviations from the "General Conditions of Contract Form A/B" shall be filled in clause, in this schedule, compliance with the Specifications will be taken as granted if the deviation are not specifically mentioned in this schedule. In case the Bidder is required to agree to the standard clause, then he may indicate the amount by which the Biddered price will thereby be increased or decreased).

Sl.No. Clause No. Deviation Price incidence (Increase/Decrease)

The Bidder hereby certifies that the above mentioned are the only deviations from the "General conditions of Contract Form A/B".

Full Signature
Name
Designation
Date

DEVIATIONS FROM TECHNICAL SPECIFICATIONS FOR HANDLING ERECTION TESTING AND COMMISSIONING

(All deviations from the Technical Specifications For Handling Erection Testing And Commissioning shall be filled in this schedule, compliance with the Specifications will be taken as granted if the deviation are not specifically mentioned in this schedule. In case the Bidder is required to agree to the standard clause, then he may indicate the amount by which the Bided price will thereby be increased or decreased).

Sl.No. Clause No. Deviation Price incidence (increase/decrease)

The Bidder hereby certifies that the above mentioned are the only deviations form the "Technical Specifications For Handling Erection Testing And Commissioning"

Full Signature
Name
Designation
Date

SCHEDULE 'L'

LIST OF RECOMMENDED SPECIAL TOOLS & TACKLES & ITS PRICES

(Bidder shall give below a list of special tools and tackles required for erection, commissioning. operation and maintance of equipment offered by him).

Sl. No.	Particulars	Recommended	Unit Prices
		Qty. in No.	Ex-works F.O.R. Destination

The Bidder hereby certifies that the above are the only special tools and tackles required for erection, commissioning. operation and maintenance of equipment offered by him.

Seal of Company

.

Full Signature	
Name	••••
Designation	
Date	•••

SCHEDULE 'M'

LIST OF RECOMMENDED TEST SETS & TESTING INSTRUMENTS & THEIR PRICES

(Bidder shall give below a list of recommended test sets and testing instruments required for erection, commissioning. operation and maintance.)

Sl. No.	Particulars	Quantity	Unit Prices
		- •	Ex-works F.O.R. Destination

The Bidder hereby certifies that the above are the only recommended test sets and testing instruments required for erection, commissioning. operation and maintenance of equipment offered by him.

Full Signature	
Name	
Designation	
Date	

SCHEDULE-N

LIST OF RECOMMENDED SPARE PARTS & THEIR PRICES

(Bidder shall give below equipment wise list of spare parts recommended for five year trouble free operation of equipment offered by them and its prices).

Sl.No.	Name of	Name of	Recommended		Unit Prices (Rs.)
	Equipment	Component	Qty. in nos.	Ex-works	FOR Destination
		Part/catalogue No.			

Full Signature
Name
Designation
Date

SCHEDULE-O

LIST OF DRAWINGS & LITERATURES ENCLOSED WITH THE BID

Sl. No.	Drawings/Literature No.	Title

Full Signature	
Name	
Designation	
Date	

SCHEDULE P

SCHEDULE OF GUARANTEED COMPLETION / DELIVERY PERIOD

1.0 COMPLETION PERIOD

The Substation shall be constructed, erected, tested, commissioned and completed in all respects within 18 months from the date of issue of letter of intent or handing over of land which ever is latter. The Bidder shall submit the Project Implementation Schedule and PERT with his Bid showing time taken for various deliveries/activities in weeks reckoned from the date of issue of letter of intent.

2.0 DELIVERY PERIOD

The Civil works and deliveries of all equipments and materials shall match the above completion period.

The delivery schedules of following major items may be specified in the table given below :

S.N.	Item	Quantity	Delivery Period in weeks reckoned from date of issue of	
			letter of intent.	
			Commencement	Completion
1.0				
1.0	Earthmat material			
2.0	Anchor Bolts			
3.0	Main Structures			
4.0	Auxiliary Structures			
5.0	Bus bar material for main, transfer,			
	jack buses & inter connections with			
	equipments etc			
6.0	250 KVA transformers			
7.0	245 KV Circuit Breakers			
8.0	145 KV Circuit Breakers			
9.0	33 KV Circuit Breakers			
10.0	245 KV C.T.s & C.V.T.s			
11.0	145 KV C.T.s & PTs			
12.0	33 KV C.T.s & PTs			
13.0	245 KV Isolators			
14.0	145 KV Isolators			
15.0	33 KV Isolators			
16.0	198 KV Surge Arrestors			
17.0	120 KV Surge Arrestors			
18.0	30 KV Surge Arrestors			
19.0	All Control & Relay Panels			
20.0	All Batteries & Battery Chargers			
21.0	AC & DC Distribution Boards			

- 22.0 0.2 accuracy ABT Energy meters
- 23.0 Control & Power Cables
- 24.0 Fire fighting equipments
- 25.0 Lighting Fixtures & associated materials
- 26.0 SAS System including C&R panel
- 27.0 D.G. Set
- 28.0 Mulsifyre System

Note- Bidder shall also furnish the delivery schedule of leftover items, if any.

3.0 COMPLETION SCHEDULE

The completion schedule of following major activities may be specified in the table given below

S.N.	Activity	Completion Period in weeks reckoned from date of issue of letter of intent.	
		Commencement	Completion
1.	Laying of Earthmat		
2.	Boundary Wall and gate		
3.	Main Store		
4.	Control Room Building		
5.	Main Structure foundations		
5.1	220 kV switch yard		
5.2	132 kV switch yard		
5.3	33 kV switch yard		
6.	Main Structure Erection		
6.1	220 kV switch yard		
6.2	132 kV switch yard		
6.3	33 kV switch yard		
7.	Equipment and Auxiliary structu	re foundations	
7.1	220 kV switch yard		
7.2	132 kV switch yard		
7.3	33 kV switch yard		
8.	Bus bars and Jack bus stringing		
8.1	220 kV switch yard		
8.2	132 kV switch yard		
8.3	33 kV switch yard		
9.	Erection Of-		
9.1	220 kV feeders , bus coupler & Tan	sfer coupler bays	
9.2	First 160/100 MVA Transformer ba	y including220/132 k V equipmen	its
9.3	Second 160/100 MVA Transformer	bay including 220/132 kVequipm	ents
9.4	132 kV feeders and bus coupler bay	s	
9.5	Both 40 MVA Transformer bays inc	eluding 132/33KV equipments	

- 9.6 33 kV feeders and bus transfer bay
- 9.7 Control and Relay Panels
- 9.8 Battery, Battery Chargers, Meters, DCDB, ACDB, and all other equipments of control room
- 9.9 Centalizeded SAS system for 220 KV & 132 KV Bays complete in all respect.
- 9.10 Mulsifyre System

10. Cable laying, termination, testing and commissioning of-

- 10.1 220/132 kV feeders and bus coupler bays with SAS system.
- 10.2 First 160/100 MVA Transformer bay including 220/132 kVequipments with SAS system
- 10.3 Second 160/100 MVA Transformer bay including 132/33 kV equipments with SAS system.
- 10.4 132 kV feeders and bus transfer bay with SAS system.
- 10.5 Both 40 MVA Transformer bays including 132/33KV equipments
- 10.6 33 kV feeders and bus coupler bays with SAS system.

11. Installation and commissioning of

- 11.1 Store lighting
- 11.2 Switch Yard and outdoor lighting
- 11.3 Control Room building lighting.
- 12. Installation and commissioning of Fire fighting system and Mulsifyre system.
- 13. D.G. Set

Note-Bidder shall also furnish the completion schedule of leftover activities, if any.

Full Signature	
Name	
Designation	•
Date	

INDEX FOR SCHEDULE - R

SI. No.	Tech Specn. No.	ITEM
1.	R-1	250 KVA 33 /0.4 KV TRANSFORMERS
2.	R-2	245 KV/ 145 KV SF 6 CIRCUIT BREAKERS
3.	R-3	245 CURRENT TRANSFORMERS
4.	R-4(i)	TERMINAL CONNECTORS
5.	R-4(ii)	JUNCTION BOXES
6.	R-5	245 KV CAPACITOR VOLTAGE TRANSFORMERS
7.	R-5(ii)	TERMINAL CONNECTORS
8.	R-5(iii)	JUNCTION BOXES
9.	R-6	245 KV / 145 KV ISOLATORS
10.	R- 7	245/ 145/36 KV POST INSULATORS
11.	R-8	198/ 120KV SURGE ARRESTORS
12.	R-9	GUARANTED TECHNICAL PARTICULARS FOR 220/132 KV FEEDER BAY
13.	R-9(ii)	GUARANTED TECHNICAL PARTICULARS FOR 160/100 MVA TRANSFORMER BAY
14.	R-9(iii)	GUARANTED TECHNICAL PARTICULARS FOR 220/132 KV BUS COUPLER BAY
15.	R-9(iv)	GUARANTED TECHNICAL PARTICULARS FOR SUBSTATION AUTOMATION SYSTEM
16.	R-10	0.2 ACCURACY ABT TRIVECTOR ENERGY METERS
17.	R-11	110 V 500 AH BATTERIES
18.	R-12	110V 500AH BATTERY CHARGER WITH DC DISTRIBUTION BOARD
19.	R-13	L T DISTRIBUTION BOARD
20.	R-14	CONTROL CABLE & POWER CABLE
21.	R-15	LATTICE TYPE MAIN & AUXILIARY STRUCTURE
22.	R-16	EARTHMAT AND CLAMPS & FITTINGS.
23.	R-17	GUARANTED TECHNICAL PARTICULARS FOR BUS BAR CONDUCTOR
24.	R-18	ANTI FOG TYPE DISC INSULATORS, BUS BAR CONDUCTORS
25.	R-19	FIRE FIGHTING EQUIPMENTS
26.	R-20	LIGHTING SYSTEM
27.	R-21	TECHNICAL DATA FOR DG SET

SCHEDULE-R-1

SCHEDULE – R – 1

The bidders are required to fill the losses of transformer at Sl. No. 20, 21 of GTP.

Sl. No.	Particulars	250KVA, 33/0.4KV Transformer
1.	Type and make of transformer	
2.	Continuous maximum rating for the maximum ambient	
3.	Temperature of 50oC and the temperature rise condition specified.	
4.	Polarity	
5.	Vector group reference No. and symbol (according to ISS)	
6.	Details of tank(approximate values)	
i)	Length	
ii)	Breadth	
iii)	Height	
iv)	Thickness of plate used	
v)	Weight	
7.	Details of core	
i)	Form of core	
ii)	Material and thickness of laminations	
iii)	Material used for insulating and laminations	
iv)	Diameter of core(approx)	
v)	Area of Cross section of Core(approx)	
vi)	Flux density	
vii)	Total weight of core	
viii)	Width of core	
ix)	Type of paint between core link and yoke	
8.	Details of the HV windings	
1)	Type of winding	
11)	Conductor used	
iii)	Insulation of conductor	
iv)	No. of coils per limb	
v)	Volts per coil	
vi)	No. to turns per coil	
vii)	Volts per turns	
viii)	Interlayer insulation details	
ix)	Volts between layers under 100% excitation	
x)	End turn insulation	
9.	Details of the LV windings	
i)	Type of windings	
ii)	Conductor used	
iii)	Insulation of conductor	
iv)	No. of coils per limb	

v)	Volts per coil	
vi)	No. to turns per coil	
vii)	Volts per turns	
viii)	Interlayer insulation details	
ix)	Volts between layers under 100% excitation	
x)	End turn insulation	
10.	Insulation details	
i)	End spacing on the HV windings	
ii)	End Spacing on the LV windings	
iii)	Between HV and LV windings	
iv)	Between LV winding and core	
11.	Clearance	
i)	Minimum clearance distance to earth in air of HV terminals	
ii)	Minimum clearance distance to earth in air of LV terminals	
iii)	Minimum clearance distance between HV terminals in air	
iv)	Minimum clearance distance between HV & LV terminals in air	
v)	Minimum clearance distance between HV & LV terminals in air	
12.	Insulation Strength	
i)	Impulse insulation strength(withstand values) with 1.2/50 microsecond full wave	
a)	HV Winding - HV crest	
b)	LV Winding - LV crest	
ii)	Impulse Chopped wave(withstand values)	
a)	HV Winding - HV crest	
b)	LV Winding - LV crest	
iii)	Power frequency high voltage test	
a)	HV and ground	
b)	LV and ground	
iv)	Induced voltage test(1 min)	
13.	HV Bushings	
i)	Name of manufacturer	
ii)	Type of bushing	
iii)	Rates voltage	
iv)	Creepage distance of bushings	
14.	Resistance per phase	
i)	HV winding	
ii)	LV winding	
15.	Tap Changing arrangement	
i)	Type and arrangement of tap changing gear	

ii)	Location of the taps	
iii)	Details of the tap and ratio on different taps	
17. i)	Increase in temperature of winding at full load(resistance) with the type of cooling employed at maxim. Ambient temperature of 50oC.	
ii)	Oil temperature rise(by thermometer) on above conditions.	
18.	Thermal time constant.	
19.	Permissible duration(in minutes) of loads following continuous running at normal rates load at a maximum ambient temperature of 50oC 10% over load 20% over load -do- 30% over load -do-	
20.	Guaranteed iron loss without any plus tolerance. – watts	
21.	Guaranteed copper losses at full load and unity power factor without any plus tolerance at 75°C.	
22.	Magnetising current at 90%, 100%, 110% and 120% excitations	
23.	Percentage resistance at 75%C	
24.	Reactance voltage drop expressed at percentage of rated voltage	
25.	Impedance voltage at 75oC expressed as percentage of rated voltage	
26.	Regulation at normal full load and unity power factor tap	
27.	Regulation at normal/full load and 0.8 power factor.	
28.	Efficiency at unity power factor and following loads Full Load ³ / ₄ Load ¹ / ₂ Load ¹ / ₄ Load	
29.	Efficiency at 0.8 power factor and following loads Full Load ³ / ₄ Load ¹ / ₂ Load ¹ / ₄ Load	
30.	Quantity of oil in the transformer tank	
31 i)	Total weight of transformer with oil	
ii)	Total weight of transformer with oil and fittings	
iii)	Over all dimensions of the complete transformer	
32.	Name and weight of the heaviest package	
33.	Shipping dimension of the heaviest package	
34.	Standard Specn. According to which the transformer shall be manufactured and tested.	
35.	Has, it been checked that transformer dimensions are suitable for transport up to destination railway station.	

SCHEDULE-R-3

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR CIRCUIT BREAKERS

Applicable Particulars to be filled in separately for 245 KV, 145 KV circuit breakers.

C M.	Denti	1	245 VV	145 VV
5.NO.	Partic	culars	243 K V	145 K V
1.	Name	e of Manufacturer		
2.	Manu	ifacturer's type/designation		
3.	Appli	cable Standards		
4.	Ratec	l voltage (kV)		
5.	Ratec	I continuous voltage for rated Mva		
	(a) M	inimum Kv		
	(b) M	laximum kV		
6.	Princ	iple of operation of Circuit Breaker.		
7.	Туре	of circuit breaker(indoor/outdoor)		
8.	Ambi	ent temperature used for designing		
	(a) M	aximum Deg. C.		
	(b) M	laximum daily average Deg. C.		
9.	Conti	nuous current under normal conditions.		
10.	Short	time current rating for 1 sec. & 3 sec. r.m.s.		
	KA	-		
11.	Maxi	mum rise of temperature over ambient for		
	curre	nt rating under clause 10 above . ⁰ C		
12.	Rated	l operating duty		
12.1	Rated transient recovery voltage.			
12.2	(a) O	pening time (in milli. sec).		
	(b) A	rcing time (in milli. sec.) at :		
	i) R	ated breaking current		
	ii) 50	% of rated breaking current.		
	iii) 25	5% of rated breaking current.		
	iv) 10	0% of rated breaking current.		
13.	Interr	upting capacity based on duty cycle in 12		
	above	2.		
	a)	Symmetrical at rated voltage, in KA &		
		MVA		
	b)	Asymmetrical at rated voltage, in KA &		
	,	MVA		
	c)	Symmetrical at service voltage in KA		
14.	Rated	l restriking voltage 100%, 60%, 30%		
-	a)	Amplitude factor		
	b)	Rate of rise at natural frequency		
15.	Maki	ng capacity. KA peak		
	a)	At higher rated voltage		
	b)	At lower rated voltage		
	b)	At lower rated voltage		

16.	Numl	per of breaks in series per pole.		
17.	Length of contact travel, mm.			
18.	Total length of break/pole, mm.			
19.	Rate	of contact travel :		
	a)	At tripping, metres/sec.		
	b)	At closing, metres/sec.		
20.	Туре	of devices if any used to obtain uniform		
	voltag	ge distribution between breaks.		
20.1	Ratec	l line charging (capacitive) current (Amps.)		
20.2	Rated	l small inductive breaking current (Amps.)		
21.	Reco	very voltage distribution between breaks in		
	perce	nt of rated voltage.		
	a)	Single line to ground fault.		
	b)	Interrupting on short lines.		
	c)	Switching off on unloaded transformer.		
22.	Туре	of main contacts		
23.	Туре	of arcing contacts and/or control device.		
24.	Mater	rial of contacts		
	a)	Main		
	b)	Arching		
	c)	Whether contacts are silver plated		
	d)	Thickness of silver coating in microns		
	e)	Contact pressure, Kg/mm ²		
25.	Insula	ation level of the breaker		
	a)	One minute power frequency withstand		
		voltage K.V. r.m.s.		
	b)	Impulse withstand test voltage K.V. (Peak)		
	c)	Switching Surge with stand test voltage KV		
		(Peak)		
26.	Coroi	na and visual discharge.		
	a)	Radio interference voltage at 1.1. U/ $\sqrt{3}$		
		(where U is maximum rated voltage)		
	b)	Visual discharge voltage for falling power		
		frequency voltage (KV)		
27.	Whet	her the circuit breaker is fixed-trip or trip free.		
28.	Meth	od of closing		
	a)	Normal		
	b)	Emergency		
29.	Туре	of closing mechanism		
30.	a)	Normal voltage of closing		
	b)	Pick-up voltage of closing		
31.	a)	Power at normal voltage of closing		
		mechanism (watts).		
	b)	Power at 85% of normal voltage (watts).		
	c)	Power at 110% of normal voltage (watts).		
32.	Туре	of tripping mechanism		
33.	Norm	al voltage of tripping coils (volts).		
34.	a)	Power at normal voltage for tripping coils		
		(watts).		

	b)	Power at 70% normal voltage for tripping	
		coils (watts).	
	c)	Power at 110% normal voltage for tripping	
		coils (watts).	
35.	Arc d	uration at 100% interrupting capacity :	
	a)	Opening :	
	Arcin	g time, no. of loops and time including	
	resist	or, current duration.	
	Resis	tor current duration (cycles/ms)	
	Total	length of Arc of maximum length of the Arc.	
	b)	Total interrupting time measured from	
		instant of trip coil energization to arc	
		extinction of resistor current (cycle/ms.)	
	c)	Closing time measured from instant of	
		application of power to closing device when	
		arcing contact touches (cycle/ms.)	
36.	Critic	al current (current giving the longest arc	
	when	a break takes place) Amps.	
37.	a)	Recovery voltage when circuit breaker	
		tested at 100% rated breaking capacity (KV	
	1.	inst.)	
	b)	Rate of rise of restriking voltage at	
		breaking.	
	1)	For 30% breaking capacity in KV/micro	
	::)	Secs.	
	11)	For 100% breaking capacity, K v/inicio	
	c)	Maximum over voltage factor of the circuit	
	0)	breaker when switching off	
	i)	Unloaded transformer	
	ii)	Loaded transformer	
	iii)	Open circuited lines	
38	Wher	switching off asynchronous system :	
20.	a)	Maximum current, KA	
	b)	Maximum recovery voltage between	
		contacts of one pole KV	
39.	Numł	ber of openings the circuit breaker is capable	
	of per	rforming without inspection/replacement of	
	conta	cts or their main parts.	
	a)	At 50% rated current	
	b)	At 100% rated current	
	c)	At current corresponding to 50% rated	
		breaking capacity.	
	d)	At current corresponding to 100% rated	
		breaking capacity.	
40.	Numł	per of opening the circuit breaker is capable of	
	perfo	rming without replacing/reconditioning SF6	
	gas		
	a)	At 50% rated current	
	b)	At 100% rated current	

	c)	At 50% breaking capacity	
	d)	At 100% breaking capacity	
41.	First	pole to clear factor	
42.	Break	king current on out of phase condition as per	
	IEC-2	267	
43.	Perce	ntage of DC component.	
44.	Perce	ntage of imported component in the offered	
	circui	t breaker.	
45.	Creep	bage distance.	
	a)	Total (mm)	
16	b)	Protected mm (at 90 deg. only)	
46.	No. o	f interruptors used in circuit breaker.	
4/.	Conta	ict resistance in ohms.	
48.	Perce	ntage leakage of SF6 gas per annum under	
40		Weight of complete circuit brooker in Kg	
49.	a) b)	Impact loading for foundation design to	
	0)	include dead load plus impact loading value	
		on opening at maximum interrupting rating	
		in terms of equivalent static loading in all	
		the three axis.	
	c)	Overall dimensions	
	Weig	ht (mm)	
	Widtl	n (mm)	
	Lengt	th (mm)	
50.	BUSI	HING/PORCELAIN	
	a)	Make	
	b)	Туре	
	c)	Description pamphlet no.	
	d)	Weight (Kg.)	
	e)	Transport dimensions, mm.	
	f)	Height above floor required to remove	
		bushings. Mm	
	<u>g)</u>	Insulation class	
	n)	WV (rms)	
	i)	10 second wet power frequency withstand	
	1)	KV (rms)	
	i)	Flashover voltage, KV	
	k)	Full wave impulse withstand voltage KV	
	Í	(peak)	
	1)	Switching surge withstand voltage KV	
		(peak)	
	m)	Corona discharge voltage, KV	
	n)	Nature of the dielectric medium employed	
		in the bushings.	
	0)	Volume of insulating medium per bushing	
		in Litres.	
	p)	Permissible safe cantilever loading on	
1		installed bushing.	

	q)	Test Certificate No. (Tested on assembled	
		breaker).	
	r)	Creepage distance.	
		(a) Total	
		(b) Protected	
51.	Pneumatic equipment for SF6 gas circuit breaker.		
	a)	Type unit	
	b)	Manufacturer's type designation.	
	c)	Air compressor	
	i)	Туре	
	ii)	Make	
	iii)	Capacity in litres/min.	
	iv)	Rated pressure Kg./cm ²	
	d)	Compressor motor	
	i)	H.P. Rating	
	ii)	Rated voltage and frequency	
	iii)	Limits of voltage and frequency variation	
		for satisfactory operation of compressor	
		motor.	
	iv)	Number of phases	
	v)	Speed (R.P.M.)	
	vi)	Class of insulation	
	e)	Safety valve opens on local receiver at	
		Kg./cm ²	
	t)	Safety value opens on control air receiver at $\frac{1}{2}$	
		Kg./cm ²	
	<u>g)</u>	Compressor starts at Kg./cm	
	<u>n)</u>	Compressor stops at Kg./cm	
	1)	Alarm switching closes on local/remote end air receiver at K_{α}/cm^2	
	i)	I ockout switch on local/remote end air	
	J	receiver operates at K α/cm^2	
	i)	Kg/cm^2 - for closing	
	ii)	Kg/cm^2 - for opening	
	iii)	Kg/cm^2 - for auto-reclosure duty	
	$\frac{k}{k}$	Time for air compressor to charge the	
	,	central storage.	
	i)	From atmospheric to pressure indicated in	
		(g) above, in minutes	
	ii)	From pressure indicated in (g) above to that	
		in (h) above in minutes	
	iii)	Number of stored close & open operations	
		in breaker local receiver (h) above to	
		permissible minimum pressure.	
52.	Sulp	hur Hexafluoride Gas	
	1)	Physical properties	
	2)	Density at 20 Deg. C and 1 bar	
	3)	Electric strength	
	4)	Compatibility	
	5)	Toxic impurities	

	6)	Impurities
	7)	Standard size of cylinders
	8)	Preferred sizes of cylinder
	9)	Test pressure of cylinder
	10)	Maximum filling ratio for tropical country.
	11)	Name of SF6 gas supplier and country of
		origin.
	12)	Quantity of SF6 gas required.
		a) As in actual use in breaker in litres.
		b) As spare in litres
	13)	Guaranteed chemical composition of SF6
		gas.
		(a) Quantity of air by weight ppm
		(b) Quantity of water by weight ppm.
		(c) Quantity of SF6 by weight ppm
		(d) Quantity of H.P. by weight ppm
		(e) Any other toxic impurities by weight
		ppm.
	14)	Details of control indication provided for
		watch on performance of compressor unit.
53.	Min	imum clearance in air
	a)	Between phases mm.
	b)	Live part & earth
	c)	Live part to ground level
SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR CURRENT TRANSFORMERS

(A) To be filled in for 245 KV CTs

S.No	Particulars			245 KV	^v CTs		
1.	Nam	e of Manufacturer					
2.	i)	Manufacturer's Type and					
		Designation					
	ii)	Applicable Standards.					
3.	Type	of Current Transformers (whether					
	"Dea	d Tank" or "Live" Tank "Design)					
4.	Rated	l voltage (KV)					
5.	Maxi	mum operating voltage (KV)					
6.	Rated	l Frequency (Hz)					
7.	a)	No. of Cores					
	b)	No. of Primary Turns					
8.	Rated	l Primary thermal					
	curre	nt (A)					
9.	Conti	nuous thermal current rating (In					
	% of	the rated primary current (Amps.)					
10.	Temp	perature rise at rated thermal					
	curre	nt ⁰ C over ambient temp ⁰ C at site					
	for :						
	a)	Winding.					
	b)	Oil at Top					
	c)	Exposed current carrying parts.					
11.	Short	time thermal current for one sec.					
	(kA r	.m.s.)					
12.	Dyna	mic current withstand value of CT					
	(kA F	Peak)					
13.	Core	Details :	Core-1	Core-2	Core-3	Core-4	Core-5
	i)	Transformation Ratio					
	ii)	Rated output (VA)					
	iii)	Class of Accuracy					
	iv)	Rated P.F. of Burden					
	v)	Minimum Knee point voltage at					
		maximum Tap.					
	vi)	Max. exciting current					
		corresponding to specified knee					
		point voltage at Max. Tap.					
	vii)	Accuracy limit Factor/					
		Saturation Factor					
	viii)	Max. secondary winding					
		resistance (Ohms) at max. tap.					
14.	One 1	ninute power frequency dry					
	withs	tand test voltage for primary					
	wind	ing and bushing. (kV r.m.s.)					

15.	One minute power freq. wet withstand			
	bushing (kV r.m.s.)			
16.	1.2/50 Micro sec. impulse withstand			
	test voltage for primary winding &			
	bushing positive and negative both (KV			
	Peak)			
17.	One minute Power frequency with			
	stand test voltage on secondaries (kV			
	r.m.s.)			
18.	Radio interference voltage			
	atkV (Micro volts)			
19.	Visual discharge voltage for falling			
	power frequency voltage (kV)			
20.	Total Creepage distance (mm.)			
21.	Type/make of Porcelain bushing.			
22.	Class of Insulation.			
23.	Mounting details.			
24.	For Metering core of C.T. composite			
	error :			
	a) At rated burden and at :			
	i) 20% rated current			
	ii) 120% rated current.			
	b) At 25% burden and at :			
	i) 20% rated current			
	ii) 120% rated current.			
25.	Method of test for transient response.			
26.	Overall height (Furnish G.A. drawing			
	too)			
27.	Weight of Oil (Insulating media)			
28.	Total weight.			
29.	Partial discharge level kV			
	(r.m.s.)			
30.	Type of Primary Connection			
31.	Detail of Insulation Material used for			
	primary & secondary windings.			

(B) To be filled in for 145 KV CTs

SL. No.		Particulars	500/1A (100MVA)	400-200-100/1A (40MVA)	800-400-200/1A (132kV Feeders)
1.	Name of Manufacturer				
2.	i)	Manufacturer's Type and			
		Designation			
	ii)	Applicable Standards.			
3.	Туре	of Current Transformers			
	(whet	ther "Dead Tank" or "Live			
	Tank	"design)			
4.	Rated	l voltage (KV)			
5.	Maxi	mum operating voltage (KV)			

6.	Rated	1 Frequency (Hz)									
7.	a)	No. of Cores									
	b)	No. of Primary Turns									
8.	Rateo	l Primary thermal									
	curre	ent (A)									
9.	Conti	inuous thermal current rating									
	(In %	of the rated primary current									
	(Amp	os.)									
10.	Temp	perature rise at rated thermal									
	curre	nt ⁰ C over ambient temp ⁰ C at									
	site f	or:									
	a)	Winding.									
	b)	Oil at Top									
	c)	Exposed current carrying									
	Í	parts.									
11.	Short	time thermal current for one									
	sec. (kA r.m.s.)									
12.	Dyna	mic current withstand value of									
	ĊT (ł	kA Peak)									
13.	Core	Details : (C-core)	C-1	C-2	C-3	C-1	C-2 C	-3	C-1	C-2	C-3
	i)	Transformation Ratio									
	ii)	Rated output (VA)									
	iii)	Class of Accuracy									
	iv)	Rated P.F. of Burden									
	v)	Minimum Knee point									
	,	voltage at maximum Tap.									
	vi)	Max. exciting current									
	,	corresponding to specified									
		knee point voltage at Max.									
		Tap.									
	vii)	Accuracy limit Factor/									
		Saturation Factor									
	viii)	Max. secondary winding									
		resistance (Ohms) at max.									
		tap.									
14.	One 1	minute power frequency dry									
	withs	stand test voltage for primary									
	wind	ing and bushing. (kV r.m.s.)									
15.	One 1	minute power freq. wet									
	withs	stand test voltage for primary									
	wind	ing and bushing (kV r.m.s.)	<u> </u>								
16.	1.2/5	0 Micro sec. impulse									
	withs	tand test voltage for primary									
	wind	ing & bushing positive and									
	negat	tive both (KV Peak)	<u> </u>								
17.	One	minute Power frequency with									
	stand	test voltage on secondaries									
	(kV r	r.m.s.)	<u> </u>								
18.	Radio	o interference voltage									
	at	kV (Micro volts)									

19.	Vis	sual discharge voltage for falling
	pov	wer frequency voltage (kV)
20.	Tot	tal Creepage distance (mm.)
21.	Ty	pe/make of Porcelain bushing.
22.	Cla	ass of Insulation.
23.	Mc	ounting details.
24.	Fo	r Metering core of C.T.
	cor	nposite error :
	a)	At rated burden and at :
		i) 20% rated current
		ii) 120% rated current.
	b)	At 25% burden and at :
		i) 20% rated current
		ii) 120% rated current.
25.	Me	thod of test for transient
	res	ponse.
26.	Ov	erall height (Furnish G.A.
	dra	wing too)
27.	We	eight of Oil (Insulating media)
28.	Tot	tal weight.
	Par	tial discharge level
	kV	(r.m.s.)
29.	Ty	pe of Primary Connection
30.	De	tail of Insulation Material used
	for	primary & secondary windings.

SCHEDULE-R-4(ii)

SCHEDULE OF TECHNICAL AND GUARANTEED PARTICULARS FOR TERMINAL CONNECTORS

S.No.	Particulars
1.	Material of connector
2.	Name of manufacturer
3.	Drawings of connectors
4.	Weight of connector
5.	Testing facility available at manufacturer's
6.	Works and list of apparatus available
(a)	What tests will be carried out on each piece
(b)	What tests will be carried out on some selected pieces
7.	Make of bolts, nuts and checknuts
	(Preferably GKW make)
8.	Make of washers

SCHEDULE-R-4(iii)

SCHEDULE OF TECHNICAL AND GUARANTEED PARTICULARS FOR JUNCTION BOXES

S.No.	Particulars	
1.	Material of Junction Box	
	(State Gauge of the sheet metal)	
2.	Name of manufacturer	
3.	Overall dimensions (mm)	
	(Furnish G.A. drawing)	
4.	Mounting Details	
	(Furnish Drawings)	
5.	Weight of Junction Box (Kg.)	
6.	Testing facility available at manufacturer's	
7.	Works and list of apparatus available	
(a)	What tests will be carried out on each Jn. Box	
(b)	What tests will be carried out on some selected Junction	
	Box	
8.	Make of bolts, nuts and check nuts	
	(Preferably GKW make)	
9.	Make of washers	
10.	Type of Paint	
11.	Grade of Terminal Block	
12.	Type of Terminals	
13.	Type of Fuse Links	
14.	Type of Fuses with rating	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR CVT/PT

Applicable Particulars to be filled in separately for 245 KV CVT, 145 KV PT PT)

S.No	Particulars		245 KV CVT			145 KV PT		
1.	Name of Manufacturer							
2.	i) Manufacturer's type and							
	Designation.							
	ii) Applicable standards.							
3.	Type of voltage transformer.							
4.	Type of insulation used.							
5.	Rated primary voltage (KV)							
6.	Maximum primary operating							
	voltage (KV)							
7.	No. of secondary windings							
8.	Rated secondary voltage (Volts)							
9.	Rated transformation ratio.							
10.	Rated frequency (Hz).							
11.	Rated secondary burden for various	C-1	C-2	C-3	C-1	C-2	C-3	
	cores (VA)							
12.	Accuracy class at rated burden for							
	metering and protection core							
	respectively.							
13.	Rated total thermal burden (VA)							
14.	Temperature rise of winding over							
	ambient (⁰ C).							
14.1	Temperature rise at 1.1 times rated							
	voltage with rated burden							
14.2	Temperature rise at 1.5 times rated							
	voltage when applied for 30 sec							
	with rated burden							
15.	Primary winding and bushing one							
	minute power frequency withstand							
	voltage for wet and dry both (KV							
	r.m.s.)							
16.	VT primary winding and bushing							
	1.2/50 micro second full wave							
	positive and negative impulse							
	withstand voltage (KV peak).							
17.	Limits of phase displacement and							
	voltage error.							
18.	One minute power frequency							
	withstand voltage of secondary							
	winding (KV)							
19.	Radio interference voltage							
	at KV (in micro volts)							
20.	Visual discharge voltage for falling							
	power frequency voltage (KV)							

21.	Rated voltage factor and time.		
22.	Creep	page distance :	
	Total	. (mm)	
23.	In cas	se of capacitor voltage	
	transt	formers:	
	i)	Rated Capacitance (p.f.)	
	ii)	Details of H.F. Capacitance	
		(p.f.)	
	iii)	Stray Capacitance	
	iv)	Stray Conductance.	
	v)	Standard reference range of	
		frequency for which	
		accuracies are valid.	
	vi)	Short circuit impedance as	
		seen from secondary.	
	vii)	Transient response	
		performance.	
	viii)	Ferro response performance.	
24.	Over	all height	
	(Furn	hish G.A. drawing. too)	
25.	Weig	tht of oil.	
26.	Total	weight.	
27.	Partia	al discharge limit at	
20	(KV)	r.m.s.)	
28.	Meth	od of connection of 36 KV	
20	VI S	econdary.	
29.	Cred		
30.	Flack	e of off.	
51.	Flash	fover voltage for protective	
22	Gap I	of 1.5 voltage factor.	
52.	frequ	encies ranging from 50 to 500	
	kiloc	vcles (dB)	
33	Trans	sient response performance	
55.	time	in which 5% rated peak	
	volta	ge will fall as a result of	
	prima	arv short ckt. When 75% rated	
	outpu	at burden is	
	conne	ected.(Millisecond)	
34.	Ferro	resonance performance of	
	secor	ndary voltage when connected	
	with	25% resistive burden as a	
	result	t of secondary short circuit	
	after	one second.(KV)	
35.	Flash	over voltage for protective	
	gap f	for 1.5 voltage factor.(KV)	

SCHEDULE-R-5(ii)

SCHEDULE OF TECHNICAL AND GUARANTEED PARTICULARS FOR TERMINAL CONNECTORS

S.No.	Particulars	
1.	Material of connector	
2.	Name of manufacturer	
3.	Drawings of connectors	
4.	Weight of connector	
5.	Testing facility available at manufacturer's	
6.	Works and list of apparatus available	
(a)	What tests will be carried out on each piece	
(b)	What tests will be carried out on some selected pieces	
7.	Make of bolts, nuts and checknuts	
	(Preferably GKW make)	
8.	Make of washers	

SCHEDULE-R-5(iii)

SCHEDULE OF TECHNICAL AND GUARANTEED PARTICULARS FOR JUNCTION BOXES

S.No.	Particulars	
1.	Material of Junction Box	
	(State Gauge of the sheet metal)	
2.	Name of manufacturer	
3.	Overall dimensions (mm)	
	(Furnish G.A. drawing)	
4.	Mounting Details	
	(Furnish Drawings)	
5.	Weight of Junction Box (Kg.)	
6.	Testing facility available at manufacturer's	
7.	Works and list of apparatus available	
(a)	What tests will be carried out on each Jn. Box	
(b)	What tests will be carried out on some selected Junction	
	Box	
8.	Make of bolts, nuts and check nuts	
	(Preferably GKW make)	
9.	Make of washers	
10.	Type of Paint	
11.	Grade of Terminal Block	
12.	Type of Terminals	
13.	Type of Fuse Links	
14.	Type of Fuses with rating	

<u>SCHEDULE – R-6</u> <u>GUARANTEED TECHNICAL PARTICULARS FOR MOTOR OPERATED</u> <u>ISOLATORS</u>

1.	Name of Manufacturer	245KV	145KV
2.	i) Manufacturer's type		
	ii) Type of Isolator		
3.	Standard/s according to which the isolators are		
	manufactured.		
4.	i) Rated Voltage		
	ii) Isolators suitable for No. of		
	phase(single/three)		
	iii) Earthing switch suitable for No. of phase		
	(single/three)		
5.	Frequency		
6.	Maximum design voltage at which the isolator		
	can operate		
7.	Maximum current that can be safely interrupted		
	by the isolators		
	Inductive		
	Capacitive		
8.	Continuous current rating :-		
	Nominal		
	Under site condition		
9.	Rated short time current :-		
	a) For 3 Second		
	b) For 1 Second		
10.	Rated peak short circuit current		
11.	Maximum temperature rise of current carrying		
	parts when carrying rated current continuously.		
12.	Ambient temperature maximum/average for		
	which above is applicable.		
13.	De-rating factor for specified site conditions		
14.	Short circuit type test certificate		

15.	Insulation tests :-
	i) Impulse voltage test :-
	a) Between open contact
	b) To earth
	ii) Switching surge voltage test:-
	a) Between open contact
	b) To earth
	iii) Power frequency voltage test:-
	a) Between open contact (dry & wet)
	b) To earth
16.	No. of auxiliary contacts
	a) Isolators
	b) Earthing Switch
17.	Contacts :-
	i) Type of main and arcing contacts
	ii) Materials of main and arching
	iii) Whether contacts are silver plated
	iv) Area of contacts.
	v) Pressure
18.	Minimum clearance in air :-
	i) Between poles (phase soaping)
	ii) Between live parts and earth
	iii) Between live parts when switch is open
	a) On the same pole
	b) Between adjacent poles
19.	Location and type of bearing
20.	Type of interlocks
21.	Total break length
22.	Torque required to operate gang operated
	isolator
23.	Number of operations the isolator can stand
	without deterioration of
24	contacts.
24.	Switch design :-
	a) Rotating/lifting
	b)Horizontal break/vertical break
25.	Operating mechanism :-
	i) Reciprocation/torsional

	ii) Position of placement of AC drive relating	
	to post insulator	
	iii) No. of phase coupling pipes & their	
	positioning	
26.	Base	
	a) Size	
	b) Weight	
27.	Actual dimensions per phase	
28.	Total weight of each isolator	
29.	A. <u>Clamps</u> :-	
	1. Clamp body	
	i) Alloy composition	
	ii) Plating, if any	
	2. Temperature rise when carrying rated	
	current at 50 degree C Ambient temperature.	
	3. Weight of each type of clamps	
	4. Height of each type of clamps	
	5. Rated current capacity	
	6. Specification of joint compound	
	7. Material of braid	
	B. <u>Bolts</u> :-	
	i) Alloy composition	
	ii) Tensile strength	
	C. Type of washers used	
30.	Operating drive of isolators:-	
	1. Manufacturer	
	2. Type & Frame size	
	3. Rated out put in KW	
	4. Rated Voltage	
	5. Allowable voltage variation	
	6. Full load current	
	7. Continuous rating	
	8. Rated speed	
	9. Full load efficiency	
	10. Starting current	
	11. Class of insulation	
	12. Starting torque	
	13. Temperature rise above 50°C	
	14. Total weight of motor in Kg.	
	15. Method of connection to drive equipment.	
	16. Type of enclosure	

	17. Can be used in outdoor?	
	18. Type of bearing	
	19. Type of breaking provided	
31.	Visual discharge voltage for falling power	
	frequency voltage for complete isolators with	
	fittings.	
32.	Radio interference voltage of complete isolator	
	with Fitting at 266KV.	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS

FOR POST INSULATORS

To be filled in separately for 245 KV, 145 KV & 36 KV Insulators

S.No.	Particulars	245 KV	145 KV	36 KV
1.	Name of Manufacturer			
2.	Description and type of the Insulator			
3.	Standard to which insulator conform			
4.	Normal working voltage KV			
5.	Highest System Voltage.			
6.	Basic Insulation Level (KV)			
7.	Glazing Colour			
8.	Surface.			
9.	No. of units in stack			
10.	Voltage of each unit KV			
11.	i) Total creepage distance mm			
	ii) Protected creepage dist. Mm			
	iii) Creepage factor			
	iv) Profile factor			
12.	Dry arcing distance mm			
13.	With stand test voltage			
	a) Dry 50 C/S KV			
	b) Wet 50 C/S KV			
	c) Impulse 1.2/50 Micro sec. full wave			
	crest			
14.	Flashover voltage.			
	a) Dry 50 C/S KV			
	b) Wet 50 C/S KV			
	c) Impulse 1.2 Micro sec. full wave.			
	i) +ve wave (KV) crest			
	ii) -ve wave (KV)crest			
15.	Power frequency puncture voltage (KV)			
16.	Ultimate bending strength Kg.			
17.	Ultimate Torsional strength KgM			
18.	Compression strength Kg.			
19.	Ultimate Tensile strength Kg.			
20.	Weight of one Insulator of unit / Kg.			
21.	Weight of one stack comprising of units	•		
22.	Height of stack mm.			
23.	Diameter of the top plate (mm.)			
24.	Diameter of Bottom Plate (mm)			
25.	Diameter of pitch circle of cap of the			
	insulator stack (mm)			
26.	Pitch circle diameter of the bottom of the			
	insulator stack (mm)			

27.	Numb	per of hole, their spacing & dia. in top				
	end ca	ap of the insulator.				
28.	Numb	per of hole, their spacing & dia. in				
	bottoi	m end cap of the insulator.				
29.	Visual discharge test voltage.					
30.	Material& technical specification of the					
	bolts & nuts for top, bottom and					
	intermediate joints.					
	i)	Top Joint				
	ii) Intermediate Joint					
	iii)	Bottom fixture.				

SCHEDULE-R-8

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR METAL OXIDE GAPLESS SURGE ARRESTERS (LAS)

To be filled in separately for 198 KV, 120 KV & 30 KV surge arresters

S.No.	Part	iculars	198 KV	120 KV
1.	Nan	ne of Manufacturer		
2.	Typ	e and model		
3.	App	licable Standard.		
4.	Rate	ed voltage (KV)		
5.	Serv	vice voltage (KV)		
6.	Rate	ed frequency (Hz)		
7.	Nun	nber of stacks per arrestor and their		
	iden	tification col.		
8.	Nun size	nber of ZnO discs per arrester pole their & designation code No.		
(A)	Deta	ails of ZnO Blocks		
Ì	1.	Manufacturer's Name		
	2.	No. of ZnO discs per lightning		
		Arrester		
	3.	Height/Thickness of ZnO discs		
	4.	Diameter of ZnO discs		
	5.	Rated Voltage of ZnO discs kV Ur.		
	6.	MCOV of ZnO discs kV, Uc		
	7.	Nominal Discharge Current of ZnO discs.		
	8.	Long Duration Discharge Class		
	9.	Residual voltage at 10 kA discharge		
		current		
	10.	Max. watt loss of discs		
	11.	Manufacturers catalogue No.		
9.	Pow	er frequency withstand voltage of		
	arre	ster insulation (KV)		
10.	Imp	ulse lightning withstand voltage (KVp)		
11.	Swi	tching impulse withstand voltage (KVp)		
12.	Max	ximum continuous operation voltage		
	(KV	()		
13.	Cros	ss over voltage.		
14.	Pow	ver frequency reference voltage (KV rms		
	Min	.)		
15.	Pow	ver frequency reference current		
	(M .	Amp.)		
16.	Non	ninal discharge current of 8/20,		
	mic	rosecond wave.		

17.	Discharge current of 8/20 micro second	
	wave at which insulation coordination done.	
18.	Long duration discharge class.	
	a) Discharge class.	
	b) Discharge capability.	
	c) Energy discharge capability test	
	procedure.	
19.	Low current long duration test value.	
20.	Pressure release class.	
21.	Residual voltage for discharge current of	
	8/20 micro second wave KVp	
	a) 5 KA	
	b) 10 KA	
	c) 20 KA	
22.	One micro second discharged voltage at 10	
	KA (Steep impulse KVp)	
23.	Maximum switching surge protective level	
	1 K Amp. with current wave having virtual	
	front time over 30 microsecond KVp.	
24.	Peak value of high current impulse of 4/10	
	microsecond wave KVp.	
25.	Temporary over voltage withstand	
	capability KV	
	a) For 3 peaks	
	b) For 0.1 second	
	c) For I second	
	a) For 10 seconds	
26	e) For 100 seconds	
26.	Over voltage test value of 10 cycles.	
27.	Protection margin available for :	
	a) Lightening Discharge	
	b) Switching Surge Discharge	
20	C) High current short duration discharge.	
28.	Minimum creepage distance.	
29.	De die interference volte se (miere volte)	
<u> </u>	Current from programs relief V A	
22	Partial discharge test at 1.05 MCOV P.C.	
32.	Continuous aurrent drawn by the arrester at	
55.	MCOV and ambient temperature MAP	
	a) Resistive component	
	b) Capacitive component	
31	D) Capacitive component.	
J - .	characteristics	
(B)	Details of Insulating Base :	
	1 Height of Insulating Base	
}	2 Weight of Insulating Base	
ł	2. Weight of Insulating Dase	
	4 Dimensions and other mounting	
	details	
L		1

35.	a)	Weight of complete arrester with	
		insulating base Kg. (Approx.)	
	b)	Shipping weight and dimension of	
		largest package.	
	c)	Weight of complete unit with	
		insulating base.	
36.	Mir	nimum cantilever strength of arrester	
	Kg.	m.	
37.	Ear	thing arrangement provided.	
38.	Mo	unting flanges dimension and whole	
	arra	ngement.	
39.	a)	Details of surge counter with current	
		meter.	
	1.	Type, Make & Model	
	2.	Type of Recording Mechanism	
	3.	Dimensions	
	4.	Type of current make and its	
		measuring details.	
	5.	Mounting	
	b)	Maximum permissible lead between	
		arrester and surge counter and surge	
		counter and earth.	
40.	Det	ails of terminal connector.	
	a)	Material used and details.	
	b)	Conductor size and configuration.	
	c)	Strength	
41.	a)	Seismic acceleration	
	b)	Test procedure	
42.	Dyr	namic over voltage test procedure.	
43.	Pro	rated sections proposed for testing.	
44.	Age	eing test procedure and calculations.	
45.	Oth	er Details	
	1.	Total weight of the arrester	
	2.	Maximum cantilever strength of	
		Lightning Arrester including wind	
		load.	
	3.	Overall height of Lightning Arrester.	
	4.	Maximum distance recommended	
		from equipment to be protected by	
		arrester (mm.)	
	5.	Minimum distance from grounded	
		object (mm)	
	6.	Minimum distance between arrester	
		legs (mm.)	
	7.	Any other particulars.	ĺ

SCHEDULE-R-9(i)

Sl. No	Item Description	Qty (No)	MAKE	ТҮРЕ
1	Simplex Panel, Panel Dimension : 800(W) x 800(D) x 2315(H) Powder coated			
	Metering			
2	ABT Compliant Trivector meter, polyphase meter.			
	3 Phase, 4 wire, 3 element, suitable for unbalanced			
	loads, Accuracy: 0.2S, with KWH (Import &			
	Export), KVARH (Import & Export), Lead &			
	Lagging VAR			
	SCADA Compatible and with standard parameter.			
3	Test terminal block			
	Control & Indication			
4	Control Switch for CB Type: Spring Return with			
	LMD, Pistol Grip Handle, 3 Pos, 10Ways			
5	Protection			
3	Numerical Bay Control unit with MIMIC with			
	Synchro check & Epergizing			
	Check(RSYN 25)			
	 Monitoring 			
	 - Metering 			
	 Tripping Logic(PTRC,94) 			
	 Disturbance Recorder(RDRE) 			
	 Event Recorder (RDRE) 			
6.	Line Distance protection relay with Main-I &			
	Main-II of different make as per IEC 61850			
	protocol with following features:			
	• - Power Swing Detection(RPSB,			
	/8) W 1 1 6 1			
	• -Week end infeed			
	-Broken Conductor check Automatic Switch on to			
	• Automatic Switch on to fault(PSOE)			
	• Residual O/C protection			
	(PDEF 67N)			
	 Two Step Over voltage 			
	 Protection(PTOV.59) 			
	• - Fuse fail supervision(RFUF)			
	• - Single Phase Tripping			
	• -Scheme Communication(PSCH.78)			
	• - Tripping Logic(PTRC,94)			
	• - Disturbance Recorder(RDRE)			
	• - Fault Locator(RFLO)			
	• - Event Recorder (RDRE)			
	• other feature required for scheme			

GUARANTEED TECHNICAL PARTICULARS FOR 220/132 KV FEEDER BAY

7.	Numerical relay type as per IEC 61850 protocol				
	with following functions:				
	• Directional O/C & E/F protection				
	inbuilt in Main-I & Main-II				
8.	RAICA for Breaker failure protection				
9.	DC Supply supervision relay				
10.	Trip circuit supervision relay				
11.	Three phase trip relay with Supervision and Reset				
	push button				
12.	Auxiliary flag relays.				
13.	Contact multiplication & lock out relay				
14	Supervision Relay for Master Trip Relay				
	Panel Accessories				
15.	Mounted inside:				
	• 1 no. Illumination lamp with				
	ON/OFF switch				
	• 1 no. Space heater with switch				
	• 1 no. 3 pin 15A socket with				
	ON/OFF switch				
	• 1 no. Earth Bus				
	• 1 set Terminal Blocks				

SCHEDULE-R-9(ii)

SI. No	Item Description	Qty (No)	MAKE	ТҮРЕ
1.	Simplex Panels , Panel Dimension : 800(W) x 800(D) x 2315(H), Powder Coated.			
	Metering			
2.	ABT compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3 element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard			
2	parameter.			
3.	l est terminal block			
4.	Control & Indication Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways			
5.	Protection Numerical Bay Control unit with MIMIC with the following functions: • Synchrocheck & Energising • Check(RSYN,25) • Monitoring • Metering • Tripping Logic(PTRC,94) • Disturbance Recorder(RDRE) • Event Recorder (RDRE)			
6.	Numerical relay with following features: • Three winding differential (87T) • - Over load Protection(PTOC,51) • - Over Excitation Protection(PVPH,24) • - Tripping Logic(PTRC,94) • - Disturbance Recorder(RDRE)			
7.	Separate Relay for REF Protection			
8.	Numerical relay with following functions: • Directional O/C & E/F protection			
9.	RAICA for Breaker failure protection			
10.	Auxiliary relays for bucholz trip/alarm, winding temp, high trip/ alarm etc., for HV & LV other annunciation relay			
11.	i rip circuit supervision relay			

GUARANTEED TECHNICAL PARTICULARS FOR 160MVA TRANSFORMER BAY

12.	DC supply supervision relay	
13.	High Speed trip relays	
14	Supervision Relay for Master Trip Relay	
	Panel Accessories	
15.	Mounted inside:	
	 1 no. Illumination lamp with ON/OFF switch 1 no. Space heater with switch 1 no. 3 pin 15A socket with ON/OFF switch 1 no. Earth Bus 1 set Terminal Blocks 	

SCHEDULE-R-9(iii)

GUARANTEED TECHNICAL PARTICULARS FOR 220/132 KV BUS COUPLER /TRANSFER COUPLER BAY

No Image: Control & Indication 1. Simplex Panels,, Panel Dimension : 800(W) x 800(D) x 2315(H), Powder Coated. Metering: Image: Control & Indication 2. ABT compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3 element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 3. Test terminal block 4. Control & Indication 4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection Image: Control & Indication	Sl.	Item Description	Qty (No)	MAKE	ТҮРЕ
1. Simplex Panels,, Panel Dimension : 800(W) x 800(D) x 2315(H), Powder Coated. Metering:	No				
Metering: Image: Compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3 element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 3. Test terminal block 4. Control & Indication 4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection Image: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways	1.	Simplex Panels,, Panel Dimension : 800(W) x 800(D) x 2315(H), Powder Coated.			
2. ABT compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3 element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 3. Test terminal block Control & Indication 4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection		Metering:			
meter, 3 Phase, 4 wire, 3 element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 3. Test terminal block Control & Indication 4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection	2.	ABT compliant Trivector meter, polyphase			
for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 3. Test terminal block Control & Indication 4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways		meter, 3 Phase, 4 wire, 3 element, suitable			
KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 3. Test terminal block Control & Indication 4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection		for unbalanced loads, Accuracy: 0.2S, with			
& Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 3. Test terminal block Control & Indication 4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection		KWH (Import & Export), KVARH (Import			
SCADA Compatible and with standard parameter.		& Export), Lead & Lagging VAR			
3. Test terminal block Control & Indication 4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection		SCADA Compatible and with standard			
3. Test terminal block Control & Indication 4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection		parameter.			
4. Control & Indication 4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection Image: Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways	3.	Control & Lodingtion			
4. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection	4	Control & Indication			
10Ways Protection	4.	with I MD Distal Grin Handle 2 Dec			
Protection		10Ways			
Trotection		Protection			
5 Numerical Bay Control unit with MIMIC	5	Numerical Bay Control unit with MIMIC			
with the following functions:		with the following functions:			
-Synchrocheck & Energising		-Synchrocheck & Energising			
Check(RSYN,25)		Check(RSYN,25)			
• - Monitoring		- Monitoring			
- Metering		- Metering			
- Tripping Logic(PTRC,94)		 Tripping Logic(PTRC,94) 			
DisturbanceRecorder(RDRE)		 DisturbanceRecorder(RDRE) 			
Event Recorder (RDRE)		• - Event Recorder (RDRE)			
6. Numerical relay for directional O/C & E/F	6.	Numerical relay for directional O/C & E/F			
protection.		protection.			
7. RACIA for Breaker failure protection	7.	RACIA for Breaker failure protection			
8. Trip circuit supervision relay	8.	Trip circuit supervision relay			
9. DC supply supervision relay	9.	DC supply supervision relay			
10. I rip lock out relays	10.	I rip lock out relays			
11. high speed tripping	11.	nign speed tripping			
12 Supervision Relay for Master Trip Relay Banal Accessories	12	Panal A accessories			
13 Mounted inside:	13	Mounted inside:			
1. no. Illumination lamp with	15	1 no Illumination lamp with			
ON/OFF switch		ON/OFF switch			
• 1 no Space heater with		• 1 no Space heater with			
switch		switch			
• 1 no. 3 pin 15A socket with		• 1 no. 3 pin 15A socket with			
ON/OFF switch		ON/OFF switch			
• 1 no. Earth Bus		• 1 no. Earth Bus			
1 set Terminal Blocks		• 1 set Terminal Blocks			

SCHEDULE-R-9(iv)

SI.	Item Description	Qty	MAKE	ТҮРЕ
No				
1	Simplex Panel (Powder coated), Panel			
	Dimension : As per design of original			
	Manufacturer			
	Metering			
2	ABT compliant Trivector meter, polyphase			
	meter, 3 Phase, 4 wire, 3 element, suitable for			
	unbalanced loads, Accuracy: 0.2S, with KWH			
	(Import & Export), KVARH (Import &			
	Export), Lead & Lagging VAR			
	SCADA Compatible and with standard			
2	Test terminal block			
3	Control & Indication			
1	Control Switch for CB Type: Spring Return			
, т	with I MD Pistol Grin Handle 3 Pos			
	10Ways			
	Protection			
5	Numerical Bay Control unit as per IEC			
	61850 protocol with MIMIC with the			
	following functions:			
	- Synchrocheck & Energising			
	 Check(RSYN,25) 			
	- Monitoring			
	- Metering			
	 Tripping Logic(PTRC,94) 			
	• - Disturbance			
	Recorder(RDRE)			
	• - Event Recorder (RDRE)			
6	Numerical relay $(8/1)$ with following			
	True winding differential			
	• I wo winding differential			
	• - Over load Protection			
	• - Impring Logic			
	• - Disturbance Recorder			
	• -LDD(Dieaker failure			
	protection			
7	Numerical relay with following functions:			
	• Directional O/C & E/F			
	protection			
8	Auxiliary relays for bucholtz trip/alarm,			
	winding temp, high trip/ alarm etc., for HV &			
	LV other annunciation relay		<u> </u>	
9	Trip circuit supervision relay			

GUARANTEED TECHNICAL PARTICULARS FOR 40MVA T/F BAY

10	DC supply supervision relay	
11	High Speed trip relays	
12	Supervision Relay for high speed trip relay	
	Panel Accessories	
13	Mounted inside:	
	 1 no. Illumination lamp with ON/OFF switch 1 no. Space heater with switch 1 no. 3 pin 15A socket with ON/OFF switch 1 no. Earth Bus 1 set Terminal Blocks 	

SCHEDULE-R-9(v)

GUARANTEED TECHNICAL PARTICULARS FOR 33 KV FEEDER BAY & 33kV B/C BAY

No Image: No 14. Simplex Panel (Powder coated), Panel Dimension : As per design of original Manufacturer Metering: Metering: 15. ABT compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3 element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 16. Test terminal block Image: Control & Indication 17. Control & Indication 17. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection Image: Protection 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: Monitoring Motiviring Motiviring
14. Simplex Panel (Powder coated), Panel Dimension : As per design of original Manufacturer Metering:
Metering: Metering: 15. ABT compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3 element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 16. Test terminal block Control & Indication 17. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection Image: Spring Return with the following functions: 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: • • Monitoring
15. ABT compliant Trivector meter, polyphase meter, 3 Phase, 4 wire, 3 element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 16. Test terminal block Indication 17. Control & Indication 17. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection Image: Protection 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: • • Monitoring
Phase, 4 wire, 3 element, suitable for unbalanced loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 16. Test terminal block 17. Control & Indication 17. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection 18. 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: • • Monitoring
loads, Accuracy: 0.2S, with KWH (Import & Export), KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 16. Test terminal block 17. Control & Indication 17. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection 18. 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: • - Monitoring
KVARH (Import & Export), Lead & Lagging VAR SCADA Compatible and with standard parameter. 16. Test terminal block 17. Control & Indication 17. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: • • Monitoring
SCADA Compatible and with standard parameter. 16. Test terminal block Control & Indication Image: Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection Image: Control Unit as per IEC 61850 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: Image: Control Unit Con
16. Test terminal block Control & Indication 17. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection 18. 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: Monitoring Motoring
Control & Indication Image: Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection Image: Control Unit as per IEC 61850 protocol with MIMIC with the following functions: Monitoring Monitoring
17. Control Switch for CB Type: Spring Return with LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection 18. 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: • • Monitoring
LMD, Pistol Grip Handle, 3 Pos, 10Ways Protection 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: - Monitoring Materian
Protection 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: - Monitoring Materian
 18. Numerical Bay Control unit as per IEC 61850 protocol with MIMIC with the following functions: - Monitoring
protocol with MIMIC with the following functions: - Monitoring
- Monitoring
- Tripping Logic
- Disturbance Recorder
• - Event Recorder
Non Directionnel O/C & E/E
• Non -Directionner 0/C & E/T
20 DC Supply supervision relay type
21. Trip circuit supervision relay
22. Three phase trip relay with Supervision and Reset
push button
23. Auxiliary flag relays
24. Contact multiplication & lock out relay.
25. Supervision Relay for high speed trip relay
Panel Accessories
26. Mounted inside:
• 1 no. Illumination lamp with ON/OFF switch
• 1 no. Space heater with switch
• 1 no. 3 pin 15A socket with ON/OFF switch
• 1 no. Earth Bus
1 set Terminal Blocks

SCHEDULE-R-9(vi)

GUARANTEED TECHNICAL PARTICULARS FOR Substation Automation System

Sl No	Item Description	Qty No.	MAKE	ТҮРЕ
1.	 Simplex type panels equipped with the following: A Pro based Control and monitoring system, including system configuration, database engineering, IEC 61850 communication system. The following hardware is included: 2 nos. : of HP/Dell/Compaq/Laxsons/equi valent make Industrial Grade PC with Latest Processor, 2GB RAM, 1 x 320 GB HDD, 1x 24x DVD Combo Drive, OS: Latest 2 nos. Managed IEC 61850 compliant 16/8 port Ethernet switches for interbay bus LAN connected in fault tolerant ring configuration, including fiber optic cable. Ino DR workstation. Ino. APC/equivalent UPS with 30 mins battery back up (1x1000VA) I no: 80 column Dot Matrix Printer incl. cable In o A4 size Laser Printer for Graphics & reports 1x Printer server (If Required). 			
	 Functionality All Basic Monitoring functions All Basic Control functions Advanced monitoring functions: Measuring reports and trends Remote parameter setting and reading Uploading disturbance fault record files 			

	Communication with RLDC integrated gateway on IEC101/104 protocol. Communication with DCS of Power plant. Advanced control functions: Automatic sequence control		
2.	Mein berg/Arbiter/equivalent make GPS receiver on SNTP protocol including antenna and cable with following ports for time synchronization:		
3.	FO Cables for connecting IEDs to Switches		

GUARANTEED TECHNICAL PARTICULARS FOR ABT METERS

1.	Maker's name & Country
2.	Type of Meters / Model
3.	Standard to which meter conforms
4.	Accuracy class
5.	Parameters measured
6.	P.F. range
7.	Over Load Capacity
8.	Variation of voltage at which system functions normally
9.	Minimum Starting current
10.	MD Reset provisions
11.	Reset count
12.	No. of digits of Display
13.	Particulars of readout by MRI
14.	Non volatile memory retention time in the absence of power
15.	Memory capacity Of Metering Module
16.	Demand integration period
17.	Pulse output for individual meter
18	Metrology indicator for each meter
19.	Communication Capability on i) Local port ii) Remote port
20.	Modem for reading over communication lines, its max. speed and transmission protocol
21.	Time synchronization of all meters within each substation

22.	Ratio and phase error compensation Linear and Non-Linear	
23.	Transformer loss Compensation	
24.	Auxiliary supplies used and the change over time	
25.	Load survey parameters	
26.	Power consumption per phase Voltage Circuit Current Circuit	
27.	Self diagnostics features	
28.	Testing facility with the meter test terminal block	
29.	Maximum no. of meters that can be installed in one cubicle	
30.	Type of port used for data download in meter and in CMRI.	
31.	Sealing arrangement for meters, and test terminal blocks.	
32.	Method used to display Import and Export data.	
33.	Features of base computer software	
34.	No of meters supported by the MODEM	
35.	Capacity of non-volatile memory of the meter	
36.	Immunity to external magnetic field	
37.	EMI/ RFI generated by the metering system	
38.	Security features to block unauthorized access	
39.	Number of user passwords levels	
40.	Provision for programming the meter's EEPROM is at site by the user for implementing error curves of CT and VT.	

41.	Maximum discrepancy between the	
	readings of main and check meters	
42.	Capability of compensating the errors	
	arising of poor accuracies of CT and VT	
43.	Provision for implementing Availability	
	based tariff.	
44.	Tamper and Anomaly detection	
45.	Compliance to meter polling software	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF 110V
500AH BATTERIES

S.No		Particulars	110V 500AH	48V 500AH
1.	Manut	facturer's Name		
2.	Capac	ity of battery at 27 [°] C at 10 hrs. rate of		
	discha	rge. (AH)		
3.		PLATES		
	a)	Type of positive plates & dimensions		
	b)	(WXIXI) (IIIII)		
	0)	(wybyt) (mm)		
4				
1.				
	a)	Overall dimensions of cell (wxhxt) (mm)		
	b)	Method of connection between cells.		
	c)	Cell designation		
5.	Type a	and material of cover.		
6.		CONTAINERS		
	a)	Whather container is recorded or blow		
	0)	type		
	c)	Thickness of container (mm)		
	i)	Minimum		
	<u>ij</u>	Maximum		
7	11)	SEPARATORS		
/.				
	a)	Type of material.		
	b)	Thickness of separator.		
8.	CLEA	ARANCE :		
	a)	Between top of plate & top of container		
		(mm)		
	b)	Between bottom of plate & bottom of		
		container (mm)		
9.	ELEC	TROLYTE:		
	a)	Quantity of electrolyte required for each		
	b)	Cell.		
	0)	sp. Gravity of electrolyte required for first filling at 27° C		
	c)	Max_electrolyte temp_that the cell can		
		withstand without any injurious effect		
	i)	Continuously (⁰ C)		
	ii)	For a short while.		
	d)	Sp. gravity of electrolyte.		
	i)	At the end of full charges at 27° C.		
	ii)	At the end of discharge at 10 hrs. rate at		
	Í	27 ⁰ C.		

10.	Open	circuit voltage of each cell at the end of		
	discha	rge of 10 hrs. rate.		
11.	Capac	ity of the battery in Amp. hrs. at 27°C.		
	a)	At 10 hr. rate of discharge (Ah)		
	b)	At 5 hrs. rate of discharge (Ah)		
	c)	At 1 hrs. rate of discharge (Ah)		
	d)	At 1/2 hr. rate of discharge (Ah)		
	e)	At 1 minute rate of discharge (Ah)		
12.	Voltag	ge per cell of the battery at the end of		
	discha	irge.		
	a)	At 10 hr. rate of discharge (Volt)		
	b)	At 5 hrs. rate of discharge (Volt)		
	c)	At 1 hrs. rate of discharge (Volt)		
	d)	At 1/2 hr. rate of discharge (Volt)		
	e)	At 1 minute rate of discharge (Volt)		
13.	How 1	ong the battery can remain uncharged		
	without	ut deterioration of the active material		
	before	e first charge is given.		
14.	Max.	discharge current of the battery		
15.	Time	for which max. current (as referred above)		
	can be	e continuously drawn such that end voltage		
	does r	not fall below 95/44 volts.		
16.	Norm	al amp. hours efficiency of the battery at		
	10 hr.	rate.		
17.	Nomi	nal watt hour efficiency of the battery at 10		
	hr. rat	е.		
18.	Max.	boost charge current of the battery.		
19.	Wheth	ner the list and quantity of items required		
	with e	ach battery set is enclosed or not.		
20.	Percei	ntage of manganese and arsenic in		
	electro	olyte.		
21.	Intern	al resistance of each cell.		
22.	WOO	DEN STAND :		
	i)	Frame thickness (should not be less than		
		65 mm).		
	11)	Height from the floor of the lowest		
		frame.		
	111)	Insulator height.		
	1V)	Insulator diameter.		
	v)	Type of wood.		
23.	INTE	R CELL CONNECTOR :		
	1)	Metal used		
	11)	Size		
	111)	Weight of each connector.		
	1V)	Drg. of connector (to be enclosed).		
	<u>v)</u>	I otal no. of connectors.		
	V1)	Metal of bolts, nuts & its size.		
24	INTE	TIER CONNECTOR ·		
	i)	Metal used		
1	1 1		1	1

	ii)	Size		
	iii)	Weight		
	iv)	Drg. of connector (to be enclosed).		
25.	STOR	TORAGE LIFE OF BATTERIES :		
	i)	Without any electrolyte filling.		
	ii)	After electrolyte filling.		

SCHEDULE –R-12

GUARANTEED TECHNICAL PARTICULARS OF BATTERY CHARGER WITH D.C. DISTRIBUTION BOARD

BATTERY CHARGER

SI. No. Particulars

- 1. Manufacturer's Name
- 2. Type

3. **<u>Rated Voltage:</u>**

- i) Input Volts.
- ii) Out put Volts.

4. <u>Charging Current:</u>

- i) Float Charger
- ii) Boost Charger
- iii) Permanent station Load
- 5. Tapping on the primary Of Float Charger (if any)
 - i) No, of Taps Nos.
 - ii) Volts per tap volts
- 6. No. of steps for boost charger unit.
 - i) Coarse
 - ii) Fine
- 7. Whether float charger's Voltage Control is step less or not (only steeples control with thyristor is acceptable

8. CHARACTERISTICS OF RECTIFIER

a) <u>Diodes :</u>

- i) Forward Voltage drop at rated current.
- ii) Reverse leakage current at rated voltage
- iii) Type of Diode used.

b) <u>Thyristor</u>

- i) Forward voltage drop at rated current.
- ii) Reverse leakage current at rated voltage
- iii) Type of thyristor used.

9. a) <u>Temperature rise on float charger at rated current</u>

i) For rectifier 0° C ii) For transformer 0° C

b) Temperature Rise on Boost Charger at rated Current

- i) On rectifier 0° C
- ii) On transformer 0° C
- 10. Whether battery can be brought from fully discharged state to fully charged state by boost charging Yes/ No

11. Dimension of Battery Charger

i)	Height	mm
ii)	Width	mm
iii)	Depth	mm

12. Weight of Battery Charger

- i) With packing
- ii) Without packing

13. <u>Gauge of Sheet</u> <u>Sheel used for</u>

- i) Doors
- ii) Side panels
- iii) Top Cover

14. Details of Transformer of Float Charger unit

- i) Capacity
- ii) Wire size
- iii) No. of turns of Primary / Secondary
- iv) Flux Density
- v) Core size of grade
- vi) Weight of:
 - a) Stamping
 - b) Windings
 - c) Gross Weight of Transformer

15. Boost Charger Unit Transformer

- i) Capacity
- ii) Wire size
- iii) No. of turns of primary/ secondary
- iv) Flux Density
- v) Core size

vi) <u>Weight of :</u>

- a) Stampings
- b) Windings
- c) Gross weight of Transformer

D.C. Distribution board

- 1. Manufacturer's Name
- 2. D.C. Bus bar Metal used Cross section size in mm. Capacity in amp.
- 3. Number of bus bar.
- 4. Size of D.C. distribution Board
- 5. Gauge of Sheet steel used
 - i) Door.
 - ii) Side Panel.
 - iii) Top Cover
- 6. Schedule's Enclosed/ not Enclosed (Make & rating of Components.
SCHEDULE – R-13

TECHNICAL PARTICULARS OF L.T. DISTRIBUTION BOARD

Sr.No.	Particular	Unit	Value
1.0	Air Circuit Breaker :		
1.1	Make		
1.2	Rating		
1.3	a. Number of pole		
	b. Service voltage	Volts	
	c. Normal current	Amps.	
	d. Frequency	Hz	
	e. Making capacity in peak	kilo-amps.	
	i) Symmetrical	KA & MVA	
	ii) Asymmetrical	KA	
	f. Short time current (1 second or 3 second as		
	applicable)	KA	
	g. Whether ACB is of indoor type.		
1.4	Constructional features		
	a. No. of breaks in circuit per pole	Nos.	
	b. Total length of break per pole	mm	
	c. Type of main contacts		
	d. Type of arcing contacts and or arc control device		
	e. Minimum clearance in air	mm	
	i) Between pole	mm	
	ii) Between live parts & earth	mm	
	f. Method of closing		
	i) Whether hand or power		
	ii) Whether the circuit breaker is designed to		
	Close and latch on making or is fitted with		
	making current release.		
	iii) Whether the Circuit breaker is trip free.		
	g. Power required at designed normal voltage to		
	close circuit breakers.		
	h. Normal voltage of shunt trip coils.		
	1. Power required at normal voltage for shunt trip		
1.5			
1.5	Operating particulars :		
	a Opening time	Sec	
	a. Opening time	Sec.	
	o. Are durations be stated for given breaking	500.	
	current including resistance are duration (if any)		
	senarately		
16	Whether draw out type		
1.0	No of years for which under satisfactory use		
2.0	Moulded case circuit breaker / isolators		
2.0	Make		
2.1	Rating		

	 a. No. of pole b. Service voltage c. Normal current d. Frequency e. Rupturing capacity symmetrical 	Volts Amps. C/s MVA at 433 volts.	
2.3	Protection devices		Over load/ short circuit protection.
2.4	Type of main contacts		
2.5	Type of arc control devices		
2.6	Whether MCCB is trip free		
2.7	Operating particulars a. Operating time at rated breaking current b. Make time at rated / breaking current		
2.8	Whether provided with standard flush mounting base assembly.		
2.9	No. of years for which under satisfactory use.		
3.0	L.T. SWITCHBOARD		
3.1	Make		
3.2	Bus bar rating		
3.3	Bus bar material		
3.4	Bus bar spacing		
3.5	Size of bus bar		
3.6	Rupturing capacity of bus bar		
3.7	Gauge size of sheet steel.		
4.0	CURRENT TRANSFORMER		
4.1	Make		
4.2	Туре		
4.3	Rated voltage		
4.4	Rated primary current		
4.5	Rated secondary current		
4.6	Rated continuous thermal current temperature rise over ambient		
4.7	Mounting details		
4.8	Overall dimensions		

GUARANTEED TECHNICAL PARTICULARS OF 1.1 KV FRLS PVC UNARMOURED COPPER CONTROL CABLE

Sl.		Particulars	Size of Cable]	
No.			2x2.5	4x2.5	6x2.5	10x2.5	
			sq. mm.	sq. mm.	sq. mm.	sq. mm.	
1.	Nam	Name of manufacturer/make					
2.	Type of cable.						
3.	Cab	le Туре					
	a)	Size.					
	b)	Standard applicable.					
	c)	Voltage rating.					
	d)	Permissible variation in					
		voltage & frequency.					
	e)	Suitable for earthed/					
		unearthed system.					
4.	Deta	ails of conductor					
	a)	Material.					
	b)	Size of conductor in mm.					
	c)	Shape of conductor.					
	d)	Maximum DC resistance per					
		core of the cable at 20 Deg.					
		C. in Ohm/Km.					
5.	Num	iber of core.					
6.	Deta	ails of insulation					
	a)	Type of insulation.					
	b)	Composition of insulation.					
	c)	Thickness of insulation					
		(mm)					
	d)	Tolerance of thickness of					
		insulation.					
	e)	Min. volume resistivity in					
		ohm/cm.					
	i)	At 27 Deg. C.					
	ii)	At 70 Deg. C.					
	f)	Minimum tensile strength of					
		insulation material					
		(Kg./sq.cm.)					
	g)	Minimum elongation					
	0	percentage.					
7.	Shea	athing details.					
7.1	Inne	er sheath					
	a)	Material of sheathing.					
	b)	Type of sheathing (Extruded					
	,	or wrapped)					

	c)	Calculated diameter over					
		stranded core (mm)					
	d)	Thickness of sheath (mm)					
7.2	Oute	er sheath					
	a)	Material of sheathing.					
	b) Type of sheathing (extruded						
		or wrapped)					
	c)	Calculated dia meter under					
		the sheath (mm)					
	d)	Thickness of sheath (mm)					
		min.					
	e)	Tolerance on thickness of					
		sheath (mm)					
8.	Nom	inal overall diameter (approx.)					
9.	Weig	ght of cable in Kg./Km.					
	(appi	rox.)					
10.	Weig	ght of copper in Kg./Km.					
11.	Weig	ght of PVC in Kg./Km.					
12.	Stan	dard specification to which the					
10	cable	e will conform.					
13.	Stan	dard drum length of cable in					
1.4	Mtrs	to be supplied.					
14.	Curr	ent rating of cable under basic					
	assu	$\frac{1}{1}$					
	<u>a)</u>	Laid in ground temp. 30 C					
	<u>b)</u>	Laid in duct temp. 30 C					
15	C) Dotin	Laid III air temp. 40 C					
15.	cond	itions of insulation					
16	Mini	mum banding radius					
10.	Shor	t circuit withstand capacity for					
17.	duration of (in KA)						
	i)						
	ii)	3 sec					
18	Insul	ation resistance at 27^{0} C (Mega					
10.	Ohm	s per Km.)					
19.	Capa	icitive reactance per Km. of					
	Cabl	e.					
20.	Indu	ctive reactance per Km. of					
	Cabl	e.					
21.	Weig	ght of drum.					
22.	Parti	culars of drum (Inside					
	dime	ensions) in mm.					
	a)	Flange					
	b)	Barrel					
	c)	Traverse					
23.	Refe	rence of standard in respect of					
	cores	5.					
24.	Refe	rence of standard to which the					
	drum	n conform.					

25.	Reference to standard in respect of cables.		
26.	Reference of license to use ISI certification mark.		

GUARANTEED TECHNICAL PARTICULARS (<u> </u>	<u>, PVC, FRLS,</u>
UNARMOURED POWER CABLE		

S.No.		Particulars	Size of Cable			
			3½x400	3½x300	3½x95	3½x50
			sq.mm.	sq.mm.	sq.mm.	sq.mm.
1.	Nam	ne of manufacturer	1	1		1
2.	Mak	e/Trade mark				
3.	Type	e of cable				
4.	Stan	dard applicable.				
5.	Volt	age rating.				
6.	Pern	nissible variation in voltage &				
	freat	uency.				
7.		Conductor				
7.1	Size	of conductor (sq.mm.)				
		Main				
		Neutral				
7.2	Shar	ne of conductor				
7.2		ninium grade				
7.5	Strat	nding details (Number of				
/.4	strar	ds/dia of each strand in mm)				
	Sular	Moin				
		Iviain Numeratura 1				
75	Man	Ineutral				
1.5	of	while at 20 day. C				
	01 Ca	ible at 20 deg. C.				
		Main				
7.6	N	Neutral				
/.6	Num	iber of cores.				
8.0		Insulation				
8.1	Туре	e of insulation.				
8.2	Com	position of insulation.				
8.3	App	licable standard.				
8.4	a)	Thickness of insulation (mm)				
		Main				
		Neutral				
	b)	Tolerance of thickness of				
		insulation.				
		Main				
		Neutral				
8.5	Min	volume resistivity in ohm/cm				
	i)	at 27 Deg. C.				
	ii)	at 70 Deg. C.				
8.6	Min	imum tensile strength of				
0.0	insu	lation material (Kg./sg.mm.)				
8.7	Min	imum elongation percentage.				

9.0	Inner Sheath			
9.1	Material of sheathing.			
9.2	Type of sheathing (Extruded or			
	wrapped).			
9.3	Calculated diameter over stranded			
	core (mm)			
9.4	Thickness of sheath (mm)			
9.5	Tolerance on thickness of sheath in			
	mm.			
10	Outer sheath			
10.1				
10.1	Material of sheathing.			
10.2	Type of sheatning. (extruded or			
10.2	Calculated dia mater under the			
10.5	sheath (mm)			
10.4	Thickness of sheath (mm) min			
10.4	Tolerance on thickness of sheath			
10.0	(mm)			
11.0	Nominal overall diameter (approx.)			
12.0	Current rating of cable under basic			
	assumption as per IS : 3961-1967.			
	a) Laid in & round temp. 30° C			
	b) Laid in duct Temp. 30° C			
	c) Laid in air temp. 40° C			
13.0	Rating factor under various			
	conditions of insulation			
14.0	Short circuit withstand capacity in			
15.0	KA for 1) 1 sec. 11) 3 sec.			
15.0	Standard drum length of cable in			
16.0	Weight of apple in Kg /Km			
10.0	(approx)			
17.0	Weight of Aluminium Kg /Km			
18.0	Weight of PVC in Kg./Km.			
19.0	Weight of drum Kg.			
20.0	Particulars of drum (inside			
	dimensions) in mm.			
	a) Flange			
	b) Barrel			
	c) Traverse			
21.0	Gross weight of drum including			
	weight of cable.			
22.0	Minimum bending radius.			
23.0	Reference to standards in respect of			
24.0	Cables.			
24.0	cores			
L	00100.	1	1	1

25.0	Reference of standard in respect of		
	drum.		
26.0	Reference of license to use ISI		
	certification mark, if any.		

<u>SCHEDULE -R15</u> GURANTEED TECHNICAL PARTICULARS FOR FABRICATION OF GALVANISED STRUCTURE

						· · · · ·
SI.No.	Description	SS reference	Tender requi	rement		Tender fill in yes/no if no specify the deviation
	Name with complete address of main for supply of structural section					
	i) Name with complete address of reroller for supply of structural section upto 8mm if these are not available with main producers					
	ii) Whether approved by TISCO/ SAIL/ BIS					
	iii) Whether supporting document in support of 3(ii) furnished					
	Structural Steel (Angle, Section, Plates, Flats etc.)					
•	Material	S:2062	Mild steel			
	Chemical composition(%)	do-	element	r.A	r.B	
	Manufacturer's test certificate is to be submittd with the		Carbon	,23	,22	
	Tender offer & at the time of inspection at firm's works)		Maganese	.5	.5	
			Sulphur	.050	.045	
			Phosphorus			

			.050	.045	
		Silicon	.4	.4	
		Carbon			
		equiv.	.42	.41	
		Var	iation of	above	
		specified limit sh	r maximu ould be a	ım as per	
Mechanical properties	do-	Test	r.A	r.B	
		Tensile strength			
		(min) N/mm ²	10	10	
		Yield strength (min) N/mm ²			
		< 20 mm thick	50	50	
		20 mm to 40 mm	40	40	
		>40 mm	30	30	
		in. elongation:			
		age (in gauge length 5.65 √So	3	3	
		end to withstand bending through 180 ⁰ (internal dia)		for less than or equal to 25 mm thickn ess	
				For more	

					than	
					25 mm	
					thickn	
					ess	
	Rolling and		(i) equal leg len	ath		
.4	Cutting Tolerence	S: 1852		J		
	(I) Leg length	1 no 13	upto and includ	aing 45 m	IM I 1.5	
		1. 110. 4.5				
			45 mm to 100 n	nm	±2.0	
			mm			
			over 100 mm		+20/	
			over 100 mm		±2%	
			(ii) Unequal leg	length a	ngle	
			45mm x 30mm			
			for longer log l	onath .	L 2 0	
			mm & -1.5 mm	engui	- 2.0	
			For shorter leg	length	as	
			per (i) above			
	(ii) Out of Square		The legs of ang	gles shall	be	
		I. no.4.3.2 &	perpendicular to	each oth	er within	
		4.3.3	a tolerence of ±1°	. The dif	ference	
			leg angles shall b	e limited	to 75%	
			of total (plus or m	ninus) sp	ecified	
			on leg length.			
			For low low with			
		Ino 4 3 4	For leg length			
		1.110.4.0.4	less than 100mm	Straigh	t	
			including 100mm&a	bove0.2	% of	
			length			
	(iv) Weight	1 no 4 3 5	For angles			
		1.00.4.3.5	Unto 3mm thickne	ss +5% o	fspecied	
			weight as per IS-80	33±5700)8	1 specied	
			Over 3mm thickne	ss + 5%:	- 3%	
	(v) Thickness		Less than 8mm	· · · · ·	+	
	tolerence of Plates	l.no.7.3	12.5% : - 5%			
			Energy One t			
			From 8mm upto	m 17	50/ .	
			5%		570	
			Over 12mm	+ 50	/0	
			In addition to the a	bove all	-	
			provisions of claus	e no. 7 sh	all	

			apply.	
	Fabrication of		(a) section sizeshould be	
.5	structures	S:802 (Part-	correct.	
		II), IS:7215,		
		Approved	(b) straightnessreasonably	
		Drawings	straight	
			(c) tolerence in overall	
			length of member±1.6mm	
			(d) stamping/markingas per	
			specification	
			(e) Hole particulars:	
			• Diameter for M16 Bolts	
			alter	
			Galvanizing1/.5mm	
			• ovalitynot permitted	
			• The maximum allowable	
			holes on the two sides of the	
			notes on the two sides of the	
			0.8mm i.e. allowable taper in	
			punched hole shall not	
			exceed 0.8mm on diameter	
			• Holing-Punching-unto	
			12mm thick	
			Drillingabove 12mm	
			thick	
			(f) Tolerence cumulative and	
			between consecutive hole	
			±0.5mm	
			(g) Tolerence on gauge distance	
			(Back Mark) ±0.5mm	
			(h) Minimum edge distance	
			• Hole center to Rolled edge	
			20mm	
			• Hole center to Sheared edge	
			23mm	
			(i) Bending of m.s. max.bend	
			method	
			Section angle	
			75x75(upto6mm) 10 ^o	
			cold	
			above $\frac{5x}{5}$ (-do) to	
			110x110(upto8mm) 5°	
			cold	
			all other angles sections and bend	
			angles not covered above shall be	
			cent not (i) Ponding of m a platag	
			U) Denuing of III.s. plates	
			bends	
			and other thickness shall be bent	
			and other unexhess shall be bellt	

			hot	
	Zinc	S:209	Purity—99.95%	
.1	Galvanising	S:2629	Proceesshot dip	
		S:4759	Mass of zinc coating:	
		S:6745	5mm thick and over 610gm/m ²	
		S:2633	Under 5mm but not	
		S:2629	Less than 2mm 460gm/m ²	
			Under 2mm but not	
			Less than 1.2mm 340gm/m ²	
			Uniformity of zinc coating— shall be as per IS:2633	
			Adhesion of zinc coating—shall be as per IS:2629	
	Routine and Acceptance test shall be as per QAP approved by the Engineer.			

Note: (1) All the provisions of ISS indicated above shall be applicable.

(2) In case above ISS have been revised, the latest values / provisions shall apply for which tenderers should indicate against particular item supported with copy of latest ISS for purpose of verification of revised values.

SCHEDULE -R-16(A)

GURANTEED TECHNICAL PARTICULARS FOR EARTH MAT

S.No.	Particulars	
1.	Manufacturer's Name.	
2.	Dia of MS rounds	
3.	Dia of MS electrodes (3 m long)	
4.	Size of MS flats.	
	a)	
	b)	
	c)	
5.	Grade of Mild steel.	
6.	Material composition.	
7.	Electrical resistivity.	
8.	Modules of elasticity.	
9.	Tolerance on dimension.	
10.	Whether test certificates will be provided	

GUARANTEED TECHNICAL PARTICULARS FOR 220, 132 & CLAMPS & FITTINGS

To be filled in separately for each type of clamps and fittings.

S.No.	Particulars	
1.	Name of Manufacturer.	
2.	Manufacturer's type.	
3.	Applicable technical standards.	
4.	Material of Clamps/Fittings.	
5.	Maximum contact Resistance (Ohms.)	
6.	Visible discharge voltage for falling power frequency voltage (kV).	
7.	Continuous Current rating of the clamps/fittings.	
8.	Temperature rise of the clamps/fittings when carrying the full load current(⁰ C).	
9.	Temperature rise of the clamps/fittings when carrying the fault current.	
10.	Minimum failing load (kg.)	
11.	Major dimensions of the clamps/fittings (with accompanied drawings).	
12.	Weight of the clamps/Fittings.	
13.	Packing details.	

GUARANTEED TECHNICAL PARTICULARS FOR BUS BAR CONDUCTOR

To be filled in separately for each type of conductor to be supplied by the Bidder.

S.No.		Particulars
1.	Manu	ıfacturer's Name & Address.
2.	Indivi	idual wires :
(i)	Alum	ninum
	(a)	Minimum Diameter of wire (mm)
	(b)	Nominal Diameter of wire (mm)
	(c)	Maximum Diameter of wire (mm)
	(d)	Cross sectional area (sq.mm)
	(e)	Mass per km. (kg./Km)
	(f)	Minimum breaking load
		Before stranding (kN)
		After stranding (kN)
	(g)	Maximum DC resistance at 20 ⁰ C (Ohm/km)
(ii)	Steel	
	(a)	Minimum Diameter of wire (mm)
	(b)	Nominal Diameter of wire (mm)
	(c)	Maximum Diameter of wire (mm)
	(d)	Cross sectional area (sq.mm)
	(e)	Mass per Km. (kg./Km)
	(f)	Minimum breaking load.
		Before stranding (KN)
		After stranding (KN)

	(g)	Maximum DC resistance at 20 ⁰ C (Ohm/km.)			
3.	Zinc coating of steel stands :				
	(a)	Number of dips the steel wise can withstand (process test)			
		Before stranding			
		After stranding			
	(b)	Maximum weight of coating.			
		Before stranding (gm/m ²)			
		After stranding (gm/m ²)			
4.	Condu	ictors :			
	(a)	Sectional area of Aluminum.			
	(b)	Total sectional area			
	(c)	Approx. overall dia (mm)			
	(d)	Approx. Mass per km. (kg./km.)			
	(e)	Calculated Maximum DC resistance at 20 ⁰ C (Ohm/km.)			
	(f)	Approx. calculated breaking load (kN)			
	(g)	Final modulus of elasticity			
	(h)	Coefficient of linear expansion per ^º C			
5.	Lay Ra	atio.			
6.	Contin conduc curren tempe	uous Maximum current rating of ctor and temperature (for given t load) above 40 ⁰ C ambient rature.			
7.	Drum	details.			
8.	Standa	ard length.			
9.	Applic	able standard.			

SCHEDULE-R-18

GUARANTEED TECHNICAL PARTICULARS FOR ANTI FOG DISC INSULATORS

S.No	Description		Description Single suspension strings with Anti-fog Insulators		Single strain strings with Anti-fog Insulators			
			14 Nos.	9 Nos.	16 Nos.	10 Nos.	3 Nos.	
1		2	3	4	5	6	7	
•	Manuf	acturer Name						
	Type of Insulator.							
•	Electromechanical strength of single Disc Kg.							
	Breaking strength of single Disc Kg.							
	Power of single	Frequency flashover voltage Disc.						
)	Dry KV						
)	Wet KV						
	Power frequency with stand test voltage.							
)	Dry KV						
)	Wet KV						
•	50% D flash ove	ry 1.2/50 micro sec. Impulse er voltage of one disc.						
)	Positive KV						
)	Negative KV						

	Impulse 1.2/50 microsec. withstand test voltage KV.				
	Power of single	r frequency puncture voltage Disc. KV			
0	Flasho variation	over values are subject to a of.			
1	Breaking strength of complete string (kg.)				
2.	Power frequency flashover voltage of complete string without corona control rings.				
)	Dry KV			
)	Wet KV			
3.	Power of comple	r frequency flashover voltage te string with corona ring.			
)	Dry KV			
)	Wet KV			
4	Power	frequency withstand voltage.			
4.)	Dry KV			
)	Wet KV			
5.	(50%) D flashover without co	ry 1.2/50 micro sec. Impulse voltage of complete string orona rings.			
)	Positive KV			
)	Negative KV			
6.	(50%) D flashover with coro	ry, 1.2/50 micro sec. Impulse voltage of complete string na rings.			

		Positive KV				
)					
		Negative KV				
)					
	Impuls	se 1.2/50 micro sec. withstand				
7.	test volt	age.				
0	Coron	a formation voltage with				
0.	normai i					
	Radio	Interference voltage micro				
9.	volts.	C C				
•	Voltag	e distribution with normal				
0.	Tittings v	vitnout corona rings.				
	1st Un	it from line conductor.				
	2nd U	nit from line conductor.				
	Qual Lin	it from line conductor				
	3ra Ur	int from line conductor.				
	Last U	nit from line conductor.				
	Voltag	e distribution with normal				
1.	fittings a	ind corona rings.				
	1st IIn	it from line conductor				
	130 01					
	2nd U	nit from line conductor.				
	3rd Ur	lit from line conductor.				
	Standa	ard to which insulators				
	conform					
22	Outsic	le diameter of the insulator				
	mm.					
	Dista	nce between centres of Discs				
3	mm.					
-						
	Cree	page distance of single Disc.				
4	mm.					
		Total mm				
	/					
		Protected mm.				
)					
1			1			

5	Weight of single Disc. kg.		
6	Creepage distance of complete string.		
) Total mm.		
) Protected mm.		
7	Weight of complete string kg.		
8	Standards to which hardware fitting conform.	5	
9	Whether drawings of each type of insulator strings attached : Yes/No.		

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF FIRE EXTINGUISHER

S.NO. Particulars

- 1.0 CO₂ type fire extinguisher
- 1.1 Manufacturer's name
- 1.2 Applicable IS:

1.3 Capacity

- (i) Trolley mounted
- (ii) Wall mounted
- (iii) Filling ratio
- 1.4 Discharge duration from time of operating valve
 - (i) 11 kg. Cylinder (sec.) Min/Max.
 - (ii) 22 kg. Cylinder (sec.) Min/Max.
- 1.5 Test pressure
- 1.6 Empty weight of cylinder.
- 1.7 Filled weight of cylinder.
- 2.0 Dry Chemical powder type fire extinguisher
- 2.1 Manufacturer / make
- 2.2 Applicable IS:
- 2.3 Capacity
 - (i) Wall mounted
 - (ii) Trolley mounted
- 2.4 Composition of powder
- 2.5 Material of body
- 2.6 Thickness of sheet.
- 2.7 Minimum bursting pressure

SCHEDULE-R-20

GUARANTEED TECHNICAL PARTICULARS OF LIGHTING SYSTEM

LIGHTING SYSTEM

Α.	Lightin	g Fixtures & Accessories	A			
1.	Manufa	cturer's Name and address	1			
	a)	Fixtures	a)			
	b)	Accessories	b)			
2.	Applical	ble standard for	2			
	a)	Fixtures	a)			
	b)	Accessories	b)			
3.	Manufa	cturer's type and catalogue no. for	3			
	a)	Fixtures	a)			
	b)	Accessories	b)			
4.	Maximu	m permissible supply	4			
	voltage	variation for satisfactory				
	operation of					

	a)	Fixtures	a)
	b)	Accessories	b)
В.	Cond	duits & Accessories	В
	(For	each type & size)	
1.	Manu	ufacturer's name and address	1
2.	Manu	ufacturer's type, designation	2
3.	Appli	cable standard	3
C.	Junc	tion Boxes	C
	(For	each type & size)	
1.	Manu	ufacturer's name and address	1
2.	Manu	ufacturer's type, designation	2
3.	Туре	of enclosure	3
D.	Light	ting Panels	D
	(For	each type & size)	
1.	Manu	ufacturer's name and address	1
2.	Туре		2
3.	Degr	ee of Protection	3
E.	Light	ting Transformer	E
1.	Manu	ufacturer's name and address	1
2.	Туре		2

3.	Rating (KVA)	3
4.	Standard Applicable	4
5.	Degree of protection for enclosure	5
F.	Lighting Poles	F
1.	Manufacturer's name and address	1
2.	Туре	2
3.	Dimensions	3
G.	Lighting Wires	G
1.	Manufacturer's name and address	1
2.	Voltage grade	2
3.	Cross section of conductor	3

SCHEDULE-R-21

SCHEDULE OF TECHNICAL DATA

DG SET (To be filled by the Bidder)

a. Engine make b. Alternator Make c. KVA Rating d. KW rating e. BHP Rating f. Physical Dimensions i. Length (mm) ii. Width (mm) iii. Height (mm) g. Shipping Weight (Kg) h. No. of Cylinder / Stroke i. Efficiency (%) j. Engine Lube Capacity (Ltrs) k. Fuel Consumption at NTP i. 100% loading (Ltrs / hr) ii. 75% loading (Ltrs / hr) iii. 50% loading (Ltrs / hr) 1. Power Factor m. System back Pressure (KPA) n. Exhaust Flange o. Exhaust Gas Flow Rate (CFM) p. Compression Ratio q. Heat Rejection to Exhaust System (KW) r. Heat Rejection to Cooling System (KW)

- s. Total Radiated Heat (KW)
- t. Exhaust Temperature (°C)

INSULATION

a. Manufacturer

b. Acoustic lining material/density

VIBRATION ISOLATION SYSTEM

- a. Manufacturer
- b. Type
- c. Deflection

PANEL

- a. ACB
- b. Controller
- c. Meters
- d. Fuses
- e. Load Manager

SECTION - VIII

TECHNICAL SPECIFICATION FOR

CIVIL WORKS

TECHNICAL SPECIFICATIONS FOR CIVIL WORKS

1.0 INTENT OF SPECIFICATION

The owner desires to have contract for construction of complete civil works at **220 KV SUBSTATION BABINA** (JHANSI) **UNDER Self Automation System**. Following civil works are to be covered in this project.

- 1. Construction of foundations (Main & Auxiliary) and Trenches for 220 KV Bays, 2 x 160 MVA Transformer Bays, 132 KV Bays, 2x40 MVA Transformer Bays and 33 KV Bays
- Construction of Control Room Building (SAS) with D.G. Set Room & required nos. KIOSKS as per approved lay out for which drawing is to be provided by the Bidder (Const. Agency), Store Shed, Sump House, Mulsifire Tank with Pump House.
- **3.** Boundary and security Wall Chain link fencing & Complete Water Supply System as per drawing approved by UPPTCL.
- 4. Misc. Civil Works like Sump and pump house, C.C Roads, Drains, Culvert, Earth Filling & Plantation etc.
- 5. Residences (2No Type-IV,2 Nos. Type-III,4 Nos. Type-II & 4 Nos. Type-I).(if required)

The work shall to be carried out both below and above ground level in involving construction of above mentioned Structures required for proper energisation, commissioning and operation of the sub station complete in all respect as per design and drawings approved by UPPTCL.

The works shall be executed on **Turn key basis**. The item wise cost, bill of quantities and the cost of project has been calculated base on Electricity Civil Transmission Circle, Lucknow Schedule of rates effective from O6/2014.. The quantum of work has been estimated as per available drawings issued time to time by ECDC, Lucknow.The quantities in BOQ are tentative and may vary up to any extent or deleted as per site requirement.

1.1 SCOPE OF THE WORK

The scope of the work to be performed under the part of contract consists of providing labour, material, plants and equipments including all incidental items not shown or specified but reasonably implied or necessary for the proper completion of all civil works in all respects, in accordance with the approved design and drawings approved by UPPCL/UPPTCL for construction of civil works at **220/132/33 KV Sub Station**. This also includes contractor's work supervision in strict accordance with the drawings and specifications or directions by Engineer-in-Charge. The main civil works are as per enclosed list.

1.2 COLONY

- 1.12.1 Residences (If required) (2No Type-IV,2 Nos. Type-III,4 Nos. Type-II & 4 Nos. Type-I).
- 1.12.2 Roads, drains and culverts.
- 1.12.3 Water supply and sewerage system.
- 1.12.4 Drainage system.
- 1.12.5 Tube wells, motor, pumps, starter etc.
- 1.12.6 Overhead tank of capacity 50 KL with 12 m staging.
- 1.12.7 Land development including earth cutting or filling and landscaping, park and plantation.

1.3 LAND DEVELOPMENT & PARK PLANTATION

Park and plantation as per given approved lay out which includes preparation of hedge and shrubs and planting various plants decided by the Engineer-in-Charge along road sides, in park and empty land out side the switch yard including arrangement of plants of specific height, shrubs, manure etc. and preparation of pits as per specification and direction of Engineer-in-Charge.

The Specification for park and plantation shall be UPPWD specification and maintaining the same for minimum six months on hale and healthy condition.

1.4 CONTROL ROOM with D.G. SET ROOM / STORE BUILDING/ALLIED BUILDING (KIOSK)

The construction of control room building (SAS),D.G room, Kiosk and Store shall be RCC framed structure with 1;1.5;3 concrete mix as per drawing to be provided by construction company and get it approved by UPPCL. Lean concrete shall be consisting of 1:6:12 Cement, coarse sand and 40 mm stone ballast. All brick work consisting of 230 mm and above thickness shall be in 1:6 while below 230 mm shall be in 1:4 cement mortar. Fully vitrified tiles/Kota stone/Group-25 industrial tiles of size not less than 496x496 mm shall be use for Control Room Building as per direction of Engineer-in-Charge. Anti termite treatment shall be carried out in Control Room Building, residential buildings, stores and security hut as per relevant I.S. specifications. Aluminum Section Door frames shall be kept in door and windows as per approved drgs and/or as per direction of Engineer-in-Charge. Lining of column and steps of main entrance shall be of 1st class quality granite stone. Construction of cable trenches including trench covers as shown in drawing and as per site requirements, shall be part and parcel of the contract.

In bath rooms and toilets ISI approved CP heavy quality fixtures as per sample approved by Engineer-in-Charge, shall be use and in floor and walls ceramic tiles of approved make shall be provided. All electrical fittings shall be carried concealed with copper wire of gauge approved by Engineer-in-Charge as per UPPWD specification with providing of 6 nos exhaust fans of heavy duty. The internal surface shall be made smooth with POP & painted with acrylic emulsion paint or equivalent paint whereas external surface shall be provided with approved weather proof exterior emulsion paint with prior coat of Birla putty.

Septic tank of suitable size shall be constructed as per UPPCL drawing and drainage system of the entire area shall be development and constructed as per direction of Engineer-in-Charge.

1.5 OUT DOOR SWITCH YARD

- 1. The connection of all structures to their foundation shall be with base plate and embedded foundation bolts.
- 2. Various RCC foundation, transformer plinth, main gantry, auxiliary structure foundation and C.C. Road etc.
- 3. Construction of cable trenches and trench covers.
- 4. Kiosk.
- 5. Construction of mulsifire system and its pump house with all fixtures.

6. Construction of fire wall between transformer plinth, land development and other associated civil works like earth filling & cutting, leveling and dressing.

Other civil works not covered above but necessary for successful completion, proper energization and its operation in all respect etc. shall be executed by contractor.

1.6 MAIN GANTRY FOUNDATION

Construction of main gantry foundation for 220 KV yard shall consists of FTM, GTM, DTM, CTM and ETM type structure, 132 KV yard shall consists of ATMS, ATM and BTM type structures,33 KV yard shall consists of EKR/ CCM type structures and shall be constructed as per drawing **approved** by UPPTCL. Where as the dia of pile is between 300 mm to 400 mm 2 nos. under reams, in 1;1.5;3 cement concrete mix shall be constructed. The template for grouting of bolts shall be arranged by the contractor at his own cost. The bolts shall be grouted in such a way that 75 mm clear height of bolts above the foundation top remains

visible Champhering the edge at 45° on all of the foundation and cable trench with 35 mm width shall be carried out.

1.7 TRANSFORMER PLINTH

Construction of transformer plinth for 40/100/160 MVA Transformer shall be carried out as per approved drawing **approved** by UPPCL. The lean concrete consists of mix 1:6:12 (1 cement : 6 coarse sand and 12-40 mm gauge stone ballast) and 1:6:12 (1 cement : 6 coarse sand and 12-40 mm gauge stone ballast) cement concrete and reinforced cement concrete mixed in 1;1.5;3 (1 cement : 2 coarse sand and 4 - 20 mm gauge stone ballast) and MS rail shall not be less than 90 pounds / yard as shown in the drawing with proper locking arrangement of transformer. The chilling tank will be covered by grating of MS angle 50×50×6 mm at 100 mm center to center and covered with round stone boulders of size 75 mm and above. The alignment and location of rails has to be exactly as per electrical requirements.

1.8 AUXILIARY STRUCTURE FOUNDATIONS

The auxiliary foundations in 220/132/33 KV yard shall consists of CT, CVT, LA, PI Tendom isolator, Line/Bus Isolator, Circuit Breaker and Station transformer shall be constructed as per drawing **approved** by UPPCL. Construction of auxiliary foundation shall be in CC/RCC with 11;1.5;3. The lean concrete 1:6:12 (1 cement : 6 coarse sand and 12-40 mm gauge stone ballast) will be provided. The foundations will also include the grouting of anchor bolts of specified length of 32 mm dia or below. The bolts shall be grouted with the help to templates, which will be arranged by the contractor at his own cost. All the edge of foundations in 36 mm width shall be champhered as per direction of Engineer-in-change.

1.9 CABLE TRENCH

The civil works of cable trench & 40 mm thick covers shall be carried out as per approved drawing **approved** by UPPCL. Racking arrangement mentioned in the drawing shall be strictly adhered. The alignment of trench, edge and racks strictly be in strictly be in straight line. The gradient of cables trench

floor shall be kept as per direction of Engineer-in-Charge keeping in view the site conditions and drainage to the surrounding area. The brick work shall be in 1:4 cement mortar and plaster in 1:4 cement mortar. The grouting of racks in trench walls shall be carried out by leaving pockets of 150×115×75 mm size in trench walls and grouting in CC 1;1.5;3 MS racks, edging and frame of RCC trench covers shall be applied with primer and two coats of approved paint. It also covers to provide numbering on trench covers as per specification and direction of Engineer-in-Charge off size trench covers be cast as per site requirement. Out side edge of trench are to be champhered as per direction of Engineer-in-Charge in 35 mm width.

1.10 MULSIFIRE SYSTEM(If required)

Mulsifire tank shall be constructed as per drawing **approved** by UPPCL. RCC rafts and walls in 1:1.5:3 mix of cement, coarse sand and 20 mm graded stone aggregate. The size and the volume of the tank shall be as per site requirement and direction of Engineer-in-Charge. It also covers the construction of pump house as per drawing and as per instruction of Engineer-in-Charge.

1.11 CAPACITOR BANK

Capacitor bank consisting of various types of foundations like gantry, isolator, series reactor, cable trenches with covers, capacitor bank and fencing the area with cage of 75 x 25 MS mesh of 10 gauge and 40 mm thick flooring of complete cage area.

1.12 PARTITION WALL/FIRE WALL

The Partition Wall shall be constructed as per drawing approved by UPPTCL.

1.13 ROAD, DRAIN AND CULVERTS

Cement concrete road 6.00 meter and 4.0 meter wide shall be constructed. The main road from the existing road to the entrance of control room building shall be 6.0 meter wide. In switch yard all transformer roads shall be 6.0/4.0 meter wide and roads in rest of switch yard and colony area shall be 4.0 meter wide. The construction of roads and culverts shall be carried out as per approved drawing **approved** by UPPCL/UPPTCL. The road sections shall be arranged by the contractor. The construction joint shall be laid down with vertical brick tiles as specified as per direction of Engineer-in-Charge. The scope of supply PVC/Concrete pipes of different dia as per requirement to carry fire-fighting pipes, street lightening cables, telephone wire etc. as per location including or specified or as per direction of Engineer-in-Charge, is also including in this work.

1.14 DRAINAGE

All internal site drainage shall be discharged at specified points near the boundary wall or location as directed by Engineer-in-Charge. Drain shall be in 1:4 cement coarse sand, brick masonry with 12mm thick plaster & 40 mm thick cc floor with gradient as per direction of Engineer-in-Charge.

1.15 STORE SHED

A permanent store shade of $15 \text{ M} \times 6 \text{ M}$ shall be constructed as per drawing **approved** by UPPCL. RCC roof with walls of brick masonry in 1:6 cement, coarse sand mortar and RCC racks at 1 M & 2 M height all around & 40 mm floor. The work also include to construct open yard store in shape of CC platform.

1.16 RESIDENCES

Residential facilities shall be provided to officers / officials manning the sub-station 2No Type-IV,2 Nos. Type-III,4 Nos. Type-II & 4 Nos. Type-I residence for operating officials and staff shall be provided. The plinth area of type-IV, type-III, type-II, and type-I residence shall be 116 sqm,75 sqm, 53 sqm & 35 sqm respectively. The walls shall be in 1st class brick laid in cement and coarse sand mortar in 1:6, 25/40 mm

thick C.C. flooring shall be laid in plain cement concrete in 1;1.5;3 mix over 1:6:12 cement concrete base M.S. Angle iron/sheet door and windows frames shall be provided. Concealed wiring shall be provided in all residence. ISI approved electrical fittings shall be provided. In bathroom Orissa WC pans and 10 liter capacity PVC low level cistern & wash basin shall be provided. In windows Shesham wood shutter and in doors flush door shutter of 35 mm thickness shall be provided. The windows shall be covered with MS grill & mosquito proof jali fixed with wooden beading as per direction of E/I. Construction of residence also includes construction of c/yard, Septic tank, soak pit, drains etc. as per approved drawings. In bathrooms & toilets floors & walls shall be covered with glazed tiles up to 1.5 m height. In type III residences the cupboard shall be covered with wooden frame & doors as per direction of E/I.

The work also includes to provide MS railing of Balcony, staircases and wherever required as per direction of E/I. The roof shall be covered with 75 cms high parapet wall in half brick thick as per specifications.

Before handing over the residence they shall be properly white washed, distempered, painted & water proof cement paint on outer surface shall be applied as per direction of E/I.

1.17 COMMITTEE ROOM (If required)

One Room set of committee room of minimum 100 sqm plinth area is also included in the scope of work and shall be constructed within Control Room Building at the substation as per approved drawing. Committee room shall be constructed with vitrified tile floor of size not less than 400x400 mm with teak wood door frames and door, windows shutters as per instructions of E/I. POP/Birla Putty will be provided on all internal surfaces of the building and in bathroom and toilets ISI marked and approved heavy quality fixtures and flooring with bathroom ceramic tiles of approved make as per sample approved by E/I shall be provided. All electric wiring shall be concealed with copper wire gauge approved by E/I as per UPPWD specification. All electrical fittings shall be of approved quality. The bathroom and kitchen, each shall be provided with exhaust fan of medium quality and approved make. The committee room shall be furnished with bed, mattress, sofa-set, curtains and curtain rods, study table, chair and 1 no. 2.0 MT A.C. of approved make. The internal surface shall be given acrylic emulsion paint or equivalent paint whereas external surface shall be provided with approved external paint weather proof with prior coat of Birla Putty. The vertical down pipe from roof shall be kept embedded in walls. The bathroom shall be connected with suitable size of septic tanks as per drawing and drainage system of entire area shall be developed as per direction of E/I. The almirah and cup board shall be covered with teak wood frame and shutters etc.

1.18 INFRASTRUCTURE FACILITIES

For providing drinking water to residents of township and fire fighting two no. tube well, with yield of 400 liter/min shall be provided. For storage of water and distribution by gravity two over head tank of 5000 liter. Capacity with 5 M staging shall be constructed. Required pipe line for distribution of water shall also be included in scope of contract. For sewerage of township area, septic tanks of suitable capacity shall be provided as approved layout and for as per direction of Engineer-in-Charge.

1.19 BORING OF TUBEWELL

Boring of tube well shall be done by bore well of 450 mm dia. and lowering of M.S pipe of dia 200-150 mm along with 7.5H.P submercible pump of KSB make. Boring of bore hole shall be done in presence of SDO with taking of samples at every 3 m depth. After completion of boring upto specified depth a bore chart shall be prepared and got approved by Engineer-in-Charge before lowering of pipe. All technical specification and make of pump/motor for deliver of water shall be got approved by Engineer-in-Charge before delivery and installation pump/motor at site. Const. of pump room shall be as per approved drawings specification and / or as per direction of Engineer-in-Charge.Water test results shall be submitted by firm.

1.20 SUMP HOUSE

A sump house shall be constructed as per approved layout plan along with construction of drain connecting lowest of cable trench to sump house. All technical specification and make of sludge pump/motor shall be got approved by Engineer-in-Charge before delivery and installation of sludge pump/motor at site.

Constriction of sump house shall be as per approved drawings, specifications and / or as per direction of Engineer-in-Charge.

1.21 MEASUREMENTS

Details measurements of the works executed by the contractor shall be recorded by UPPCL/ UPPTCL as per BOQ. The contractor will executed the work as per UPPTCL/UPPWD specification strictly and as per approved drawing provided by UPPCL/UPPTCL. The measurements shall be recorded as per drawings, execution of work at site and with the standard prevalent method in UPPCL. No work shall be measured if it is not executed as per specification and/or without proper clearances form UPPCL. The contractor will do such activities only at his own cost and responsibility. Any work executed by contractor not as per specification or proper clearance from UPPCL has to be corrected as per specifications and to the sati fiction of Engineer-in-Charge at his own cost.

The contractor will be required to obtain clearance from UPPCL after every stage of execution of work such as excavation, foundation, superstructure construction, laying of roof slab, boring of piles, concreting etc. and for which a register shall be maintain wherein all such clearance as given by the supervision staff of UPPCL/UPPTCL

The payment will be made monthly only and the Firm/contractor is advised to submit the bill accordingly. The Firm/Contractor will submit the bills for the works executed by him in triplicate (in three copies) to UPPCL/UPPTCL and the same shall be checked, verified and passed by UPPCL/UPPTCL on the basis of recorded measurements.

1.22 PAYMENTS

90% running payment shall be released to the contractor on basis of measurements of the work executed, per month on monthly basis. 10% payments shall be retained by the corporation as security which shall be released as per clause No 25 C of Form 'A' ''General Conditions of the Contract." The work is to be completed in all respect to the requirement / satisfaction of UPPCL/UPPTCL and it should be function. The contractor is advised to study the site condition and he should be aware of the quantum of work involved. No extra claim / payments by the contractor other than specified at the time of award of the work shall be entertained in any circumstances.

1.23 LAYOUT AND LEVELS

The layout and levels of all structures etc. shall be made by the contractor according to bench mark levels decided by the UPPCL/UPPTCL. The contractor shall give all help in providing instruments, materials and manpower to the Engineer-in-Charge for checking the detailed layout and levels but the contractor shall be solely responsible for correctness of layout and levels.

1.24 DESIGN AND DRAWINGS

All civil work shall be executed according to the approved drawing of UPPCL/UPPTCL.

1.25 SUBMISSION OF PROGRAMME OF CONSTRUCTION

Contractor shall prepare the programme for all construction activity (Bar Chart) and submit within period not exceeding 2 weeks form date of award of contract.

1.26 MATERIALS

- 1. The brick shall be of 1st class quality with minimum comp. Strength 150 kg/sqcm.
- 2. Pozzolana Portland Cement of approved make conforming to IS: 1489 (Part-1) 1991 shall be used by the contractor in construction of substation. The cement procured by contractor shall be of standard brand like ACC, BIRLA, ULTRA TECH., JP etc.. Test certificate shall be submitted before use.
- 3. Water to be use shall be clean, potable and free of salts, iron and injurious organic matters.

- 4. Coarse sand shall be of minimum finesse modulus of 2.25.
- 5. The cold twisted deformed bars (Fe 415 N/sqmm) confirming to IS : 1786 shall be use as reinforcements.
- 6. All aggregates shall confirm to all provision and test methods of IS : 383 or IS : 515.
- 7. Contractor has be to carry out any test regarding quality of materials at his own cost when ever desired by Engineer-in-Charge.

1.27 VARIATION IN QUANTITY OF WORK

Quantites in B.O.Q may vary to any extent during actual execution of the work. However, tendered unit rates shall remain firm upto any variation of the tendered quantity of the Contract.

1.28 EXTRA ITEMS

The Engineer of Contract shall have power to make any alteration in, omissions from, additions to or substitutions for the original SPECIFICATION, drawings, designs, and instruction, that may appear to him to be necessary during the progress of the work and the contractor shall carry out the work in accordance with any instructions which may be given to him in writing signed by the Engineer-in-Charge, and such alterations, omissions, additions, or substitutions, shall not invalidate the contract and any altered, additional or substituted work which the contractor may be directed to do in the manner above specified as part of the work shall be carried out by the contractor on the same conditions in all respects on which he agreed to do the main work. The rates for such additional, altered or substituted work under this clause shall be worked out in accordance with the following provisions in their respective order :

- (i) If the rates for the additions, altered or substituted work are specified in the contract for the work, the contractor is bound to carry out the additional altered, or substituted work at the same rates as are specified in the contract for the work.
- (ii) If the rates for the additional, altered or substituted work are not specifically provided in the contract for the work, the rates will be determined according to the rates for similar class of work as specified in the contract for the work.
- (iii) If the altered, additional or substituted work includes any work for which no rates are specified in the contract for the work or can not be ascertained from similar item or work in the contract then such work shall be carried out at the rates entered in the Circle Schedule of Rates for District, minus or plus percentage which the total tendered amount bears to the estimated cost of the entire work put to tender.
- (iv) If the rates, for the altered, additional or substituted work can not be determined in the manner specified, additional or substituted work can not be determined in the manner specified in sub clause (i) to (iii) above, then the rates for such work shall be worked out on the basis of the schedule of rates of the District specified above minus or plus the percentage which the total tendered amount bears to the estimated cost of the entire work put to tender provided always that if the rate for such part or parts will be determined by the SUPERINTENDING ENGINEER (Civil) on behalf of the UPPCL on the basis of prevailing market rates when the work was done.
- (v) It the rates for the altered, additional or substituted work can be determined in the manner specified in subclause (i) to (iv) above, then the Contractor shall within 7 days of the date of receipt of order to carry out the work inform the class of work supported by analysis of the rates claimed and the SUPERINTENDING ENGINEER (Civil) shall determined the rate or rates on the basis of the prevailing market rates and pay the contractor accordingly. However, the Engineer of the contract, by notice in writing, will be at liberty to cancel his order to carry to such class of work and arrange to carry it out in such manner as he may consider advisable. But under no circumstances the contractor shall suspend the works on the plea of non settlement of rates of items, failing under this section.

The rates under sub-clause (i), (ii) and (iii) shall be worked out by the E/I subject to the approved of SUPERINTENDING ENGINEER (C) invariably.

No extra item shall be executed / started by the Contractor without written permission and decision of rates failing which the Contractor shall be responsible for any expenditure incurred or risk involved as such. Contractor is strictly prohibited to start extra items without written permission and decision of rates by SUPERINTENDING ENGINEER (C). All extra items shall be submitted to SUPERINTENDING ENGINEER (Civil) through Engineer-in-Charge under registered cover and SUPERINTENDING ENGINEER (Civil) decision in matter shall be final.

Any violation of this clause will mean breach of the contract.

1.29 SAFETY PRECAUTIONS

The contractor shall at all time exercise reasonable and proper precautions for all safety of the labour and equipment at site. The contractor shall be wholly responsible for all risk to the lives and property belonging to the Corporation and other contractor working in the area. Although all the responsible and proper precautions may have been taken by the contractor, he shall be called upon by a court of law to make good any loss or damage to the property ascertained by reasons of any act of negligence or commission on the part of the contractor which the Corporation may be required to pay in respect there of any amount of any cost of charge including legal charges in connection with all legal proceedings which the Corporation may incur in reference to these shall be chargeable from the contractor.

TECHNICAL SPECIFICATION FOR EARTH WORK

Scope :

This shall include all work involved in excavation, dressing of soil, shoring, filling around foundations and trenches, carting of sand or good quality earth if required for filling, disposal of residual earth at a place as directed by the Engineer-in-Charge. Boring and Sub surface data regarding nature of soil, sub-soil water etc. Shown on drawings or otherwise furnished to the contractor shall be taken as a guidance only and variation, therefore, shall not affect the terms of the contract. The Contractor must satisfy him self with character and volume of all work under this item and expected surface sub-surface, and/or Sub-soil water to be encountered. He must also satisfy himself about general conditions of site and ascertain the existing and future obstructions likely to come up during the execution of the Contract.

Excavation

Excavation shall include the removal of all materials required to execute the work properly and shall be made with sufficient clearance to permit the placing, inspection, setting of forms and completion of all works for which the excavation was made.

Earth sides of excavation shall not be use in lieu of form work for placement of concrete unless authorized in special cases by the Engineer-in-Charge, where limitation of space for large excavation necessitate such a decision.

When machines are use for excavation, the last 300 mm before reaching the required level shall be excavated by hand or by such equipment that will leave the soil at the required final level in its natural condition.

Suitability for bearing of the bottoms of excavation shall be determined by the Engineer-in-Charge.

The bottom of excavation shall be trimmed to the required levels and when carried below such level due to contractor's fault, the excess depth shall be filled up to the required level at the contractor's cost with cement concrete 1:6:12 or as directed by the Engineer-in-Charge in each individual case.

Excavated material shall be placed beyond 1.5 meter away from the edge of the pit or half the depth of the pit whichever is more or farher away, as directed by the Engineer-in-Charge.

The contractor shall be responsible for assumptions and conclusions regarding the nature of materials to be excavated and the difficulty of making and maintaining the required excavations and performing the work required as shown on the drawings and in accordance with these specifications, Cofferdams, sheeting, shorting, bracing, drawing, de-watering etc. shall be furnished and installed by the contractor as required / directed by the Engineer-in-Charge and the cost there of shall be included in the unit rate quoted for the items of excavation. The contractor shall be held responsible for any damage to any part of the work and property cause by collapse of sides of excavations. Material may be salvaged if it structures, as approved by the Engineer-in-Charge. However no extra claim shall be entertained if any damage to UPPCL / contractors property as a result of collapse has occurred. He shall not be entitled to any claim for re-doing the excavation as a result of the same.

All excavation for installation of under ground facilities such as piping, sewer lines, tunnels, ducts, drain, lines etc. shall be open cuts. Any timbering if required or as per direction of E/I to retain the earth on cut surfaces shall be done at contractor's cost and no extra claim will be entertained in this regard. Excavation for foundations where specified shall be carried at least 100 mm below of bottom of structural concrete and then be brought to the required level by placing lean concrete 1:6:12 with aggregate of 40 mm maximum nominal size stone ballast.

Where excavations requires timbering, bracing, sheeting or shoring etc. the Contractor shall submit to the Engineer-in-Charge drawings showing arrangement and details of the propose installation, and shall not proceed until he has received approval from the Engineer-in-Charge. Contractor will make arrangements for timbering, bracing, shelling or sharing if required at his own lost.

For purpose of excavation of earth work, the term soil shall apply to all kinds of soil containing any percentage of Kankar, moourm of shingle etc.

Disposal of Surplus Earth

The contractor shall arrange to transport the surplus excavated soil to in/out side the project area as direction of E/I.

Measurement of For Excavation

The unit of measurements shall be cum. Nothing extra would be payable for slope, shoring, strutting etc. irrespective or whatever is provided. The overlapped portion in the case of adjacent foundation shall be paid only once.

Excavation Below Water Table

Wherever water table is met with during the excavation, the contractor shall immediately report the fact of the E/I who shall arrange to record the exact level of the water table. The decision of the Engineer-in-Charge in the matter shall be final.

The contractor shall de-water and maintain the water table below the bottom of the excavated level during excavation, concreting and back-filling. Nothing extra shall be paid to the contractor for excavation below water table.

Backfill

The Contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings and as described herein.

After completion of foundation footings, and walls and other construction below the elevation of each the final grades and prior to back-filling, all forms, temporary shoring, timber etc. shall be removed and the excavation cleaned of all trash, debris and perishable materials, back-filling shall being only with the approved of Engineer-in-Charge.

Back-filling shall be done with inorganic materials obtained from the excavation or borrow pits, if suitable and subject to the approval of the Engineer-in-Charge.

Backfill shall not be dropped directly upon or against any structure or facility where there is danger of displacement of damage to the structure foundation.

Backfill shall be placed in horizontal layers not to exceed 20 cm in thickness. Each layer shall be compacted with proper moisture content and with such equipment as may be required to obtain a density not less than 96% of maximum dry density as determined by the relevant Indian Standards, Trucks of heavy equipment for depositing or compacting backfill shall not be use within 1.5 m of building walls, pipes, or other facilities which may be damaged by their weight or operation. The methods of compaction shall be subject to the approval of the Engineer-in-Charge. Pushing of earth for back-filling shall not be adopted under any circumstances.

Backfill adjacent to pipes shall be hand placed free of stones, concrete etc. compacted uniform on both sides of the pipe and where practicable to a depth of 300 mm over the top of pipes. While compacting around pipes, care shall be taken to avoid unequal pressures.

On completion of structures the earth surrounding them shall be accurately finished to line and grade as shown on the drawings. Finished surface shall be free of irregularities and depressions and shall be within 50 mm on the specified level. No extra shall be paid for backfilling.

TECHNICAL SPECIFICATION FOR MASONRY WORKS

MASONRY WORK (BRICK MASONRY)

Scope

This section covers the furnishing of all labour materials and equipment and the performing of all operation required for the supply of masonry, materials and erection work and incidental items pertinent thereto, all in accordance with the drawings and these specifications.

General Requirements :

Masonry products such as face bricks, common bricks concrete blocks and tile shall be products of producers or suppliers approved by the Engineer-in-Charge.

Delivery, Storage & Handing of materials shall be done as follows :

- (i) All materials shall be delivered to the site, stored & handled so as to prevent intrusion of foreign substances, damage by breakage, exposure to the weather and contact with the soil.
- (ii) Cementation materials shall be delivered in unbroken containers or packages or stored in weather-proof enclosures.

Materials :

PPC conforming to the requirements of IS: 1489 (Part-1) 1991 (latest edition)

Water for mortar shall be clean & potable and free of salts, iron & injurious amounts of organic matter.

Sand shall conform to the requirements of IS : 650.

Common bricks and face bricks shall conform to the requirement of IS : 1077 and shall be of uniform colour, strength and size. Bricks shall not absorb more than 20% of their own dry weight when soaked in water. The bricks shall be 1st class quality of class A. The colour of brick shall be cherry red and no under burnt brick shall be use in the work.

Crushing strength of first class bricks and brick tiles shall not be less than 150 kg/cm²

Reinforcement for masonry walls wherever required shall be of mild steel 6/8 mm dia to bar in the Engineerin-Charge approves it in a particular situation.

Samples of all materials shall be submitted for the approval of the Engineer-in-Charge.

Mortar of specified proportions as shown on the drawings shall be mixed by volume with just enough water and produce a workable mix. Only freshly prepared mortar shall be use. Mortar shall conform the requirements IS : 1925.

Bond of Coursing

All masonry walls shall be laid with horizontal course level & true in English Bond. All masonry units shall be laid up in full beds of mortar with all units butter solidly against adjacent units with mortar in between.

All masonry units having appreciable water absorption potential shall be soaked as per relevant Is code.

Vertical surfaces of all masonry walls and partitions shall be in plumb and true to line on uneven surface with a maximum total variation of 25 mm in any plane of 12.5 mm in 5m.

Where two walls meet or inter sect, the masonry course shall be carried up together bonding at least fifty percent of the units at the intersection.

Horizontal surfaces of masonry not being worked on shall be protected from the natural elements by the use of non-being worked on shall be protected from the natural elements by the use on non-staining water proof coverings properly secured in places.

Brick tiles where shown on drawings shall be laid staggered vertical joints and shall be bonded with bricks walls.

Masonry in contact with structural steel including beams and columns, shall be anchored to the steel works as indicated on the drawings.

Concrete for precast copings, Sills and lintels shall be of grade M 15 with maximum aggregate size of 10-12 mm.

Surfaces of precast concrete to be exposed to view after erection shall have a smooth finish.

Built-In-Works

Built-In-Works shall be carried out as per instruction communicated by the Engineer-in-Charge during or before the work is taken up.
Door fames shall be set in plumb and accurately aligned and checked for proper position.

Anchors for door frames, copings partitions bonding walls to concrete and structural steel and other anchors shall be securely located and installed.

Water proofing membrane, within masonry walls, where required, shall be carefully installed in accordance with ``water-proofing'' and ``Damp-proofing'' specifications mentioned in this volume.

Steel lintels and base plates shall be set over doors or other openings where required. The lintel or plates shall be set in cement mortar grout.

All structural steel members enclose or in contact with masonry work shall be waterproofed with a heavy coating of asphalt mastic of approved quality.

Masonry Joints :

All joints in masonry wall surfaces to receive plaster shall be raked out to a depth of 12 mm to create mechanical bond for the plaster finsh.

Joints in exterior walls to be left expose shall be neatly tooled with a weathered joint.

Where masonry shuts, penetrating built-in-items such as door frames etc. the joints shall be 6 mm wide and raked to a depth of 20 mm for subsequent caulking.

Where opening are left in masonry for fixing doors windows etc. or where masonry is discontinued for extending at a later, date the masonry work should be left at an angle not steeper than 60 degrees.

Cleaning

All exposed brick work shall be scrubbed down and rinsed with clean water thoroughly.

All work stained or discolored during the process of cleaning shall be replaced by the contractor at his own expense.

Green work shall be protected from the effects of sun rain etc. by suitable covering. All the masonry work shall be kept constantly moist on the faces for a period of seven days.

Measurements :

The unit of measurement for this item shall be cubic metre and shall be based on the volume of masonry actually constructed or the volume of masonry as worked out from the dimensions indicated in the drawings and the lower of the two values shall be adopted for payment. No deductions shall be made for drain holes etc.

Mild steel for walls and anchors for columns shall be paid for by weight separately on the basis of the quantity calculated.

TECHNICAL SPECIFICATION FOR DAMP PROOF COURSE

Scope :

This sections covers the furnishing of all labour, materials and equipment and performing of all operations for laying DPC consisting of cement concrete layer including application of bitumen.

Cement Concrete layer

It shall be C.C. of proportion 1:2:4, of 50 mm thickness unless otherwise specified in the item of the bill of quantity / approved drawings, including shuttering, curing etc. complete including application of hot bitumen at the rate 1.7 Kgs/mt on the surface of dried concrete.

The surface of the brick work shall be leveled and prepared before laying the cement concrete. Edges of DPC shall be straight and even. The side shuttering shall consist of wooden forms and shall be strongly and properly fixed so that it does not get disturbed during compaction and mortar disturbed during compaction and mortar does not leak through. The concrete mix shall be of workable consistency and dense. When the side shuttering are removed, the surface should come smooth without any honey combing.

Curing :

The DPC shall be cured for at least 7 days after which it shall be allowed to dry.

Application of Hot Bitumen :

Cement concrete shall be allowed to dry for 24 hours after curing and hot bitumen at the rate of 1.7 kg/sq mere shall be applied over the dried surface of cement concrete properly cleaned with brushes and finally with a cloth soaked in kerosene oil. The bitumen shall be applied uniformly so that no blank spaces are left any where.

Measurement :

Measurement shall be made for its surface area in sq. metre correct to two places of decimal. The length as well as breadth shall be measured correct to the cm.

TECHNICAL SPECIFICATION FOR CEMENT CONCRETE

SCOPE

The specification deals with Cement concrete plain or reinforced for general use. And covers the requirements for concrete materials, their storage, grading, mix design, strength and quality requirements, pouring at all levels, reinforcement protection, curing for work, finishing, painting, admixtures, inserts and other miscellaneous work.

The provisional of the of IS : 456-1978, shall be complied with unless permitted otherwise and any other Indian Standard Code shall from a part of this specification to the extent it has been referred to for application within this specification.

GENERAL REQUIREMENTS

The Contractor shall furnish all labour, material and equipment to from, place and finish all cement concrete items complete as indicated in the approved drawing and as described therein.

All materials, test, mixing, placing, from work reinforcing and workmanship shall conform to code of practice for plain and reinforced concrete for general building construction IS : 456-1978 and other relevant IS Codes.

MATERIALS

Cement :

For construction of sub stations, Cement use shall be PPC conforming to IS : 1489 (Part-1) 1991 . Cement which has set or partially set shall not be use.

Aggregates :

All aggregates shall conform to provisions of IS : 383. Samples of aggregates propose to be use shall be submitted free of charge in three bags, each containing 2 cu.ft. of the aggregates, to the Engineer-in-charge for his future reference.

Coarse Aggregates :

The maximum size of coarse aggregates shall be as follows :

- 1.For Lean concrete of grades M-5, M-7.5 and M-1040 mm size
- 2. For Concrete of grades M-15, M-20 and higher grades 20 mm size

(Plain Cement Concrete and Reinforced Cement Concrete)

The coarse aggregates to be use shall be graded. The grading of coarse aggregates for a particular size shall generally conform to relevant IS codes and shall also be such as to produce a dense concrete of the specified proportions and/or strength and consistency that will work readily into position without segregation.

Fine Aggregates :

Coarse and fine sand shall be wall-graded within the limits by weight as specified in IS 383. Finencess modulus shall not vary by more than plus or minus 0.20 from that of the approved sample. Fineness

modulus for coarse sand should be not be less than 2.25. Washing of aggregates by approved means shall be carried out. If desired by the Engineer-in-charge at no extra cost to the employer. Fine aggregates of zone 1st grading shall not be use for concreting.

Water :

Water shall be clean, fresh and free organic or other deleterious matters in solution or in suspension in such amounts than may impair the strength or durability of the concrete. Potable water is generally satisfactory. IS : 3025 and 3550 may be followed for testing, if required.

Storage of materials : Materials shall be as so stored as to prevent deterioration or intrusion of foreign matter, and to ensure the preservation of their quality and fitness for the work. Any materials, which has deteriorated or has been damaged or as otherwise Engineer considered defective by the Engineer-in-charge, shall not be use and shall be removed from site immediately, failing which the Engineer-in-charge shall be at liberty to get the materials removed and the cost there of shall be realized from the contractor's dues. The contractor shall maintain upto date accounts of receipts, issue and balance (stock wise) of all materials.

Grades of Concrete :

Concrete shall be of grade M-5, M-7.5, M-10, M-15, M-20 or as indicated in the approved drawings/items of the bill of quantity.

Workability of Concrete :

Ranges of values of workability for different placing condition is suggested as below :

Placing Conditions	Degree of Workability	Values of Workability	
(1)	(2)	(3)	
Concerting of shallow section with vibration	Very low	0.75-0.80, compacting factor	
Concerting of lightly reinforced section with vibration	Low	0.80-0.85, compacting factor	
Concerting of lightly reinforced section without vibration or heavily reinforced section with vibration	Medium	0.85-0.92, compacting factor or 25- 75 mm, slump for 20 mm aggregate	
Concerting of heavily reinforced section without vibration	High	0.92, compacting factor or 75-125 mm, slump for 20 mm aggregate	

SAMPLING AND TEST OF STRENGTH OF CONCRETE :

Samples from fresh concrete shall be taken as per I.S. : 1199-1959 and the specimen cubes shall be made and tested as per I.S. : 516-1959. The preliminary test (compressive strength test at 7 days) are carried out in addition to 28 days compressive strength test only to get a quicker idea of the quality of the concrete which may be expected to give the required strength. But in all cases, 28 days compressive strength specified in IS : 456-1978 shall alone be the criterion for acceptance or rejection of the concrete. **At least one sample shall be taken from each shift.** Three test specimen shall be made from each sample for testing at 28 days. Additional cubes may be required to test the concrete at 7 days. The test strength of the sample shall be the average of the strength of the three specimens. The individual variation should not be more than + 15% of the average. The cost of all sampling and testing of concrete shall be borne by the contractor.

DURABILITY OF CONCRETE

Besides ensuring the required strength of the design mix concrete, the concrete must also have and adequate cement content and a low water cement ratio. The minimum cement content and the maximum water cement ratio shall conform to the provisions of clause 7 of I.S.: 456-1978.

WORKMANSHIP

General : Concrete shall not be placed in any unit of the work until after the forms/centering and shuttering, bracing reinforcing steel and other properties for casting are fixed in positions and approval given to proceed with casting.

Mixing Concrete : Mixing concrete shall conform to IS : 456-1978. Mixing shall be continued till materials are distributed and uniform colour of the entire mass obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case, shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer. Mixer which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of the normal quantity of coarse aggregate. When hand mixing is permitted by the Engineer-in-charge for concrete to be use in unimportant structures it shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand mixing, extra cement 10% shall be added to each batch at no extra cost to the employer.

The workability of the concrete shall be checked at frequent intervals by slump test as required by the Engineer-in-charge. Alternatively the compacting factor test in accordance with IS : 1199 shall be carried out.

Transporting, placing compacting & curing :

The method of transporting and placing concrete shall be approved by Engineer-in-charge. Concrete shall be so transported and placed that there is no contamination and segregation or loss of its constituent materials takes place.

All formwork and reinforcement contained in it shall be cleaned and made free from standing water, dust, immediately before placing of concrete.

No concrete shall be placed in any part of the structure unit the approval of the Engineer-in-charge has been obtained.

If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge, concreting then shall proceed continuously over area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete when deposited shall have a temperature of not more than 45° C and less than 38° C. It shall be compacted in its final position within 30 minutes of its discharge from mixers unless stirred on properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of the cement to the mix and within 30 minutes of its discharge from agitator. Except when otherwise agreed to the Engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.30 meter when internal vibrators are use and not exceeding 0.20 meters in all other cases.

Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 2 meters. When chutes are use, they shall be kept clean and use in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted, and covered with a 20 mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 20 mm layer of mortar shall be freshly mixed and placed before placing of new concrete. No extra payment will be done for this layer of mortar.

Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, Care being taken to avoid dislodgment of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm in thickness, and shall be well rammed against old work. Particular attention being given to corners and close spots.

All concrete shall be compacted to produce a dense homogenous mass with assistance of vibrations, unless other wish permitted by the Engineer-in-charge for exception cases, such as concreting under water, where vibrators cannot be us. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.

Internal vibrators shall be capable of producing not less than 10,000 cycles per minute, and external of form vibrators not less –1,000 cycles per minute. Vibration shall not be applied through reinforcement, and where vibrators of the immersion type are use, contact with reinforcement and all inserts shall be avoided, as far as practicable.

Concreting Under Water :

When it is necessary to deposit concrete under water, the methods, equipment materials and proportions of the mix to be use shall be got approved from the Engineer-in-charge before any work is started. Concrete shall not be placed in water having temperature above 45° C. The temperature of the concrete. When deposited, shall be not less than 16° C, not more than 38° C.

Concrete under water shall contain 10% more cement than that required for the same mix placed in the dry conditions. The material shall be so proportioned as to produce a concrete having a slump of not less than 100 mm and not more than 150 mm. The slump shall be tested as per IS : 516 Coffer dams or forms shall be sufficiently to ensure still water conditions if practicable and to reduce the flow of the water to less 3m/ minute through the space into which concrete is to be deposited, coffer dams or forms in still water shall be sufficiently tight to prevent loss of mortar through the joints in the wall, pumping shall not be done while concrete is being placed, or until 24 hours thereafter. Concrete shall be deposited continuously until it has been brought to the required height. While depositing the top surface shall always be kept as nearly leveled as possible and formation of seams avoided. Depositing of concrete may be done by ``**Tremei Pipe**'' or ``**Drop Bottom Bucket**''.

Curing of Concrete :

Immediately after completion concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibrations, traffic, rapid temperature changes, frost and drying out process. It shall be covered with wet sacking, hessian or other similar absorbent material approved by the Engineer-incharge soon after initial set, and shall be kept continuously wet for a period not less than 14 days from the date of placement.

Finishing :

Immediately after removal of forms, all exposed bars or bolts passing through the reinforced cement concrete member and use for shuttering or any other purpose shall be cut inside the reinforced cement concrete members to a depth of at least 25 mm below the surface of concrete and the resulting holes to be closed by cement mortar. All fills cause forms joints, all cavities produced by the removal of form tiles and all other holes and depressions, honey comb spots, broken edges or corners and other defects shall be thoroughly cleaned saturated with water are carefully pointed and rendered to true with mortar of cement and fine aggregates mixed in the proportions use in the grade of concrete that is being finished and to as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of 24 hours.

If rock pockets/honey combs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect strength of the structure materially or endanger the life of the steel reinforcement, he may declare the concrete defective and required the removal and replacement of the portions of the structure affected at contractr's own cost.

Construction Joints

When the work it to be interrupted, the concrete shall be related at the joint to such shape and size as may be required by the Engineer-in-charge or as shown on the drawing. All vertical construction joints shall be made with stop boards, which are rigidly fixed and slotted to allow for the passage of the reinforcing steel. If desired by the Engineer-in-charge, keys and dowel bars shall be provided at the construction joints. In the case of water retaining structures and base and under ground passages etc., water stop of approved material shall be provided if so specified on the approved drawing as desired the Engineer-in-charge. Construction joints shall be provided in position as shown on the drawings. Where it is not shown in the drawings, the joints shall be in accordance with the following. In a column, the joint shall be formed about 75 mm below the lowest soffit of the beams framing into it. Concrete in a beams shall be placed throughout without a joint but if the provision of a joints is unavoidable the joints shall be vertical and at the middle of the span. A joint in a suspended floor slab be vertical at the middle of the span and at right angle to the principal reinforcement.

In forming a joint concrete shall not be allowed to slop way to thin edge. The locations of construction joints shall be planned by the contractor well in advance of pouring and have to be approved by the Engineer-incharge.

Construction joints in foundations of equipment shall not be provided without specific concurrence of the Engineer-in-charge.

Before fresh concrete is placed, the cement skin of the partially hardened concrete shall be thoroughly removed and surface made rough by backing water jetting, air jetting or any other method as directed by the Engineer-in-charge. The rough surface shall be thoroughly wetted for about two hours and shall be dried and coated with freshly mixed cement sand slurry immediately before the slurry sets. Special cares shall be taken to see that the first layer of concrete placed after a construction joints is thoroughly rammed against the existing layer.

At the construction joints a key along with extra reinforcement shall be provided. In addition to this 12 mm M.S. pipe at regular intervals will be inserted in the concrete at the construction joint. A part of the pipe will have threads and will be covered by a M.S. plug. The complete arrangement of the pipe will be as shown in the drawings. After pouring of concrete, the plug of the M.S. pipe will be removed and pressure grouting with cement and with suitable admixture of proper consistency will be done to fill the gap in concrete at construction joint. This grouting shall be got executed by specialist in this field. The injection grouting will be required only for water retaining structure. For all other construction joints in under ground facilities like cable trenches etc. 30 mm wide PVC water stops may be provided.

The unit rate of concrete work shall in clued the cost of preparation of construction joints as mentioned above (including pressure grouting at construction joints) and no extra payment shall be admissible on this account.

Measurement of Concrete

Measurement of concrete shall be in cubic metres correct upto second place or decimal Deductions shall be made for all block cuts and openings but not embedment and reinforcement.

REINFORCEMENT

Reinforcing steel shall be clean and free from loose mill scales, dust loose rust and coats of paints, oil, grease or other coatings, which may impair or reduce bond. It shall conform to the following IS specifications.

- i) Mild steel & Medium Tensile Steel Bars and Hard drawn steel wire conforming to IS-280-1978.
- ii) Cold Twisted Bars conforming to IS : 1786-1979
- iii) Structural steel sections conforming to IS-226-1975. All steel reinforcement including and above 6 mm diameter shall necessarily be of tested quality.

The work of providing reinforcement include cutting of reinforcement bars their bending and placing them in position as per approved drawing including welding not less than No. 16 SWG. (1.65 mm dia). Bar support, chairs and bolsters (as approved by Engineer-in-charge) shall be sufficiently strong to support the steel properly.

- iv) Reinforcement shall be bent and fixed in accordance with procedure specified in IS : 2502 and shall not be straightened in a manner that will injure the material. Bar bending schedule as shown in the approved drawing shall be followed for construction purpose.
- v) Procedure as specified in IS-456-1978 shall be followed in general unless and otherwise permitted by Engineer-in-charge.
- vi) As far as possible, bars of full lengths shall be use. In case it is not possible, overlapping of bars shall be done as directed by the Engineer-in-charge. When practicable, overlapping bars shall not touch each other and be kept apart by 25 mm of the dia of the bigger bar or 1.25 times the maximum size of the coarse aggregate whichever is greater for easy concreting between them. The overlaps shall be staggered for different bars and located at points along the span where neither shear not bending moments in maximum.
- vii) Welding of mild steel reinforcing bars conforming to I.S : 432 shall be permitted Welding of Cold Twisted Deformed Bars conforming to I.S. : 1786 shall in general be prohibited except in special cases mentioned in I.R.C. 21-1987. Test shall be made, if directed by the Engineer-in-change, to ensure that the joints are of full strength.
- viii) Measurement : Steel work in reinforcement shall be measured in running meters and converted to weight in accordance with the standard sectional unit weight for different diameter bars provided in IS : 1786-1979 or IS : 432 (Part I 1966) as the case may be Other provisions shall be as per IS : 1200 (Part 8 1971) No allowance shall be made for wastage and no payment shall be made for binding wire, chairs and spacers as the cost of these in included in the unit rate for the item of reinforcement.

Form Work :

General: Form work shall be as per IS : 456-1978. The form-work shall confirm to the shape lines and dimensions as shown on the drawings. It shall be composed of steel and/or best quality shuttering wood on non-absorbent timber and shall be free from knots Hard woods shall be use as caps and wedges under or over posts.

Plywood or equivalent shall be use where specified to obtain smooth surfaces for exposed concrete work. Struts shall generally be ot mild tubes, and or strong sal ballies 150 mm in dia, or above. Bamboos, small diameter ballies etc. shall not be use unless approved by the Engineer-in-charge in specified cases.

Where metal forms are use, all bolts and rivets shall be counter-sunk and well grounded to

provide smooth and plain finish. The forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging. The forms shall be strong enough to withstand all pressures, ramming and vibration without deflection from the prescribed lines. Screw-jacks or hard wood wedges shall be provided where required to make up any settlement in the form work before or during the placing of concrete.

Suitable cambers shall be provided in horizontal members of structures especially in long spans to counteract the effect of any deflection. Unless otherwise specified, fillets of size 25 mm x 25 mm shall be provided in all edges of form work to avoid sharp corners.

Release agents wherever required, shall be applied on the inside surface of the form work except in case of permanent form work strictly in accordance with the manufactures instructions.

Procedure laid down in IS : 456-1778 latest edition) shall be followed for removal of forms.

Tolerance : It shall conform to IS : 456-1978.

Mode of measurement :

The rate of R.C.C./C.C. includes the cost of form work and no additional payment shall be made for any form work.

ANCHOR BOLTS, ANCHORS, OPENINGS, SLEEVES, AND OTHER PARTS BUILT IN FIXTURES

The contractor shall provide openings, grooves, chas, etc. in concrete work as required for section of equipment and structures. He shall embed into concrete work the materials notes below as shown on the approved drawings or as required by the Engineer-in-charge.

The contractor shall erect all embedded parts in accordance with the drawings and specifications including setting materials in concrete on grouting pieces in place, furnishing all labour, scaffolding tools, services necessary incidental to its transporting, unloading, storing, handling and erection.

Materials to be embedded :

- a) In sets, hangers, anchors, opening frames manhole cover frames, floors chips, & conduits etc.
- b) Anchor bolts & plates for machinery, equipment & for structural steel work.
- c) Lugs or plug for door and window frames occurring in concrete work.
- d) Flushing and jointing in concrete work.
- e) Any other build-in-fixtures as may be required.

Cost of cement concrete of 1:2:4 mix for embedment/grouting shall be included in the items of above fixtures unless otherwise specified in the respective items.

TECHNICAL SPECIFICATION FOR SAND FILLING

The contractor shall furnish all labour, equipment and materials required for complete performance of work in accordance with the drawings and as described herein. Sand filling will be done below flooring in residences, control room building, store sheds, compressor house etc. before laying the floor.

General requirements :

Sand shall be clean and free from dust organic and foreign matters subject to approval of Engineer-incharge. The spaces for filling shall be cleaned of all debris bricks bats etc. The filling shall be done in not exceeding 20 cm each layer. Consolidation of each layer shall be done by flooding with water. Surface of the consolidated sand shall be dressed to required level or slope. Concreting of floor and sand filling shall not be started till the Engineer-in-charge has inspected and approved of the sand filling.

Measurements :

volume of only consolidated filling shall be measured. The dimensions shall be measured correct to the

nearest and cubical contents worked out in cubic metre correct to two places of decimal.

TECHNICAL SPECIFICATIONS FOR STEEL DOORS AND WINDOWS, VENTILATORS AND ROLLING SHUTTERS

STEEL DOORS :

Scope :

This section covers the furnishing of all materials, labour and equipment and performing all operations to complete all work involving the installation of all angle steel door/window accordance with the drawings and specifications or as directed by E/I.

Materials :

Single sheet metal door shall be in accordance with requirement of I.S. specifications no. 1038 sheet steel for hollow metal frames and for door plates shall be of flat rolled, stretcher leveled, annealed and picked steel free form visible waves or other surface defects.

Sheet steel for concealed members, reinforcement for fittings and similar items shall be 5 mm thick for all other items, adequately sized to receive each item.

Glazing :

Glazing shall be of `A' quality glass conforming to IS : 1761 (latest edition)

The glass panes on all windows and ventilators shall be fixed with bred and putty of approved quality.

TECHNICAL SPECIFICATION FOR DOOR, WINDOW FRAME AND DOOR WINDOW SHUTTERS :

General :

The work shall be carried out as per detailed drawings or as directed by E/I. Angle iron shall be use in doors, windows. Shutters and frames as per relevant PWD specifications.

Cutting and Panneling

All pieces shall be accurately cut and planed smooth to be full dimensions and rebates, rounding and molding as shown in the drawing without any pitching or plugging of any kind. The thickness of style and frames shall be specified for the shutters. Styles, rails and sockets panels in door and window shutters shall be of the same specifications of timer unless otherwise specified.

PANNELING AND GLUING OF JOINTS :

All panels upto a width of 30 cms shall made out of one piece. When made from more than one piece the pieces shall be jointed, glued together and reinforced with metal dowels. The glue shall be from skin or bone material and shall be of such nature that it may be use without harm.

Glazing :

Unless otherwise specified the glass use for panels shall of good and durable quality weighing not less than 7.2 Kg/SqM.

SPECIMEN DOORS AND WONDOWS

The contractor shall submit a complete specimen of door, window and cupboard door for the E/I approval before commencing the work.

TECHNICAL SPECIFICATION FOR ALUMINUM DOORS & WINDOWS

This consists of providing and fixing anodized aluminum extrusions of Hindalco or equivalent make approved by the Engineer-in-charge for fully glazed doors and windows with frames including the glazing with 5.5 mm thick float glass. For doors, the top rail and the lock rail extrusion shall be 83.5 mm x 44.5 mm and bottom rail extrusion shall be 114.5 mm x 44.5 mm and the styles (i.e. vertical members) shall be 85 mm x 44.5 mm or as per drawing. For windows, the extrusion shall be 48.5 mm x 44.5 mm for all horizontal and vertical members or as per drawing. The extrusion for aluminum frames for doors and windows shall be 63.5 mm x 38 mm and the extrusion for aluminum frame for fully fixed glazing shall also be 63.5 mm x 38 mm. The works include the glazing with 5.5 mm thick float glass as stated above with neoprene beading/ Urubber and aluminum beading. The thickness of anodizing powder coating on all Aluminum sections shall be min. 20 microns with a ± 2 microns tolerance. The aluminum frame shall be fixed to masonry wall/RCC columns by means of 80 mm long approved counter-sunk screws provided at 500 mm c/c or part thereof starting from 100 mm above the bottom in vertical member & 100 mm from both the ends of horizontal top & bottom member. The aluminum windows shall be fixed with heavy quality aluminum hinges & all other fittings like concealed tower bolts, handles door seal etc. Open able gate/door portion will include pivots of heavy guality &all other fittings like concealed tower bolts, push plates door seals, approved make by cutting floor/RCC slab. grouting and making good the floor/slab and and/or single action floor springs shall also be provided by cutting floor and/or RCC slab and grouting the same

Measurement for Payment :

The measurement for the work of providing and fixing of aluminum extrusion of glazed doors, windows and fully fixed glazed portion shall be made as per area of opening covered by them including the frame in sq. m. unit. The contract rate per square metre for doors, windows and fully fixed glazed portion shall include the cost of all fixtures and fittings also of the respective items as described above.

TECHNICAL SPECIFICATIONS FOR PLASTERING AND POINTING

Scope :

The section covers the furnishing of all materials and equipment and performing of all operation necessary to complete all interior and exterior plaster work.

Materials :

Cement shall be PPC or as specified conforming to the requirement of IS : 1489 (latest edition)

Sand shall be clean, fine, sharp siliceous particles free from loam clay, salts and organic matter and shall conform to the requirement of IS : 15 : 1542

Water shall be clear potable and free from salt, acid and injurious amounts of organic matter.

Mortar : Specified mortar shall be use.

Preparation of Surface : Dust and mortar power shall be brushed out of the joints. The surface shall be thoroughly washed with water cleaned kept wet. Before plastering is commenced.

Plastering :

Plastering shall be started from the top and proceed towards the ground. The mortar shall be applied in uniform layers through the surface and spread over by wooden trimmers finishing complete.

All corners, angles and junction, vertical or horizontal as the case may be shall be neatly finished Rounding off corners and junctions where required shall be done without any extra payment to the contractor.

No portion of surface shall be left out initially to be patched later on.

Any crack which may appear on the surface and all portions which sound hollow where as tapped or are found to be soft or otherwise yielding/defective, shall be cut out and redone as directed by the Engineer.

Curing : Curing shall be started as soon as the plant has hardened sufficiently not to be injured. The plaster shall be kept wet for a period of at least 7 days. During this period it shall be adequately protected from the sun, rain and other damages.

Pointing :

Scope :

Pointing, shall be of the type specified such as `flush' `ruled' or `cut' and `weather-struck' etc.

The following general specifications shall apply to the types of pointing. All joints shall be raked to such depth that the minimum depth of the new mortar measure from either the sunk surface of the finished pointing or from the edge of the brick shall not be less than 12 mm mortar and specified mix only shall be use.

The mortar shall be pressed into the raked out joint with a pointing trowel either flush, sunk or raised according to the type of pointing required. The mortar shall not be spread over the corner, edges, surfaces of the masonry. The pointing shall then be finished with the proper tool as required for the particular kind of pointing specified. The superfluous mortar shall than be cut off from the edges of the lines and the surface of the masonry shall also be cleaned of all mortar. The finish shall be such that the pointing is to the exact size and shape stipulated and the edges are straight, neat and clean.

Curing :

The pointing shall be kept wet for 7 days. During the period, it shall be suitably protected from all damages. The pointing lines shall be truly horizontal and vertical except where the joints are slanting as in Random Rubbles Masonry. Lines of joints from different directions shall meet neatly at the junctions instead of crossing beyond.

The rate shall include the cost of all materials & labour involved in all the operations required for pointing.

Measurement :

The measurements shall be in sq. m of the finished work. This shall be measured correct to second place of decimal. Deduction for openings etc. shall be made as under :

- a) No deduction will be made for opening at the end of the joints, beams, posts, girders steps etc. upto 0-5 sq. m each in area.
- b) For openings exceeding 0.5 sq. m. and upto 3 sq.m. each when only one face of the wall is plastered and the other face is not plastered neither deduction shall be made from the opening nor shall any addition be made for reveals, soffits and sills etc.
- c) For openings exceeding 0.5 sq. m and upto 3 sq. m. each when both faces of the walls are plastered deductions shall be made as detailed below but no addition shall be made or reveals, sophist, jambs, sills etc. for the openings.
 - i) When both the faces of the walls are plastered with same thickness of plaster deduction shall be made for one side plaster only.
 - ii) When the two faces of the walls are plastered with different proportions of plaster or if one is pointed and the other face plastered deductions shall be from the plaster or pointing on the side of the frames of doors. windows etc. on which the width of reveals is less and no deduction shall be made for other side.
- d) For opening with areas exceeding 3 sq.m. deduction shall be made for the full openings on both the faces of the walls, while as the same the jambs, sills and soffits shall be measured for payment in measuring the jambs soffits & sills, deductions shall be made for the area in contact with the frames of doors/windows.

Measurement :

The measurement for payment of bitumen impregnated fiber board use as a joint filler shall be based on the actual surface area in sq. m. covered by the board correct to the second place of decimal. The unit rate shall be inclusive of the cost of the materials, labour, equipment, etc. Complete and installation. The cost of glue required to attach the fiber board to the joint included in the unit rate noted.

TECHNICAL SPECIFICATION FOR WATER PROOFING CEMENT ADDITIVE

Scope :

This specification covers the technical requirement for furnishing, placing and mixing water proofing cement additive of make Reliance Recon 3s or equivalent in all kinds of cement concrete plain or reinforced and cement mortar for all kinds of structures at all levels including encasement of steel sections, as shown in drawing or otherwise specified.

General requirement :

The contractor shall furnish all labour and equipment to place and mix water proofing cement additive in concrete of any grade and cement mortar, there after carryout the work as specified for concrete and then complete the work as indicated on the drawing and described herein.

Material :

The material shall be water proofing cement additive like Reliance Recorn 3 S or equivalent which conform to IS : 2645 (latest edition) and ISI certification marks subject to approved by the Engineer-in-Charge.

Water proofing additive shall be as far as possible free from aggressive chemicals like chloride, sulphate etc. which can cause corrosion of steel reinforcement in RCC and pre stress concrete work.

Mixing :

Water proofing additive shall be use @ 125 Gm/bag or specified by the manufacturer (which ever is maximum) and shall be mixed with water as required by the engineer-in-charge.

TECHNICAL SPECIFICATION OF WATER PROOFING FOR ROOF

Scope :

Four course roof treatment shall be carried out as per UPPCL specifications.

TECHNICAL SPECIFICATION FOR WHITE WASHING, DISTEMPER AND SPECIAL FINISHES

White Washing :

Scope :

This section covers the furnishing of all labour, materials and equipment and the performance of al operations required for the completion of the work of white washing on roof ceiling and other situations as directed by the Engineer-in-charge.

Preparation of Surfaces :

The surface shall be thoroughly cleaned of mortar drops and foreign matter.

Materials :

The wash shall be prepared from fresh white lime-stone of approved quality. The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. The cream shall be screened through a clean coarse cloth and 300 gms. of gum dissolved in hot water added to each 10 cu. dm. of the cream. Water shall be added at the rate of 5 litres/kg. of lime to produce a milky solution.

Application.

The wash shall be applied with a brush, the coats being laid vertically and horizontally alternately, each coat being allowed to dry before the next coat is applied. The wash should show no sign of cracking.

No portions of the surface shall be left out initially to be patched up later on.

Three or more coats shall be applied till the surface present a smooth and a uniform finish. The last coat being applied vertically.

Doors, windows, floors and other articles of furniture etc. shall be protected from being splashed upon. Splashing and droppings, if any, shall be removed and the surface be cleaned.

Measurement : The method of measurements for white washing shall be the same as indicated under the item of plastering work.

ACRYLIC DISTEMPER

All the interiors of the building shall be painted with acrylic distemper as per PWD specification including preparing smooth finished base with POP.

WATER PROOF CEMENT PAINT/WEATHER SHIELD EXTRIOR PAINT

Scope :

This section covers the furnishing of all materials, labour and equipment and performing of all operations for the preparation and finishing of external faces of the walls with water proofing cement paint. or weather shield exterior paint of approved quality.

Materials :

Water proofing cement or weather shield exterior paint of approved quality of approved quality and shade and conforming to relevant IS code only shall be use.

Preparation of Surface :

The surface shall be thoroughly cleaned of all water droppings, dust, foreign material, grease etc. by brushing and washing. All patches and cracks in the surface shall be repaired to make the surface smooth with or without a coat of birla party.

To avoid cracking and flaking, working in the sunshine shall be avoided. In dry weather, the surface after application shall be lightly sprayed with water to keep it wet.

Measurement :

The measurement for this item shall be in square metres and shall be in accordance with the item under plastering.

Painting synthetic enamel paint :

Scope :

This section includes the cost of all labour, materials, equipments consisting of all operations as detailed below etc. complete including the cost of primers and paints

The surface to be painted shall be thoroughly brushed to remove accumulated dust and all loose powdered material. If on exterior surfaces, there is an extensive growth of vegetable matters and this cannot be removed by brushing, the growth shall be killed by applying a 2 ½ percent solution of magnesium silica fluoride. When the growth is dead and dry, the remains of the growth shall be brushed off. Any loose or hollow areas or any major cracks shall be cut out and made good, and the repairs allowed to dry thoroughly before painting. Minor repairs can be made with mastic cement to avoid the delay cause by the use of cement. A coat of ready mixed alkali resistant primer conforming to IS : 109 shall then be applied over the prepared surface. The next day, a second but a slightly heavier coat of primer shall be applied thereafter the under coat and finishing coat with synthetic enamel paint conforming to IS : 133 should be given to get an even and smooth finish.

In all other respects, the specifications, mentioned under the specifications for painting and finishing shall be applicable.

Measurement :

b)

d)

The measurement for the work done on the exposed surface of misc. and structural steel shall be on total surface without any deduction for the portion embedded in concrete or masonry in sqm.

Measurement for payment for doors windows for both sides shall be as follows :

- a) Unglazed doors & windows including rolling shutters- Area of opening X 2 for both sides for both sides.
 - Half or partly glazed doors & windows area of opening X 1.25
- c) Full glazed windows- Area of opening X 1.0

From grills/Gates/Hailing – Area of opening X 0.5

Technical specification for pipes and pipefittings water supply pipes and fittings

G.I Pipes and Sockets

Scope : This section covers the finishing of all materials, labour and equipments and performing of all operations necessary to complete the piping work inaccuracies with drawings and specifications.

Materials : The pipes shall be galvanized mild steel welded pipes and seamless, screwed and socketed tubes conforming to the requirements of IS : 1239-1984 for medium grade. They shall be of diameter (nominal bore) specified in the description of the item. The sockets shall be designated by the respective nominal bores of the pipes for which they exits.

The pipe shall be smooth and of uniform thickness; all galvanized in and out and free from cracks, surface flaws, laminations and other defects, all screw threads shall be clean and well cut. The ends shall be cut clearly, and square with the axis of the tube.

The details of pipes and sockets regarding nominal bore, thickness and weight in kg/m are given in the table below.

Tabel

(Particulars of Medium Grade G.I. Pipes/Sockets)

Nominal Bore	Dim ol	ensions of pipes utside diameter	Thickness	Dimensions of Ordinary socket		Weight of pipe
Mm	Max.	25.262 Min	Mm	Approximate Out side dia	Minimum Length	Kg/met
15	21.8	21.5	2.65	26.90	34	1.21
20	27.3	26.5	2.65	33.70	36	1.57
25	34.2	33.5	3.25	42.60	43	2.42
32	42.9	42.0	3.25	51.00	48	3.1
40	48.8	47.9	3.25	57.00	48	3.59
50	60.8	59.7	3.25	70.00	56	5.07
65	76.6	75.3	3.65	88.90	65	6.49
80	89.5	8.0	4.05	101.60	71	8.43

Pipe Fittings :

The fittings shall be malleable cast iron or mild steel tubes complying with all the appropriate requirements given in para 2.1.2 or as specified. The fittings shall be designated by the respective nominal bores of the pipe for which they are intended.

The fittings shall have screw threads at the ends conforming to the requirements of IS : 554-1995. Female threads on fittings shall be parallel and male threads (except on running supplies and collars of unions) shall be tapered.

Cutting, laying and jointing

The pipes and fittings shall be inspected at site before to ascertain that they conform to the ISI specification. The defective pipes shall be rejected. Where the pipes have to be cut or re-threaded, the ends shall be carefully filed out so that no obstruction to bore is offered. The ends of the pipes shall then be threaded confirming to the requirements of IS : 554-1995 with pipe dies and taps carefully in such a manner that will not result in slackness of joints when the two pieces are screwed together.

The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the sockets and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn warped round the screwed end of the pipe. The end shall then be screwed in the socket. Tee etc. with a pipe wrench.

Any threads exposed after jointing shall be painted or in case of underground piping thickly coated with approved anti-corrosive paint to prevent corrosion.

Internal work

For internal work the galvanized iron pipes and fittings shall be done by means of standard pattern holder bat clamps, keeping the pipes about 1.5 cm clear of the wall when it is found necessary to conceal the pious casing may be adopted or pipes fixed in the ducts or necessary etc. provided there is sufficient space to work on the pipes with the usual tools. The pipes shall not ordinarily be buried in walls or solid floors. Where unavoidable, pipes may be buried for short distances provided adequate protection is given against damages and where so required joints are not buried. Under the floors, the pipes shall be laid in the layer of sand filling done under concrete floors.

All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standard pattern holder bat clamps of required shapes and sizes so as to fit tightly on the pipes when tightened with screw bolts.

For G.I. pipes 15 mm to 25 mm dia the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However, for larger pipes the holes shall be carefully made of the smallest size as directed by Engineer-in-charge. After fixing the pipes the holes shall be made good with cement mortar 1.3 (1 cement and 3 coarse sand) and properly finishing to match the adjacent surface.

Testing of Joints

After laying and jointing the pipes and fittings shall be inspected under working conditions of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced at the contractors cost. The pipes and fittings after they are laid shall be tested to hydraulic pressure of 6 kg/cm2 (60 metre). The pipes and fittings shall be test in sections as the work of laying proceeds, keeping the joints exposed for inspection.

Method of measurement :

The pipes shall be measured along its central line in running metre correct to a cm. for the finished work which shall include G.I. pipe and G.I. fittings such as bends, tees, elbows, reducers, crossed plugs, sockets, nipples and nuts, but exclude brass or gun metal taps (cocks), valves, lead connection pipes and shower rose. The pipe shall be described as including all cuttings and waste. In case of fittings of unequal bore, the largest bore shall be measured.

The rate for internal work shall include the cost of labour and material involved in all the operations described above. the rate also includes the cost of cutting holes in walls and floors and making good the same .it includes painting of pipes and providing sleeves wherever necessary .

Brass Water Fittings :

Scope : This section covers the furnishing of all materials, labour and equipment and performing all operations necessary to complete the installation work in accordance with drawings and specifications.

Material :

The brass fitting shall be of approved quality. Manufacture and pattern with screwed or flanged ends as specified. The fittings shall in all respects confirm to the requirement IS : 781-1959 All supplies shall be made according to the approved samples.

All cast fittings shall be sound and free from laps below holes and fittings both internal and external shall be clean, smooth and free from sand etc. Burning plugs, stopping or patching of the casting shall not be permissible. The bodies bonnets, spindles and other parts shall be axial, parallel and cylindrical with surface smoothly finished. The area of the water way of the fittings shall not be less \than the area of the nominal bore.

Brass Bib Cock and Stop Cock :

They shall be of specified size and shall be of screw down type. The minimum finished weights of the bib tap (cock) and stop tap (cock) shall be as follows :

25.262.1 Size	Minimum Finished Weight	
	25.263 Bib Tap	Stop Tab
mm	Kg.	Kg.
8	0.25	0.25
10	0.30	0.35
15	0.40	0.40
20	0.75	0.75

When the bib cock or stop cock are required to be chromium plated, the same shall be grade B type conforming to IS : 1069-1958 (latest edition). The chromium shall never be deposited on brass unless a heavy casting of nickel is interpose in case these are required to be nickel plated, the plating shall be of the first quality with a good thick deposit of silvery whiteness capable of taking high polish which will not easlity tarnish or scale :

Brass Full Way Valve :

Full way valve is a valve with suitable means of connection for insertion in a pipe line for controlling or stoping the flow. The value shall be of brass fitted with a cast iron wheel and shall be of valve type opening full way and of the size as specified.

The value shall be of the quality as approved by the Engineer-in-charge and shall have the following approximate weights with a tolerance of 5 percent.

Size	Weight	
	Flanged ends	Screwed ends
mm	Kg.	Kg.
15	1.02	0.567
20	1.503	0.680
25	2.495	1.077
32	3.232	1.539
40	4.082	2.268
50	6.691	3.232
65	10.149	6.804
80	13.381	8.845

Lead Connection pipe :

The lead connection pipes shall be of 15 mm nominal bore and 450 mm in length with wiped soldered joints including brass unions each of 65 mm length at the ends. It shall have an approximate weight of 1.85 kg/m with tolerance of 5%.

Method of Measurement

The water cocks valves and similar type of fittings shall be counted in numbers for each item separately.

The rate shall include the cost of materials and labour involved in all the operation describe above and shall paid for under the respective items.

Technical specification for sanitary fittings :

Scope :

Tis section covers the furnishing of all materials, labour and equipment and performing of all operations, necessary to complete the sanitary fittings in accordance with drawings and specifications.

General requirements :

All the materials and fittings use shall be of the best approved quality.

Any damage cause to the building or to electric, sanitary, water supply or other installations etc., either due to negligence on the part of the contractor or due to actual requirement of the work, shall be made good and the building or the installation shall be restored to its original condition by the contractor. Nothing extra shall be paid for this, except as otherwise specified.

All masonry work shall be made good at contractor's cost using the same class of work as use in the original construction work and to the satisfaction of the Engineer-in-charge. Cement concrete shall be made good at the contractor's cost with a mix of same proportion as previously use. On completion of the work the site shall be cleaned and all rubbish disposed off as directed by the Engineer-in-charge.

Materials and Installations :

All sanitary appliances shall be of the size and design as specified in relevant IS. Codes or as directed by the Engineer-in-charge.

Orison type W.C. pan shall be either of vitreous china or white glazed fine clay or white glazed earthenware complete with foot rests low level flushing cistern of 10 liter capacity hind ware make fixed with necessary brackets and fittings for symphonic arrangement with PVC ball valve and float including PVC long bend/flush pipe and coupling etc. complete in all cases a pan shall be provided with 100 mm S.C.I. trap P or S' type with approximately 50 mm water seal and 50 mm dia vent horn where required by the Engineer-in-charge. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet to enable quick disposal. The European type W.C. pan shall be of white glazed fine clay and type I with S or P trap complete with cover seal, low level flushing cistern complete as described above if required.

Wash basin :

Wash basin shall be of white glazed earthen ware, white vitreous china or white glazed fine clay as specified. It shall be of one piece construction and shall be complete in all respects including waste, pipes, fittings taps, rubber plug with C.P. brass chain etc.

Towell rail shall be C.P. brass with two C.P. brass brackets. The size of the rail shall be 75 cm x 20 mm dia 1`.25 mm thick or as specified chromium plating shall be of grade B type confirming to IS 1968 (latest edition) The brackets shall be fixed by means of C.P. brass screws to wooden plugs firmly embedded in the wal.

The mirror shall be superior glass with edges rounded off or beveled as specified. It shall be free from flaws, specks or bubbles. The size of the mirror shall be 600 x 450 mm and unless specified otherwise its thickness shall be not less than 6 mm. The glass for the mirror shall be free from silvering defects. Silvering shall have a protective uniform covering of red lead paint. The mirror shall be mounted on 6 mm thick plain asbestos sheet ground and shall be fixed in position by means of C.P. brass screws and C.P. brass washer, over rubber washers and wooden plugs firmly embedded in the wall C.P. brass clamps with C.P. brass screws may be an alternative method of fixing when so directed Chromium plating shall be of grade B-type conforming to IS : 1968 (latest edition) Unless specified otherwise the longer sides shall be fixed horizontally

Water storage tanks. The water storage tanks shall be of best quality, SINTEX or equivalent make of capacity as specified in the item. The type of tank to be placed shall be approved by the Engineer-in-charge.

The liquid soap container shall be of glass or plastic as specified in the drawing complete with C.P. brass lid and brackets etc.

Testing of pipe lines for Drainage & Sanitation :

Comprehensive tests of all pipe lines shall be made by simulating conditions of use. The method of actual tests shall be decided by the E/I. All tests recorded and submitted to the E/I for review and instruction. The Engineer-in-charge's discretion regarding tolerance shall be final.

General guidance for he test given below :

a) Smoke Test

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gas tight by a smoke test conducted under a pressure of 2.5 M of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning only wastes or tar paper or similar material in the combustion chamber of a smoke machine. Chemical smoke are not satisfactory.

b) Water test

Cast iron pipes shall be subjected to a test pressure of at least 1.5 M head of water at the highest point of the section under test. The tolerance figure of two liters per centimeter of diameter per kilometer may be allowed during a period of 10 minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed in at the low end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Measurements :

The measurements of sanitary fittings for the purpose of payment shall be on the basis of numbers of individual items. The payment for pipes shall be made on the basis of the lengths of pipes actually installed including head, bend, shoes, tees and specials. Over laps shall not be measured. No separate measurements for payment shall be made for fixing devices and testing. The pipes shall be measured in running meters. Pipes of different dia, shall be measured separately and paid for accordingly.

Technical Specification for Manholes :

Scope :

The work shall comprise of constructing manholes complete with all operations as detailed below inclusive of providing all labours, materials and T&P etc. Manholes of different types and sizes as specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawings or as directed by the Engineer-in-charge. The size specified shall indicate the inside dimensions of the manholes.

Sewers of unequal sectional area shall not be joined at the same invert level in a manhole. The invert of the smaller sewer at its junction with main shall be at least 2/3 the diameter of the main above the invert of the main. The branch sewer should deliver

Sewage in the manhole in the direction of main flow and the junction must be made with care so that flow in main is not impeded.

The various sizes of manholes to be adopted under different conditions are indicated below :

Size of manhole

Remarks

90 x 80 cm 120 x 90 cm 140 x 90 cm or 140 cm circular	For House drainage For depth less than 2.45 metre for main drainage work For depths of 2.45 m or more for main drainage work The width or diameter of manhole shall be increased on bends, junctions or pipes with diameter more than 45 cm so as to have a minimum benching width of 22.5 cm. on either side
	of the channel.
	90 x 80 cm 120 x 90 cm 140 x 90 cm or 140 cm circular

Manhole on foot paths and within the width of roads are provided with covers of medium duty casting respectively .

Excavation :

The manhole shall be excavation true to dimensions and levels shown on the plans or as directed by the engineer -in-charge.

Back- filling : As per specification under sub -head "Backfill"

Bed concrete : The manhole shall be built on a bed of cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 grades stone aggregate 40 mm brick ballast nominal size). The thickness of the bed concrete shall be 20 cm for manholes upto 4.25 m. depth and 40 cm for depths beyond 4.25 m. unless otherwise specified or directed by the Engineer-in-charge. The bed concreting shall be done as explained under sub-heard concrete.

Brick work : the brick work shall be with first class bricks in cement mortar 1 :6 (1 cement : 6 fine sand). The external joints of the brick masonry shall be finished smooth and the joints of the pipes with masonry shall be made perfectly leak proof. For arched tube and circular manholes arch ring over the brick masonry in arches and the pipes shall be with 1st class bricks in cement mortar 1:3 (1 cement : 3 fine sand). In the case of manholes of circular type the access shaft shall be corbelled inwardly on three sides at the top to reduce its size to that of the cover frame to be fitted. For brick work refer specification under subhead 'Brick work' in Masonry Chamber'.

The walls shall be built of 20 cm. brick work for depth upto 4.25 m. Below a depth of 4.25 m in ordinary subsoil the wall thickness shall be increased to 30 cm and at 9.75. below ground, the wall thickness shall be 40 cm.

Plaster and pointing : the walls of the manholes shall be plastered inside with 12 mm thick cement plaster 1:3 (1 cement 3 coarse sand) finished smooth. In the case of arched type manholes, the walls of the manhole shall be plastered only inside all-round upto the crown level, and flush pointed for the shaft with cement mortar 1:2 (1 cement 2 fine sand). where the saturated soil is met with, the external surface of the walls of the manholes shall also be plastered with 12 mm cement plaster 1:3 (1 cement 3 coarse sand) findished smooth upto 3 cm above the highest sub-soil water level, with the approval of the Engineer-incharge. The plaster shall further be water proofed with addition of approved water-proofing compound in a quantity as per manufacturer's specification for plastering refers to specification under sub-head Plastering.

R.C.C. Work : R.C.C. work for slabs and lintels shall be in cement concrete, M-15 with steel reinforcement. Plain concrete where use for fixing the frames of manholes covers, shall be of grade M-15. This concrete shall be laid in one operation integral with R.C.C. slab underneath. For specifications refer to sub head `Concrete & Reinforcement.'

Foot Rests :

All manholes deeper than 1.20 M shall be provided with M.S. foot rests. Foot rests shall be of 20 mm square of M.S. round bars as specified. These shall be embedded 20 cm deep with 250 x 250 x 150 mm blocks of cement concrete 1:2:4 (1 cement, 2 coarse sand, 4 graded stone aggregate 20 cm nominal size). The block with M.S. foot rest placed in its centre shall be cast in situ along with the masonry and surface finished with 12 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) finished smooth. Foot rests shall be fixed 30 cm apart vertically and staggered laterally and shall project 10 cm beyond the surface of the wall. The top foot rest shall be 45 cm. below the manhole cover. Foot rests shall be painted with coal tar, the portion embedded in the masonry or cement concrete block being painted with thick cement slurry before fixing.

Manhole covers and Frames : The covers and frames shall confirm to IS : 1726-1960. Only heavy duty manhole covers shall be use at all places.

Technical specification of under Reamed piles :

Scope :

The scope of work covers designing and providing under reamed piles and piles caps for the foundation of control room and steel towers and columns of switchyard area. The dia of piles may very from 250-400 mm & length upto 3.5-10 M. However, exact dia & length shall be obtained at the time of designing. depending upon safe load i..e ultimate load & factor of safety.

Design and Drawings/Construction :

The work is to be executed as per drawing issued by UPPCL. The construction of under reamed piles shall be carried out as per IS code 2911 (Part III) and other relevant standards. The piles shall also meet the requirements of the HANDBOOK ON UNDERREAMED BORED COMPACTION PILE FOUNDATIONS OF C.B.R.I. (Roorkee)

Layout :

The complete setting out work required for piling shall be done by the contractor at his own cost. The layout of the general grid of the plot shall be approved by the Engineer-in-charge. The Contractor (at his own cost) shall build and preserve bench marks constructed with reference to the parmanent bench marks indicated by the Engineer-in-charge. He shall give all help with instruments, materials and men to the Engineer for checking the detailed layout and levels.

Materials :

Concrete :

The concrete mix for piles, piles cap and grade beams shall be of grade M-15 (1:2:4 mix i.e. 1 cement : 2 coarse sand :4 graded crushed stone aggregate of size 20 mm). The "Technical Specification of Cement Concrete" described earlier shall apply here also.

Reinforcement :

The longitudinal reinforcement shall not be less than 0.4% of the cross sectional area of the pile and diameter of longitudinal bars shall not be less than 12 mm. The lateral reinforcement may be of the type, and dia of reinforcement shall not be less than 6 mm. The technical specification of "Reinforcement" described earlier shall apply here also.

Sequence of piling :

Individual piles and pile groups shall be cast-in-situ in such a sequence that the adjacent piles already installed are not disturbed, nor their carrying capacity reduced by subsequence boring operation. In a group, the piling operation shall proceed from the centre of the group towards the periphery.

Boring/Drilling :

Bore holes shall be made by earth augers. In case of manual boring, and auger boring guide shall be use to keep the bores vertical or to the desired inclination and in position. After the bore is made to the required depth enlarging of the base shall be carried out by means of an under-reaming tool.

The diameter of the under reamed bulb shall be 2.5 times the diameter of the pile stem/shaft. the centre to centre spacing for under-reamed piles shall be as shown in the approved drawing but in no case shall it be

less than 2 Du (where Du is the under reamed diameter) for under-grade beams, the maximum spacing of pile shall not exceed 3 meter.

In ground with high water table having unstable pile bores, boring and under reaming may be carried out using a suitable drilling mud (Betonies drilling mud of 7% or upto 8% consistency by weight i.e. 7 kg or upto 8 kg. per 100 liter of water). In normally mud soil strata, drilling mud can be poured from top while boring and under reaming can be done by normal spiral earth auger and under reamer. The level of drilling mud should always be about 1 metre above the water table or the level at which caving – in occurs. In case of very unstable strata with excessive caving – in, continuous circulation of drilling mud using suitable pumping equipment and tripod etc. along with modified auger and under reamer to avoid back action shall be use. At least 2 m long temporary M.S. casing be provide of required size be provided at the top of every bore hole to guide the cutting tools and also to avoid the bore hole from being damaged due to continuous flow of slurry and movement of cutting tools etc. This M.S. Casing should be taken out when the concrete would reach at the level. The contractor shall arrange this casing at his own cost Nothing extra shall be paid to him for the same.

Control of Alignment :

For vertical piles a deviation of 1.5% and for batter piles a deviation of 4% should not be exceeded to. Piles should not deviate more than 75 mm or 1/10th of dia of pile whichever is more (in case of piles having diameter more than 600 mm) from their designed position at the working level. In the case of single pile under each leg of column the positional clearance shall not be more than 50 mm. In case of piles deviating beyond limits, to such an extent that the resulting eccentricity can not be taken care of by redesigning of pile cap or pile ties, the pile should be replaced (r) supplemented by one or more additional piles at contractors own cost.

Placing reinforcement :

Reinforcement as required shall be made into staff cages sufficiently wired with IS/20 gauge annealed soft iron binding wire or welded to withstand handling without any damage or distortion. Reinforcement shall be placed immediately after cleaning and inspection of bottom of bore holes.

The projecting lengths of longitudinal bars beyond the pile cut-off level shall be equal to a minimum of 50 times the bar diameter. Concrete cover over all rain for cement shall be 50 mm. The inside dimension of reinforcing cage shall be adequate for operating the termini pipe when use.

Concreting :

Before start of concreting for the cast in situ under reamed pile, the contractor shall get checked the bore hole/under reamed bulb of each and every pile by the Engineer-in-charge or his authorized representative/subordinate looking after the work and obtain an O.K card/slip from him for proceeding with the operation of concreting. A register/cut file shall be maintained at the site by the contractor to record necessary information about boring and concreting of piles e.g. date, the pile number, dimension of pile and any other detail as required by the Engineer-in-charge. The contractor shall put up the same before the Engineer-in-charge regularly during the period of construction of piles.

The bottom of the bore hole shall be cleaned of all the loose materials, debris and all the water shall be removed by pumping and bailing just before the concreting starts.

In case of bore holes established by `Bentonite' slurry and of bore holes which are not dry, concrete shall be placed by means of rermie pipe which will be suitably close at bottom at the start of concreting. The rermie pipe must extend upto the bottom of the bore-hole and shall at all times be embedded in the be concrete to a minimum depth of one meter. Placing of concrete should continuous and the termie pipe shall be held concentric in the hole. The borehole shall be maintained full with the drilling fluid where use throughout the concreting operation.

Since supervision at night becomes difficult, concreting shall be carried out only from morning to evening. The procedure of concreting shall be got approved by the E/I.

Finishing pile heads :

The top of the pile shall be brought up above the cut off level to permit all laitance and weak concrete to be removed and to ensure that it can be properly keyed into the pile cap the minimum distance of keying of pile into pile cap shall be 5 cm. Any defective concrete in head of the completed pile shall be cut away and made good with new concrete. The clear cover between the reinforcement in pile cap from the top of the pile shall not be less than 10 mm. The reinforcement in the pile should be exposed for a sufficient distance to permit it to be adequately bonded in the pile-cape

Replacement of rejected pile :

Piles that are defective or exceed the tolerance specified, shall be left in place or pulled out, as directed by the Engineer-in-charge, without adversely affecting the performance of adjacent piles.

Contractor shall install replacement pile/piles in lieu of rejected piles as directed by Engineer-in-charge.

Contractor shall not be paid any additional amount for expenses incurred for extraction of rejected piles, provision of extra piles, enlargement of pile cap necessitated due to faulty work of the contractor.

Measurement for Payment of Under Reamed Piles :

The bore hole of piles (stem/shaft only ie. excluding under reamed bulbs) upto 3.5 m depth below ground level shall be measured and paid for in "each" unit for all such numbers of piles. The under reamed bulbs (2.5 times of the stem dia) shall also be measured and paid for in "each" unit for all such numbers of the under reams (bulbs) separately against another item. However additional depth of stems of piles beyond 3.5 m depth shall be measured and paid for separately in "metre" unit or as per BOQ item.

The measurement for payment of cement concrete 1:2:4 for stems/shafts of cast in-situ R.C.C. piles (excluding under reamed bulbs) shall be in "cubic metre" unit for such number of under reamed bulb.

If due to any reason the size of under reamed pile (i.e. the depth and dia of the bore-hole or the dia of the under reamed bulbs which has to be 2.5 times the dia of the respective stem) becomes more than that specified on the approved drawing, the whole pile shall be cast with same mix. with the reinforcement having been placed only in the designed depth as per approved drawing. Nothing shall be paid extra to the contractor for the increased size of the bore-hone/under rearmed bulb and the concrete for the same.

Reinforcement use for construction of the cast in-situ R.C.C. under reamed pile shall be measured as per standard weight and paid for separately.

Pile caps :

The caps shall be cast over a 7.5 cm thick leveling course of concrete of mix 1:6:12 or as specified in the approved drawings. The clear overhang of the pile cap beyond the outer most pile in the group shall normally be 10-15 cm depending upon the pile size.

The clear cover for the main rein forcement from the bottom of cap shall not be less than 6 cm.

The reinforcement from the pile should be properly tied to the pile cap.

The pedestals of foundations shall be 15 cm above the formation level.

The pile should project 40 cm into the cap concrete.

Each leg of towers/columns shall be welded with the base plate with proper anchorage to be provided in the pile cap, with required nos. of foundation bolts to the fixed in the left out block cuts in the pile cap. This job will be done in the presence of Electrical Engineer of employer.

Measurement of Pile Cap for Payment :

The C.C. for the R.C.C. work in pile caps shall be measured in cubic metre and paid against the item of providing/laying C.C. for R.C.C. work in plinth. Nothing extra shall be paid to the contractor for any enlargement of pile cap necessitated due to faulty work of the contractor.

Note : In order to assess and have an idea of the volume of the cement concrete in under reamed pile foundation, the following formula as suggested by the C.B.R.I. (Roorkee) may be use.

V = π /4 x d² x (l + K.n.d.) L = Depth of pile from cut-off level d= Diameter of stem of pile n= Nos. of Under Reamed Bulbs k= Constant For under reamed dia = 2.5 d, For under reamed dia = 2.0 d,

K = 4 K = about 3

TECHNICAL SPECIFICATION FOR ROADS

This shall consist of the following as per approved UPPCL drawing.

1- Subgrade

- 2- Sub-base : It shall consists of soling with well-burnt clay bricks laid on edge in one layer.
- 3- Lean concrete in 1:6:12 to laid in 100 mm thickness.
- 4- 100 mm C.C. in 1:2:4 over lean concrete with nominal reinforcement. The CC road shall be constructed as per drawing issued by UPPCL.

Sub Grade :

This consists of construction of sub-grade with approved material obtained from excavation for road construction, borrow pits or other sources, in lines grades and cross section as shown in the approved drawing or as directed by the Engineer-in-charge.

Materials :

The materials use in sub-grade shall be earth, moorum, gravel, a mixture of these or any other material approved by the Engineer-in-charge. The size of coarse material in the mixture of earth shall not exceed 650 mm when placed in the sub-grade. Clays shall not be use in the sub-grade.

Construction of Sub-grade :

Consolidating/compacting ground supporting sub-grade : In all cases the original ground shall be consolidated by rolling with six passes of 10 ton roller.

The ground shall be excavated to an average depth of 15 cm and the surface below this level shall be suitably consolidated with six passes of 10 ton roller including making good the undulations.

In sub-grade composed of clay, fine sand or other soils that may be forced up into the coarse aggregate during rolling operation, an insulation layer of granular material of suitable thickness shall be provided for blanketing the sub grade. Payment to be made for this separately.

Materials :

The material to be use for the work shall be well burnt clay bricks, natural moorum, or crushed stone.

Anti-termite Treatment :

Scope :

The scope of work is to set up a chemical barrier against attack by subterranean termites in the areas like cable trenches, control room etc.

General :

All work shall in general be executed as specified in IS : 6316 (Part-II). 1971 All necessary work to ensure uniform distribution and proper penetration of treating solution shall be done according to the instruction of the Engineer-in-charge. Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

Chemicals and Rate of Application :

Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be supplied by pressure pumps uniformly over the are treated :

Chemical	Concentration by weight percent.
Deildrin (IS : 1051-1962)	0.5
Aldrin (IS : 1306-1958)	0.5
Chlordane (IS : 2863-1964)	1.0
Heptachlor	0.5

In case the chemical specified above/in the respective item of the bill of quantity is not available then any equivalent make of the chemical may be use after getting the same approved by the Engineer-in-charge.

Measurement for Payment :

It shall be measured for the area treated in sq.m. In case of building, the plinth area at ground floor shall be measured.

Technical specification for floors

General :

The flooring provided in the control room hall, carrier room, officers/staff room, battery room and else where in the sub station shall be Industrial flooring, C.C flooring, Glared tiling etc. as specified in the approved drawing.

Concrete Floors

Scope :

This section covers the furnishing of all materials labour and equipment and performing all operations necessary to complete the concrete floor.

Materials :

Concrete for floor topping shall be in proportion 1:2:4 (1 cement, 2 coarse aggregate 4 stone aggregate 12 mm and below) consistent with requirements of this section of the specification. The thickness shall be kept as 25/40 mm unless other wise specified in the drawing.

Installation :

The concrete floor shall be laid in panels 1 m x 1 m or less separated by glass strip. Alternate panels shall be laid in the followed by the other group of alternate panels the next day.

The concrete shall be laid in the panels and tamped with wooden mallets till a cream of mortar covers the structures.

The junction of floor and walls, floors, and dado or skirting shall be rounded off as directed without any extra payment.

Method of Measurement :

Measurement of flooring shall be in square metres. The length and width shall be measured from the finished faces, correct to an cm. No deductions shall be made for any openings upto 0.1 m2. The glass strip shall be paid for separately in running metre.

TECHNICAL SPECIFICATION CERAMIC TILES :

The section covers the finishing of all labour materials and equipment and performing all operations necessary to complete al interior and exterior tile work in accordance with the drawing and specifications.

Material :

Glazed and unglazed tiles shall be of dense and fine grained hard burnt clay suitable for use on wall faces. Tiles shall not be less than 6 mm in thickness. Water absorption by weight shall not exceed 0.005%. Caps, base inside and outside corners trimmed all required. Special shapes shall be provided for a complete installation colour and pattern shall be as selected by the Engineer.

Preparation of Surface :

Before fixing tiles the vertical surfaces of the walls shall be cleaned and thoroughly wetted. In case of masonry walls the joints shall be raked out and in the case of concrete, the surface shall be hacked and wire brushed.

Installation :

Tiles shall be installed using the conventional method as described ahead. A bed of 10 mm thick mortar consisting of Portland cement and sand in the proportion of 1:3 mix shall be laid. Before the plaster has hardened, the back of each tile shall be covered with a thin layer of neat Portland cement slurry and tile shall then be gently tapped against the wall with wooden mallet. The sides of the tiles shall be coated with white cement slurry and butt jointed. The joints shall be as thin as possible.

Ceramic wall tile shall be accurately laid out with horizontal joints level and vertical joints pub. Finished surface shall be flat and free from perceptible imperfections.

In completion of tile work all surface shall be flat and free of mortar sports, laitance and loose particles. All finished surfaces shall be finally cleaned after at least 7 days of curing with a mild solution of soap and water and thoroughly rinsed. No acid shall be use to clean tile work.

Measurements :

The measurements of this item shall be based on the area (sq. metres) actually covered by the tiles.

Fully vitrified tile flooring :

S/F of 10 mm thick vitrified floor tiles of approx. size (400 x 400) mm or any other approved size of First quality of Bell, Kajaria, Somany or equivalent make clolur and pattern to be approved by the E/I, laid with approved quality of adhesive including pointing the joints with white cement and matching pigment etc. complete.

MISCELLANEOUS STEEL ERECTION

Scope :

This section covers the technical requirements for the erection of all miscellaneous steel parts by the contactor. The extent and type of miscellaneous steel to be erected shall be as per the detailed drawings.

Materials :

The miscellaneous steel shall be furnished to the Engineer-in-charge, detailed and fabricated in accordance with the requirements as indicated in the detailed drawing. The miscellaneous steel shall be furnished within the project area and the contractor shall make his own arrangements at his cost to transport the same to the work site.

Miscellaneous steel parts shall include items such as Anchor bolts, pipe sleeves, puddle, finagle through floors and walls, equipment mounting plates, steel pieces for setting in or attachments to turbine generator foundation, steel pieces for setting in or attachment to pump house and discharge structures, hoist structures, ladders, roof ventilator support frames, steel pieces set in concrete for trench digging, frames and floor plate covers, concrete inserts, expansion bolts, auxiliary framing for equipment supports, miscellaneous frames, loose lintels etc. Erection of material shall include setting in forms for connecting in place and grouting as required. The grouting operations shall be performed as per the direction of the Engineer.

The above list provides only as an illustration of the type of steel items to be considered as miscellaneous steel and some items listed may not appear in the actual miscellaneous steel to be erected. It shall not also be construed as limiting the materials to be erected specifically to such items only.

The contractor shall erect all miscellaneous steel in accordance with the drawings and these specifications including setting materials in concrete or grouting pieces in place furnishing all labour, materials scaffolding and services necessary for an incidental to its transporting unloading, storing, handling and erection. The contractor shall furnish welding rods and arrange for field welding as required in accordance with IS : 816.

Installation :

During erection, the contractor shall provide necessary temporary bracing or supports to ensure proper installation of the materials. All materials shall be erected in true location. as shown in the drawings, plumb and level.

The Engineer-in-charge will furnish copies of the shop and assembly drawing prepared by the fabricator of the miscellaneous steel showing the necessary information for erection.

Measurements :

The measurements for this item shall be based on the member of parts or as per relevant item and as per approved drawing.

TECHINCAL SPCIFICATION FOR GROUTING

Scope :

These specifications cover the furnishing of all labour, materials and equipment and performing of all operations necessary to complete the work of grouting of block cuts, foundation bolt holes and space between bottom of base plate and top of foundation concrete.

Material :

Cement shall conform to the stipulations contained in IS : 1489 (Part-1) 1991

Sand shall conform to the stipulations contained in IS : 383 and shall have fineness modules not exceeding 3 and not less than 2.25.

Water shall be clean and fresh and shall be of potables is quality.

Aluminum powder or anti-shrinkage admixture of standard brand from a reputed manufacturer shall be use instead, "shrinkomp" by ACC Ltd. Which is a ready mix concrete containing anti-shrinkage admixture can also be use. Materials to be use shall be got approved by the Engineer prior to their use on work.

The block-cuts and bolt holes which have to be grouted shall be cleaned thoroughly by use of compressed air immediately before taking up the grouting operations.

Grouting shall be adopted for filling block-cuts, foundation bolt holes and space between the underside of base plates and top of foundation concrete. Thickness of grouting under the base plate shall not be less than 50mm Mortar made up of cement and sand in the proportion of 1:1 by weight and blended with aluminum powder (about 0.005% by weight of cement) of anti-shrinkage admixture in a suitable proportion to the cement mortar in accordance with the recommendations of manufacturer and subject to the approval of the E/I, shall be use.

Cement, sand and aluminum powder or approved anti-shrinkage admixture shall first be blended thoroughly in the required proportion. The mortar shall than be prepared by mixing with a quantity of water which will produce a sufficiently workable mix to enable complete and proper compaction of the mortar.

Alternatively "shrinkomp" by ACC ltd. a ready mix concrete will be mixed with water to produce a sufficiently workable mix to enable complete and proper compaction of the mortar.

The mortar will then be placed in the block cuts and bolt holes either from the sides or through holes provided for this purpose in the base plate. It shall be ensured by ridding and by tapping of bolts that the block-cuts are completely filled without leaving any voids. The pouring shall cease as soon as each hole is filled and any excess grout found on the surface of the concrete foundation shall be completely removed and the surfaced dried. For placing mortar between the bottom of base plate and top of foundation concrete, steps shall be taken to ram the mortar that oozes out through the bolt holes in the base plate. When it is clear that the centre of the base plate has been properly filled, the mortar outside the base plate shall be briefly rammed to ensure compaction below the edges. Any mortar, which has been mixed for a period longer than half an hour, shall not be use in the work.

Curing : The work shall be cured for a period of at least 7 days commending after 12 hours after the completion of the grouting operations. The curing shall be done by covering the surfaces with wet gunny bags.

Measurements : Measurement for grouting shall be in cubic meter correct to the second place of decimal. Measurement for grouting shall be calculated by volume of the block-cut or bolt holes including the space between the under side of the base plates and the top surface of foundation concrete as per the dimensions shown in the drawing. No deduction shall be made for bolts, shims, shear keys and such other embedment in the block-cuts or bolt-holes. The unit rate is inclusive of the cost of admixtures etc. and raring.

Technical Specification for fencing, Gates and side barriers :

Scope :

This section covers the supply of all materials furnishing of all labour, equipment etc., and performing of all operations necessary to complete the installation of fencing poles, fixing of woven G.I. Plain wire mesh (chain link mesh) 50 mm x 50 mm of 8 gauge in fencing, supply, fabrication and erection of structural steel gates and side barriers, etc, complete in accordance with these specifications and approved drawings.

Materials :

Structural Steel :

The material required for the gates shall consist of steel conforming to IS : 226

Fabrication of Gates and Side Barriers :

All the gates required for installation in the security fencing shall be fabricated by welding the required sections as indicated in the detailed drawings. The welding & fabrication of the gates shall be done in accordance with IS : 823 and IS : 800.

All operations like cutting, bending. shaping, formation of ornaments, shapes etc as required in the drawing shall be carried out in accordance with the drawings.

After the fabrication of the gate, the gate shall be cleaned thoroughly by use of wire brushes or by emery paper and shall be painted with three coats of an approved paint of approved colour conforming to specifications and approved by the Engineer-in-charge.

Measurements : Measurement for steel gate shall be as per relevant item for steel fabrication in B.O.Q. Measurement for Chain link fencing shall be in sqm of area fixed with chain fencing as per relevant item in B.O.Q.

Technical specification of Ballast for filling the soak-pits of transformers and reactors

Scope :

This section cover technical specification for the supply of stone ballasts for filling the sock pits of transformers and reactors and furnishing of all labour, materials, equipment, transport etc. and performing of the operations necessary to complete the work of ballast filling in soak pits as per approved drawings and instruction of Engineer-in-charge.

Materials :

The stone ballast shall be of nominal size 60 mm conforming to IS : 383 (latest). The aggregate passing through 40 mm sieve shall not be use. The aggregate shall not be weathered and shall not contain foreign and any deleterious material.

The grading of ballasts shall be such as to achieve 40% voids after filing them in soak pits.

Filling of Soak Pit :

The required quantity of ballast shall be brought to side and stored in regular stacks. The filling of ballast shall be carried in horizontal layers of about 300 mm taking the material from successive stacks. The filled ballast shall be properly tamped and leveled by rakes etc.

The final layer shall be laid slightly higher then the finished level and brought to required level by tamping. The finished surface of ballast shall be regular and uniform.

Measurements :

The measurement of above work shall be done in cubic metres of ballast filled, correct upto second place of decimal. the unit rate is inclusive by the cost of all materials labour T & P etc. required for completing the job as per approved drawing and instruction of Engineer-in-charge.

Fencing Posts :

The fencing posts shall consist of structural steel angles of size 65 mm x 65 mm unless otherwise specified on approved drawing. The height of fencing posts shall be about 1.8 metre and centre to centre spacing 3 mts. unless specified otherwise on holes and straining bolts etc. necessary for fixing chain link mesh. The inclined angle portion shall also have provisions (holes etc.) for fixing barbed wire as shown on the drawing.

Applying Red Oxide Primer/Painting :

All steel members use in fabrication of mid steel gates and fencing shall be given one coat of red oxide primer in shop after fabrication except the portions which shall get embedded in concrete. The cost of one coat of red oxide painting shall be included in the rate of the respective M.S. work.

After erection, they shall be finished and painted with two coats of paint with trimming cost of approved shade and quality for specifications, refer specification under subhead painting and finishing.

Installation of Fencing Post

The fencing posts shall be embedded in concrete blocks of mix 1:2:4 of suitable dimensions as shown in approved drawings.

TECHNICAL SPECIFICATION FOR TRENCH COVER, M.S. FRAME AND REINFORCEMENT OF TRENCH COVER AND M.S. ANGLE IRON NOSING/EDGING OF TRENCH WALLS :

Scope :

Theis covers the design, casting of trench covers with cement concrete 1:1.5:3 (1 cement 1.5 coarse sand : 3 graded stone aggregate 12 mm normial size) 40 mm thick or 45 mm thick as may be specified in the items of the bill of quantity in M.S. angle frame with reinforcement bars welded to it as per approved drawings along with necessary bar handles welded/fixed in the concrete covers. This also includes necessary arrangements / preparation of plate form with necessary release agents for casting of the C.C. covers. It also includes providing and fixing of M.S. angle nosing / edging at the top of the trench walls as shown on the approved drawings with necessary lugs grouted in C.C. blocks 1:2:4 of size 10 cm x 10 cm x 10 cm the size of M.S. angle shall be as per approved drawings.

Design :

The trench covers shall be designed for a live load of 2 MT. Per sq. m for working out the reinforcement etc. unless other wise specified by the Engineer-in-charge.

Measurement for Payment :

The trench covers of C.C. 1:1.5:3 mix with 10mm down gauge stone aggregate of specified thickness shall be measured by its area in sq. m. and paid against respective item of bill of quantity. The reinforcement bars and the M.S. frames shall be measured by weight in quintal after noting their lengths and multiplying them by their respective unit weights as per Hand Book and these shall be paid against item of mild steel work in built up section. The structural steel of M.S. angle in nosing/edging of top of cable trench walls including lugs for fixing shall be measured and paid by weight against the item of mild steel works in single section. Welding required for fixing of lugs to angle nosing shall be paid for separately. All the above steel members shall be painted with a priming coat of red oxide paint. Besides, nothing extra shall be paid for arrangement/preparation of platform for costing of the C.C. covers as this shall also be included in the item rate.

TECHINCAL SPECIFICATION FOR PLINTH PROTECTION :

PLINTH PROTECTION :

Scope :

This covers the cost of furnishing all labour material, equipment and the performing of all operations as detailed below etc. complete.

General :

This shall be provided as specified or as directed by the Engineer-in-charge. It consists of 40 mm thick cc floor laid over one layer of lean concrete 1:6:12 in 40 mm stone ballast of 75 mm thick. Plinth protection shall be laid with min. out ward slope of 1:25.

Materials :

For cement, concrete, aggregate and masonry work, refer to the specification under the sub-head ``Cement'', ``Concrete'', ``Aggregate'' and ``Masonry Work'' described elsewhere in this volume.

Preparation of ground :

The ground shall first be prepared to the required slope around the building. The high portions of the ground should be cut down; hollows and depressions filled up to the required level from the excavated earth and rammed so as to give uniform outward slope. All cutting and fillings as included in this. Bed shall be watered and rammed with heavy iron square rammers.

Sub-grade :

This shall be made up with 75 mm thick bed of C.C. 1:6:12 in stone aggregate of 40 mm nominal size. This shall be spread over the prepared ground to a depth of 75 mm with a minimum outward slope of 1:25. Aggregate shall be carefully laid and packed, bigger size being placed at the bottom.

Concrete Topping :

After the sub-grade has been compacted thoroughly, 40 mm thick plain cement concrete of M-15 grade (1 cement : 2 fine aggregate : 4 coarse aggregate) floor shall be laid and properly, compacted and finished.

Measurement :

This shall be measured in relevant unit for different items of works executed as dialed above correct of the second place of decimal. No deduction shall be made nor paid for any openings for the pipes etc. Upto 0.1 sq. metres.

TECHINCAL SPECIFICATION FOR CULVERT/DRAINAGE SYSTEM :

Scope :

This section covers the draining of water (including rain water) from sub-station/switch yard areas.

Drainage shall be carried out by

- i) Culvert.
- ii) Drains.

Culverts :

Culverts shall be constructed as per drawing issued by UPPCL/UPPTCL.

Drains :

This work consist of constructing surface or sub-surface grains in accordance with the requirements of these specification and to the lines, grades, dimensions and other particular shown in the drawings or as directed by the Engineer-in-charge. Schedule of work shall be so arranged that the drains are completed in proper sequence with roadway and pavement works to ensure that no excavation of the competed works is necessary subsequently of any damage is cause to these works due to lack of drainage.

Surface drains shall be excavated to the specified lines, grades, levels and dimensions. The excavated material shall be removed from the area adjoining the drains and, if found suitable, utilized in embankment construction. All unsuitable material shall be disposed off as directed.

Where so indicated, drains shall be lined or lined or turfed with suitable materials in accordance with details shown on the drawings.

All works on drain construction shall be planned and excavated in proper sequence with other works as approved by the Engineer-in-charge, with a vied of ensuring adequate drainage for the areas.

Detailed specification of C.C. drain has already been covered in the specification of brickwork, cement concrete, plastering and painting etc. and may be referred.

TECHNICAL SPCIFICATION FOR SITE CLEARANCE

Before the earth work is started, the area coming under cutting and filling shall be cleared of shrubs, wild vegetation, grass, bushweed, trees and saplings of girth upto 30 cm measured at a height of one metre above ground and rubbish removed upto a distance of 50 metres outside the periphery of the area under clearance.

The trees of girth above 30 cm. Measured at height of one metre above ground, shall be cut only after permission of the Engineer-in-charge, obtained in writing.

Levelling of site :

This includes excavation and back-filling and other leveling operations involved. The materials for leveling the site at required level shall be obtained form the approved sources with preference given to materials becoming available from nearby areas. All the excavated materials shall be the property of UPPCL. Where the excavated materials is directed to be used in the filling of the site, it shall be directly deposited at the required location.

All hard materials such as hard moorum, kankar rubble etc. not intended for use shall be stacked neatly for future use as directed by Engineer-in-charge. The ground levels shall be taken at 10 metres intervals or at close intervals where local mounds, pits, or undulations are met with. The ground levels shall be recorded in field books for plotting on plans. The labour required for taking levels shall be supplied by the contractor at his on cost.

The actual measurements of the filling where earth is bought form outside the sub satiation area shall be calculated by taking levels of the original ground before start of the work site clearance and after compaction of the filling material by heavy mechanical machinery at optimum moisture content as per IS : 2720 (Part VII), 5% deduction for voides shall be make from volume of filled up earth. If compaction is done by earth filling in layer (20 cm thick) and reaming & underling done by light mechanical machines there a deduction @ 10% for voids shall be make from the quantity of earth filled. If filled up earth is loosely compacted a destruction of 20% shall be make for voids from the quantity of earth filled up. For cutting & filling with in the s/s area the lesser of the two quantities i.e. cutting or filling shall be paid, as per fixed level sheets of the area.