

POWER TRANSMISSION CORPORATION OF UTTARAKHAND LTD.
TENDER NOTICE

Sealed and separate tenders in two parts (Part-I & II) are invited from original manufacturers/their accredited representative of Electric ‘A’ Class valid license holder from Uttarakhand Government or equivalent authority of following supply/works. The tender documents shall be down loaded from our internet website of www.ptcul.org. The date of opening of tenders if happens to be public holiday, tenders shall be received and opened on next working day at scheduled time. The undersigned reserves the right to reject one or all tenders without assigning any reason thereof.

Tender shall be received through Registered Post only (acknowledgement due) addressed to Chief Engineer (O&M), Kumaon Zone, PTCUL, 220KV S/S Kamaluaganja, Post Office Kamaluaganja, Haldwani in the office upto 5.00 PM on specified date. The department shall not own any responsibility regarding the postal delay in the receipt of the tender.

The Part-II of the tenders, belonging to only those tenders who qualify for the work on the basis of the documents supplied by them in Part-I, shall be opened publicly same day. The due date of opening of tenders if happens to be public holiday, tenders shall be received and opened on next working day at scheduled time. All other terms and conditions shall be as per tender documents.

Part I & II shall contain the following :

(A) Part-I : Part-I of the tender shall contain the following :-

- i) Cost of tender document : In the form of Bank Draft in favour of Executive Engineer, 220KV O&M Division, PTCUL, Haldwani payable at Haldwani.
- ii) Earnest Money : In the form of FDR/CDR/NSC/TDR duly pledged in favour of Executive Engineer, 220KV O&M Division, PTCUL, Haldwani payable at Haldwani.
- iii) Experience Certificate : Experience certificate issued by an officer not below the rank of Executive Engineer for the related works must be furnished with Part-I.
- iv) Annual Turn over : The annual turn over of the firm/contractor should be not less than one crore of last year for which Income Tax return for the last year must be furnished in Part-I.
- v) Registration : The Firm/contractor must be registered in Sales Tax, Income Tax / Service Tax Department.

Relevant documents in support of above must be furnished. If these documents are not furnished alongwith the tender in Part-I, the offer will be liable to be rejected summarily.

(B) Part-II : shall contain Techno-Commercial and Price Bid.

- 1- Tender specification No. : GM(O&M)/01/2013-14
- a) Name of work : Construction of 33 KV Bay for M/s Shirdey Industries at 220 KV Substation Pantnagar.
- b) Earnest money : Rs. 50,000.00
- c) Cost of tender document : Rs. 2000.00 + 13.50% VAT
- d) Starting date for down loading tender document : 10-05-2013
- e) Closing date for down loading of tender document : 10-06-2013 upto 5.00 PM
- f) Last Date for submission Of Tender Document : 16-06-2013 at 5.00 PM
- g) Opening date of Tender Part-I & II : 17-06-2013 & 24-06-2013 respectively at 11.00 AM.
“Save Electricity in the interest of nation”

Chief Engineer (O&M)
220KV S/S Kamaluaganja
Haldwani (Nainital)

TENDER FORM

TENDER FOR

.....
against Tender Specification No.GM(O&M)/

From,

To,

The Chief Engineer (O&M)
Kumaon Zone,
Power Transmission Corporation of Uttaranchal Ltd.
220KV Kamaluaganja
Haldwani(Distt.-Nainital)

Sir,

With reference to your invitation to tender for the above, I hereby offer to the Power Trans. Corp. of Uttaranchal Ltd. items in the schedule of prices and delivery annexed or such portion thereof, as you determine in strict accordance with the annex condition of contract form "B" specification and schedule of rates to the satisfaction of the purchaser or in default thereof to forfeited and pay to Power Trans. Corp. of Uttaranchal Ltd. the sum of earnest money mentioned in the said condition.

The rates quoted are inclusive pro-rate and in full of satisfaction of the all claims.

I/We agree to abide by this tender for the period of 120 days from the date fixed for receiving the same

A sum of Rs. in the form of is herewith forwarded duly endorsed in favour of Executive Engineer, 220KV O&M Division, Haldwani as earnest money deposit, the full value of which shall be retained by the Power Transmission Corporation of Uttaranchal Ltd. on account of security deposit specified in clause-3 of the said conditions of form "A".

Yours faithfully

Signed

Dated the day of 200

SIGNATURE OF THE
TENDERER IN FULL

Witness
Address
Occupation

TENDER PERFORMA

SCHEDULE 'C'

Sr. Particulars

1. Specification No. against which you have tendered.
2. Receipt No. & date by which cost of the Tender Specification deposited by you.
3. Specification of the material for which tender has been submitted. Are you a manufacturer of the item ordered for or ace-credited Agent of manufacture?
4. Quantity offered (In there are two or more items state quantities separately with units.)
5. Amount of form in which earnest money deposited with Executive Engineer, 220KV O&M Division, Haldwani(UA) Please give referenda in this connection.
6. Do you agree to all the conditions of the Tender specification clearly which you would desire in the general conditions of contract form(It may please noted that it shall be entirely at the discretion of the purchaser to accept or to reject the modification proposed.)
7. Please state clearly(Answer Yes or No) if you would agree to undertake the supply incase the modification as suggested under Sl. 6 is not acceptable to the Corp. without imposing any further condition/conditions from your side.
8. Give the reference who can certify your financial status & capability to undertake such supply order. One of the references should be schedule Bank of India.
9. Do you confirm that there are no typographical errors/omissions in your tender and all other documents forming part of the Tender? (Yes/No).

10. Have you submitted list of past suppliers work executed.
11. What is the validity period of your Tender?
12. What is the Delivery Period? Please state if the delivery is guaranteed under penalty state the delivery date/month.
13. Are you agreeable to the delivery period being reckoned from the date of receipt of acceptance letter by you?

PRICE/PRICES

1. Is the quoted prices for each item FIRM/Firm in all respect?
2. If the quoted prices is variable please give the price variation formula and also the basis (with documents) of quoted price.
 - (A) Do you agree that the price variation clauses shall be applicable only within the guaranteed completion period as mentioned in tender and shall no be applicable there after even if extension in delivery is granted at later stage on any ground whatsoever.
 - (B) Have you furnished the documentary evidence in respect of basis mentioned in item 2(A) above?
3. Is the quoted price exclusive of Sale Tax?
4. If the price is inclusive of Sale Tax. What is the amount of Sale Tax included and at what rate?
5. Is the quoted price exclusive of Excise Duty on finished product?
6. If the quoted price is inclusive of Excise Duty included and at what rate?
7. In the quoted price exclusive of transit Insurance charges covering 30 days?

8. If the quoted prices is inclusive of insurance that the amount of insurance charges included to what rate?
9. Please state if you would claim any other charges over & above the price as extra which are not covered by Sl. No. to If yes, please state extra separately indicating the amount in rupees against each on per unit basis.
10. Do you offer any discount and if so what is the discount in unit.
11. Have you read the standard clause 2.10 of special conditions which for change of price/prices or its/their structure after the opening of tender?

TECHNICAL SPECIFICATION:-

1. Is the material offered according to the specification of the purchaser?
2. If the material offer is/not exactly accordingly to the purchasers specification. Please get the verification from the same.
3. Have you enclosed leaflets, descriptive and illustrative catalogues in triplicate?
4. Have you enclosed copies of test certificates in respect of material offered?
5. Have you submitted sealed sample (Non refundable) and delivered the same to the office of Dy. General Manger, Trans. Haldwani.
6. Have you filled up the schedule of technical particulars?
7. Guarantee of offered material shall be 6 or 12 months.

ADDRESS

Place:

Date:

SCHEDULE "B"

DEPARTURE FROM SPECIFICATION

Sl.No.	Name of Items	Description of Departure	Reference of Clause in Specifications
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APPLICATION FROM TENDERER

(On a Non-judicial stamp paper of Rs.5/- plus 0.20 paise revenue stamp affixed)

AGREEMENT

Tender invited by
Tender for
Tender Notice No.
and Date
Name of Tenderer

In consideration of the Power Transmission Corporation of Uttaranchal Ltd. having treated the tenderer to be an eligible person, whose tender maybe considered, the tendered, the tenderer here-by agrees to the condition that the proposal in response to the above invitation shall not be withdrawn within three months from the date of opening of the tender and also to the condition that if there, after the tenderer withdraws his proposal within the said period, the Earnest money deposited by him may be forfeited to the Power Transmission Corporation of Uttaranchal Ltd. on the discretion of the Engineer-in-charge.

Signed this day of 200

SIGNATURE OF TENDERER

Full Name

WITNESS

- 1.
- 2.

**UNDERTAKING EXPERIENCE AND FINANCIAL CAPACITY FOR
EXECUTING THE WORK**

A. Working experience for last 3 years.

Sl.No.	Name of Work	Cost	Date of completion	Total time of completion	Name and address of office under whom work was executed with certificate
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Note :-

1. Testimonials in support of the above may be submitted from officer not below the rank of Executive Engineer.
 2. Attach additional paper if details are not covered in this table.
- B. Position of last Income Tax clearance.
C. Financial capacity of Contractor.
(Give bankers name and capacity of execute work).

SIGNATURE OF TENDERER

**Bill of Quantity & Technical specification against Tender Specification No. GM(O&M)/01/2013-14
for construction of 33KV Bay for M/s Shirdev Industries at 220 KV Substation Pantnagar.**

Sl. No.	Description of work	Qty.	Rate (Rs.)	Amount (Rs.)
(A)	COST OF MATERIAL :			
1-	33KV SF6 circuit breaker	1 No.		
2-	CT 400/200/1	3 Nos.		
3-	Isolator with E/S 33KV line isolator, 800A, motor operator	1 No.		
4-	Bus Isolator 33KV line isolator, 800A, motor operator	2 Nos.		
5-	30 KV LA with surge counter	3 Nos.		
6-	Control cable			
	(a) 2.5 x 2 core	0.5 Km.		
	(b) 2.5 x 4 core	0.5 Km.		
	(c) 2.5 x 6 core	1 Km.		
	(d) 2.5 x 10 core	2 Km.		
7-	Insulator string disc insulator, hardware, conductor, bus bar material, cable tray, bay MK, clamp & connector, earth wire, earthing material etc.	1 Set		
8-	33KV Control & relay panel	1 No.		
9-	G.I. Lattice type structure with nut & bolts & foundation bolts	3 MT		
10-	G.I. pipe type structure with foundation bolt & nuts & bolts	3 MT		
11-	Earth mat & riser	200 Mtr.		
	(a) 40 mm MS Rod	100 Mtr.		
	(b) 75 x 12 GI strip	100 Mtr.		
	(c) 50 x 6 GI strip			
	SUB TOTAL (A) :			
(B)	COST OF ERECTION WORK :			
1-	33KV circuit breaker	1 No.		
2-	CT 400/200/1	3 Nos.		
3-	Isolator with E/S	1 No.		
4-	Bus Isolator	2 Nos.		
5-	LA with surge counter	3 Nos.		
6-	Control cable laying including connection at both end gladding ferruling tagging & finishing			
	(a) 2.5 x 2 core	0.5 Km.		
	(b) 2.5 x 4 core	0.5 Km.		
	(c) 2.5 x 6 core	1 Km.		
	(d) 2.5 x 10 core	2 Km.		
7-	Insulator string disc insulator hardware conductor bus bar material cable tray bay MB camp connector earth wire earthing material etc.	1 Set		
8-	33KV Control & relay panel	1 No.		
9-	Pipe type structure erection	3 MT		
10-	Lattice type structure erection	3 MT		
11-	Structures foundation			
	(a) Gantry	1 No.		
	(b) CB	1 No.		
	(c) CT	3 Nos.		
	(d) LA	3 Nos.		

	(e) Bus isolator	2 Nos.		
	(f) Line isolator	1 No.		
12-	Making of trenches & trench cover & providing support of MS flat for control cable			
	(a) 30cmx30cm	100 Rmt.		
	(b) 60cmx60cm	100 Rmt.		
13-	Erection of earth mat including laying of 40mm MS round welding with riser at least 0.6 mtr. below the round and spreading of gravels	L.S.		
14-	Earthing of all equipments and structure at 2 points	1 Job		
15-	Turffing of switchyard with 10 cum. With CC 1:4:8 and 25mm gauge stone gravel of 10 cm. thick layer	700 Sq.Mtr.		
16-	Illumination system	1 Job		
17-	Cubical metering system with meter etc. complete job	1 Job		
	SUB TOTAL (B) :			
	GRANT TOTAL (A+B) :			

Terms & Conditions :

- 1- The work shall be carried out under the strict supervision of Engineer Incharge.
- 2- The contractor will arrange all the material, T&P and labour required for the proper completion of work.
- 3- The contractor shall use best quality material of PTCUL approved venders only.
- 4- The contractor shall be solely responsible for any kind of loss/damage of its material, T&P and labourer during the complete course of agreement.
- 5- The contractor shall make sure that all the safety measures are followed by its labourers while working inside Substation.
- 6- The work shall be carried out according to standard specification of UAPWD/CPWD which ever is applicable. 43 grade cement of standard ISI Company shall only be used.

**Chief Engineer (O&M)
Kumaon Zone, Haldwani.**

**Signature of Tenderer
With Seal**

TECHNICAL & ERECTION DOCUMENT

1.0 Technical Document Of Equipments

1.1 SF-6 /ANY GAS FILLED CIRCUIT BREAKERS

The circuit breaker 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.	Title	Standard
1.	Aluminium and aluminium alloy ingots and castings for general engineering purposes.	IS 617
2.	Porcelain post insulators for systems with nominal voltage greater than 1000 volts.	IS 2544
3.	Recommended practice for hot dip galvanizing on iron and steel.	IS 2629
4.	Hollow insulators for use in electrical equipment.	IS 5621
5.	High voltage AC Circuit Breakers.	IS 13118
6.	Methods of synthetic testing of high voltage AC circuit breakers.	IS 13516
7.	HV AC Circuit Breakers.	IEC 62271-100
8.	Document and acceptance of new Sulphur Hexafluoride.	IEC 376, 376A, 376B

Reference standards	Name and address
IEC	International Electro Technical Commission Bureau Central de la Commission, Electro Technique International, 1 Rue de verembe Grneva, Switzerland,
IS	Indian Standard bureau of Indian standards Manak Bhawan, 9 Bhaadur Shah Zafar marg, New Delhi-110002 (INDIA)

- In case of conflict, the order of procedure shall be (1) IEC (2) Indian Standard (3) Other alternative standards. This list is not to be considered exhaustive and reference to a particular standard or recommendation in this document does not relieve the supplier of the necessity of providing the goods complying with other relevant standards or recommendation.
- Equipment meeting with the requirement of any other authoritative standards. Which ensure equal or better quality than the standard mentioned above shall also be acceptable.

➤ AUXILIARY POWER SUPPLY

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

(i)	Power devices (like drive motors)	415 V, 3 phase, 4 wire 50Hz neutral grounded AC supply.
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(ii)	D.C. Alarm, control and protective devices	24V DC ungrounded 2 wires.
(iii)	Lighting	230 V, Single Phase 50 Hz. A.C. Supply.

The bidder offering three phase motor for spring charging shall have to make provision of suitable relay contact in series of supply to motor to ensure that supply is switched off immediately after one phase goes. Merely providing MCB in circuit shall not be sufficient.

The purchaser at the terminal point for each circuit breaker for operation of accessories and auxiliary equipment. Supplier's scope include supply of interconnecting cables, terminal boxes etc. The above supply voltage may vary as indicated below and all devices shall be suitable for continuous operation over the entire range of voltages:

(i)	A.C. Supply	Voltage + 10% - 15% Frequency \pm 5%.
(ii)	D.C. Supply	- 15% to + 10%

➤ GENERAL

The manufacturers whose SF6 Circuit Breaker are offered should have designed, manufactured tested as per IEC/IS or equivalent standard supplied the same for the specified system voltage at least for 2 years as on the date of award of contract.

The circuit breakers and accessories shall conform to latest IEC/IS standards.

Circuit breaker offered would be of sulphur hexa-fluoride (SF6) type only..

The circuit breaker shall be complete with terminal connectors one no. trip coil & one no. close coil as spare operating mechanism, control cabinets, piping, cable accessories like glands, terminal blocks, marking, ferrules, lugs, density switches alongwith fixed or detachable type dial gauges, galvanized support structure for CB and control cabinets, their foundation bolts and all other circuit breaker accessories required for carrying out all the functions the circuit breaker is required to perform.

All necessary parts to provide a complete and operable circuit breaker installation such as main equipment, terminals, control parts, connectors and other devices whether specifically called for herein or not.

The support structure of circuit breaker as well as that of control cabinet shall be hot dip galvanized. All other parts shall be painted as per shade 631 of IS-5.

➤ DUTY REQUIREMENTS

The circuit breaker shall be re-striking free as per IEC under all duty conditions and shall be capable of performing their duties without opening resistors. The circuit breaker shall meet the duty requirements for any type of fault or fault location also for line switching when used on a 33 KV effectively grounded system, and perform make and break operations as per the stipulated duty cycles satisfactorily.

(i) Out of phase closing:

One closing operation under phase opposition that is with twice the voltage across the terminals.

(ii) The breaker shall be capable of interrupting the steady state and transient magnetizing current corresponding to rating of the Power Transformers. It shall also be capable of breaking 25% of the rated fault current at twice rated voltage under phase opposition condition.

- (iii) The Breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energisation of lines with trapped charges. The breaker shall also withstand the voltages as per Technical Requirements.

➤ **CONSTRUCTIONAL FEATURES**

The features and constructional details of circuit breaker shall be in accordance with requirement stated hereunder:

CONTACTS

The gap between the open contacts shall be such that it can withstand at least the rated phase ground voltage for 8 hours at zero gauge pressure of SF6 gas due to the leakage. The breaker should be able to withstand all dielectric stresses imposed on it in open condition at lock out pressure continuously (i.e. 2 p.u. across the breaker continuously).

The SF6 circuit breaker shall meet the following additional requirements:

- (a) The design and construction of the circuit breaker shall be such that there is a minimum possibility of gas leakage and entry of moisture. There should not be any condensation of SF6 gas on the internal insulating surfaces of the circuit breaker.
- (b) All gasketed surfaces shall be smooth, straight and reinforced. If necessary, to minimize distortion and to make a tight seal, the operating and connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals. The SF6 gas leakage should not exceed 1% per year. (In case the leakage under the specified conditions is found to be greater than 1 % after one year of commissioning of circuit breaker, the manufacturer will have to supply free of cost, the total gas requirement for subsequent ten (10) years, based on actual leakage observed during first year of operation after commissioning).
- (c) The dial type SF6 density monitor shall be adequately temperature compensated to model the pressure changes due to variations in ambient temperature within the body of circuit breaker as a whole. The density monitor shall meet the following requirements:
 - (i) It shall be possible to dismantle the density monitor for Checking/replacement without draining SF6 gas by using Suitable interlocked non-return valve coupling.
 - (ii) It shall damp the pressure pulsation while filling the gas in Service so that the flickering of the pressure switch contacts does not take place.
- (d) Circuit breaker shall be capable of withstanding a vacuum of minimum 8 millibars without distortion or failure of any part.
- (e) Sufficient SF6 gas will be required for gas Analysis during filling shall be provided to fill the circuit breakers installed. In addition, spare gas shall be supplied in separate unused cylinders as per requirement.
- (f) Minimum 5 nos N.O and 5 nos N.C potential free contact in addition to those required for internal mechanism of breaker shall be provided. Separate limit switches each having required no. of contacts shall be provided in both service and test position of breaker. All contacts shall be rated for making continuously carrying & breaking 10 Amp. At 240 V A.C and 2 Amp 110 V DC.

- (g) For 36 kV rating breakers gang operating mechanism shall be provided.
- (h) The terminal connector shall be as per latest ISS suitable for ACSR dog / Panther conductors.

➤ **SULPHUR HEXAFLUORIDE GAS (SF6)**

- 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.
- 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.

- SF6 gas shall be tested for purity, dew point, air, hydrolysable fluorides and water content as per IEC-376, 376A and 3768 and test certificates shall be furnished to Purchaser.

➤ **INSULATORS:**

The post insulator shall conform in general to latest IS: 2544, IEC-168 and IEC-815.

❖ **Constructional features**

Post type insulator shall consist of a porcelain part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators will be acceptable.

Porcelain used shall be homogenous, free from lamination, cavities and other flaw or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

Glazing of the porcelain shall be of uniform brown in color free from blister, burrs and other similar defects.

The insulator shall have alternate long and short sheds with aerodynamic profile. The shed profile shall also meet the requirements of IEC-815 for the specified pollution level.

When operating at normal rated voltage there shall be no electric discharge between conductor and insulators, which would cause corrosion or injury to conductor, or insulators of substance produced by chemical action.

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.

All ferrous parts shall be hot dip galvanized in accordance with the latest edition of IS: 2633 & IS: 4579. The zinc used for galvanizing shall be grade Zn 99.95 as per IS:

209. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux ash, rust stains, bulky white deposited and blisters. The metal parts shall not produce any noise-generating corona under the operating conditions.

Every bolt shall be provided with a steel washer under the nut so that part of the threaded portion of the bolts is within the thickness of the parts bolted together.

Flat washer shall be circular of a diameter 2.5 times that of bolt and of suitable thickness. Where bolt heads/nuts bear upon the beveled surface they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt.

All bolts and nuts shall be of steel with well-formed hexagonal heads forged from the solid and shall be hot dip galvanized. The nuts shall be good fit on the bolts and two clear threads shall show through the nut when it has been finally tightened up.

Contractor shall make available data on all the essential features of design including the method of assembly of shell and metals part, number of shells per Insulator, the manner in which mechanical stresses are transmitted through shell to adjacent part, provision for meeting expansion stresses results of corona and thermal shock tests, recommended employed to increase life under service conditions.

- ❖ Hollow porcelain should be in one integral piece in green and red stage. No jointed porcelain will be acceptable.

➤ **OPERATING MECHANISM AND CONTROL**

General Requirements

- **36 KV Circuit Breakers shall be operated by spring charged mechanism only.**
- **The mechanism shall be housed in a weatherproof and dust proof control cabinet.**
- The operating mechanism shall be strong, rigid, not subject to rebound and shall be readily accessible for maintenance for a man standing on ground.
- The mechanism shall be anti pumping and trip free (as per IEC definition) under every method of closing.
- The mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operation of the power operating devices.
- A mechanical indicator shall be provided to show open and close position of the breaker. It shall be located in a position where it will be visible to a man standing on the ground level with the mechanism housing closed. An operation counter shall also be provided in the central control cabinet.
- Working parts of the mechanism shall be corrosion resisting material bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker.
- The Contractor shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker. The instruction manuals shall contain exploded diagrams with complete storage, handling, erection, commissioning, troubleshooting, servicing and overhauling instructions.

▪ **Type Of Circuit Breakers:**

Sl. No	Voltage	Gang operated
1.	36KV	√

- **Operating Mechanism For Different Ratings:**

Sl.No.	Ratio	36KV
1.	Rated Current	1250 Amp.
2.	Operating Mechanism	Spring Operated
3.	Quenching medium	SF6

- **Control**

The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.

Each breaker pole shall be provided with two (2) independent tripping circuits, pressures switches and coils each connected to a different set of protective relays.

The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provisions shall be made for local electrical control. For this purpose, a local/remote selector switch and close and trip control switch/push buttons shall be provided in the Breaker central control cabinet.

The trip coils shall be suitable for trip circuit supervision during both open and close position of breaker. The trip circuit supervision relay would be provided on relay panels. Closing coils and associated circuits shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip coil and associated circuits shall operate correctly under all operating conditions of the Circuit breaker up to the rated breaking capacity of the circuit breaker and at all values of supply voltage between 10% and 110% of rated voltage. However, even at 50% of rated voltage the breaker shall be able to operate. If additional elements are introduced in the trip coil circuit, their successful operation and reliability for similar applications on outdoor circuit breakers shall be clearly brought out in the additional information schedules.

Density Meter contacts and pressure switch contact shall be direct use as permissive in closing and tripping and closing circuits. Separate contacts have to be used for each of tripping and closing circuits, If contacts are not suitably rated and multiplying relays are used then fail safe logic schemes are to be employed. DC supplies for all auxiliary circuits shall be monitored and provision shall be made for remote annunciations and operation lockout in case of DC failures. Density monitors are to be so mounted that the contacts do not change on vibration during operation of circuit breaker.

The auxiliary switch of the breaker shall be positively driven by the breaker-operating rod.

This, however, does not absolve the Contractor from the responsibility for safe and reliable operation of the breaker in its lifetime.

- **Spring Operated Mechanism:**

- 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.
- As long as power is available to the motor, a continuous sequence of the closing and opening operations has to be possible. The motor shall have adequate thermal rating for this duty.

- After failure of power supply to the motor one close open operation shall be possible with the energy contained in the operating mechanism.
- 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.
- Closing action of circuit breaker shall compress the opening spring ready for tripping.
- When closing springs are discharged after closing a breaker, closing springs shall be automatically charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.
- 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.
- The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.

➤ **SUPPORT STRUCTURE**

- a) The structure design shall be such that during operation of circuit breaker, vibrations are reduced to minimum.
- b) The Contractor shall provide suitable platform with steps on both sides of the circuit breaker for easy accessibility.

➤ **TERMINAL CONNECTOR PAD**

The circuit breaker terminal pads shall be made up of high quality electrolytic copper or aluminum. The terminal pad shall have protective covers which shall be removed before interconnections.

➤ **INTERPOLE CABLING**

All cables to be used by contractor shall be armoured and shall be as per 15-1554 (1100 Volts Grade). All cables within and between circuit breaker poles shall be supplied. Only stranded conductor shall be used. Minimum size of the conductor shall be 2.5 sq. mm. (Copper)

➤ **FITTINGS AND ACCESSORIES**

Following is a partial list of some of the *major* fittings and accessories to be furnished by Contractor in the central control cabinet. Number and exact location of these parts shall be indicated in the bid.

- i) Cable glands (Double compression type), Lugs, Ferrules etc.
- ii) Local/remote changeover switch.
- iii) Operation Counter
- iv) Control switches to cut off control power supply.
- v) Fuses as required.
- vi) The number of terminals provided shall be adequate enough to wire out all contacts and control circuit's plus 24 terminals spare for future use.
- vii) Antipumping relay
- viii) D.C. Supervision relays
- ix) Rating and diagram plate in accordance with IEC incorporating year of manufacture

➤ **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 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* suitable wrapped or other protected. All paints shall be carefully selected to withstand tropical heat and extreme weather within the limit specified. The paint shall not scale off or wrinkle or be remove abrasion due to normal handling.

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

➤ **Galvanizing**

All ferrous parts including all sizes of nuts, bolts, plain and spring was support channels, structures, shall be hot dip galvanized conforming to latest version -2629 or any other equivalent authoritative standard.

➤ **TECHNICAL PARAMETER**

Installation	:Outdoor
Nominal Voltage (kV)	:33
Highest Voltage (kV)	:36
Rated Current(A)	:1250
Rated Short Time Current (kA)	:31.5 KA for one second
Rated Frequency (Hz)	: 50
No of poles	: 3 (Three)
Type	: SF6 Gas Insulated
Mounting arrangement	: Structure mounted
Operating mechanism	: A.C Motor -wound spring charged (Gang Operated)
Total Break Time (ms)	: < 60
Control Local & Remote	: 79 . 650
Insulation level (kVp)	: 170
Power frequency withstand voltage kV RMS	: 70
Temperature rise	: As per IEC 56
Zinc coating (g/m ²) for galvanized items except hardware	: 610

Insulator

Total creepage (mm)	: 900
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Auxiliary Supply

AC supply for motors and for heaters	: 415V±10%, 3-Ph, 50Hz, 4 wire
DC Control supply for operation	: 220 V 2-wire, ungrounded

OPERATING MECHANISM BOX

Material of sheet for mechanism box	: MS (Painted) / Aluminium
Thickness of sheet in mm	: 2 mm MS / 3 mm Aluminium
No. of Trip Coil	: 2 Nos.

➤ firm shall not be considered.

. CONTROL & RELAY PANELS

TYPE OF PANELS

Simplex Panel

Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from rear for control panels & either front or rear for relay panels. In case of panel having width more than 800mm, double leaf-doors shall be provided. Doors shall have handles with either built-in locking facility or will be provided with pad-lock.

CONSTRUCTIONAL FEATURES

Control and Relay Board shall be of panels of simplex type design as indicated in bill of quantity. It is the responsibility of the Contractor to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes be properly accommodated in the panels without congestion and if necessary, provide panels with larger dimensions. No price increase at a later date on this account shall be allowed. However, the width of panels that are being offered to be placed in existing switchyard control rooms, should be in conformity with the space availability in the control room.

1. Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-31 in accordance with IS: 2147.
2. Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.
3. All doors, removable covers and panels shall be gasketed all around with neoprene gaskets. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.
4. **Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces tune and smooth.**
5. **Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti vibration strips made of shock absorbing materials that shall be supplied by the contractor, shall be placed between panel & base frame.**
6. **Cable entries to the panels shall be from the bottom. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the panel/station through a flexible braided copper conductor rigidly.**

MOUNTING

1. All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush. No equipment shall be mounted on the doors.
2. Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.
3. Contractor shall carry out cut out, mounting and wiring of the free issue items supplied by others which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.
4. The center lines of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The centre lines of relays, meters and recorders shall be not less than 450mm from the bottom of the panel
5. The center 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.
6. At existing station, panels shall be matched with other panels in the control room in respect of dimensions, colour, appearance and arrangement of equipment (centre lines of switches, push buttons and other equipment) on the front of the panel.

PANEL INTERNAL WIRING

- 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**
- 2 All wiring shall be carried out with 650V grade, single core, stranded copper conductor wires with PVC insulation. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows:**
 - All circuits except current transformer circuits and voltage transfer circuits meant for energy metering - one 1.5mm sq. per lead.
 - All current transformer circuits one 2.5 sqmm lead.
- 3 All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & troughs shall be used for this purpose.**
- 4 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.**

- 5 Wire termination shall be made with solderless crimping type and tinned copper lugs , which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule.
- 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.
- 7 Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipments

TERMINAL BLOCKS

- 1 **All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be 650 V grade and have 10 Amps continuous rating, mounded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.**
- 2 Disconnecting type terminal blocks for current transformer and voltage transformer secondary leads shall be provided. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.
- 3 **At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.**
- 4 Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of external cable on each side
 - All CT & PT circuits: minimum of two of 2.5mm Sq. copper.
 - AC/DC Power Supply Circuits : One of 6mm Sq. Aluminum.
 - All other circuits: minimum of one of 2.5mm Sq. Copper.
5. **There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate or panel side wall. Also the clearance between two rows of terminal blocks edges shall be minimum of 150mm.**
- 6 Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring-duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the Owner's external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.
- 7 The number and sizes of the Owner's multicore incoming external cables will be furnished to the Contractor after placement of the order. All necessary cable terminating accessories such as gland plates,

supporting clamps & brackets, wiring troughs and gutters etc. (except glands & lugs) for external cables shall be included the scope of supply.

PAINTING

- 1) All sheet steel work shall be phosphated in accordance with the IS:6005 "Code of practice for phosphating iron and steel".
- 2) Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.
- 3) Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with a slightly alkaline hot water and drying.
- 4) **After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.**
- 5) The phosphate coating shall be sealed with application of two coats of ready mixed, stoved type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.
- 6) **After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall be of a slightly different shade to enable inspection of the painting.**
- 7) **A small quantity of finished paint shall be supplied for minor touching up required at site after installation of the panels.**
- 8) **In case Powder Coating shall also be acceptable. Each coat of finishing synthetic enamel paint shall be stoved. The paint thickness shall be not less than fifty (50) microns.**
- 9) In case the bidder proposes to follow any other established painting procedure like electrostatic painting, the procedure shall be submitted for PURCHASER's review and approval.

MIMIC DIAGRAM

- 1) Coloured mimic diagram and symbols showing the exact representation of the system shall be provided in the front of control panels.
- 2) Mimic diagram shall be made preferably of anodized aluminum or plastic of approved fast colour material, which shall be screwed / plugged on to the panel and can be easily cleaned. Painted overlaid mimic is also acceptable. The mimic bus shall be 2mm thick. The width of the mimic bus shall be 10mm for bus bars and 7mm for other connections.
- 3) Mimic bus colour will be decided and shall be furnished to the successful Bidder during Engineering.
- 4) When semaphore indicators are used for equipment position they shall be so mounted in the mimic that the equipment close position shall complete the continuity of mimic.

- 5) **Indicating lamp, one for each phase, for each bus shall be provided on the mimic to indicate bus charged condition**

NAME PLATES AND MARKINGS

- 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.
- 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.
- 3) **Each instrument and meter shall be prominently marked with the quantity measured e.g. KV, A, MW, etc. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.**
- 4) **Name Plates shall be made of non-rusting metal or 3 ply lamicaid. Name plates shall be black with white engraving lettering.**
- 5) **All the panels shall be provided with name plate mounted inside the panel bearing LOA No & Date , Name of the Substation & feeder and reference drawing number.**

MISCELLANEOUS ACCESSORIES

Plug Point :

240V, Single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15 Amps pin round standard Indian plug, shall be provided in the interior of each cubicle with ON-OFF switch.

Interior Lighting :

Each panel shall be provided with a fluorescent lighting fixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch.

Switches and Fuses :

Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB). Selection of the main and sub-circuit MCB rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall conform to IS :13947 . Each MCB shall be provided with one potential free contact and the same shall be wired for annunciation purpose. However voltage transformer circuits for relaying and metering shall be protected by fuses. All fuses shall be HRC cartridge type conforming to IS:13703 mounted on plug-in type fuse bases. . Fuse carrier base as well as MCBs shall have imprints of the fuse 'rating' and 'voltage'.

Space Heater :

Each panel shall be provided with a space heater rated for 240V , single phase, 50 Hz Ac supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit .

EARTHING

- 1) All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq.mm perforated copper with threaded holes at a gap of 50mm with a provision of bolts and nuts for connection with cable armours and mounted equipment etc for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of Contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.
- 2) All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 sq. mm. The colour code of earthing wires shall be green.
- 3) 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.
- 4) 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.

Annunciation System

- 1) Alarm annunciation system shall be provided in the control board by means of visual and audible alarm in order to draw the attention of the operator to the abnormal operating conditions or the operation of some protective devices. The annunciation equipment shall be suitable for operation on the voltages specified in this specification.
- 2) The visual annunciation shall be provided by annunciation facia, mounted flush on the top of the control panels.
- 3) **The enunciator facia shall be provided with translucent plastic window for alarm point with approximate size of 35mm x 50mm. The facia plates shall be engraved in black lettering with respective inscriptions. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall not be less than 5 mm.**
- 4) **All Trip facia shall and all Non-trip facia shall be identified separately.**
- 5) **In case of static / Microprocessor based Annunciator scheme, special precaution shall be taken to ensure that spurious alarm condition does not appear due to influence of external**

electromagnetic /electrostatic interference on the annunciator wiring and switching disturbances for the neighboring circuits within the panels.

- 6) The audible alarm shall be provided by Buzzer/ Hooter /Bell having different sounds and shall be used as follows.

1 Hooter	Alarm Annunciation
2 Bell	Annunciation DC failure
3 Buzzer	AC supply failure

- 7) **Sequence of operation of the annunciator shall be as follows :**

Sl No	Alarm condition	Fault contact	Visual Annunciation (by Hooter)	Audible Annunciation
1.	Normal	Open	OFF	OFF
2.	Abnormal	Close	Flashing	ON
3.	Accept push button pressed	Close	Steady on	OFF
	Steady on	Open	OFF	
4	Reset push button is pressed	Close	On	OFF
		Open	OFF	
5	Lamp test push button pressed	Open	Steady On	OFF

- 8) Audible annunciation for the failure of DC supply to the annunciation system shall be provided and this annunciation shall operate on 240 Volts AC supply. On failure of the DC to the annunciation system for more than 2 or 3 seconds. (adjustable setting), a bell shall sound. A separate push button shall be provided for the cancellation of this audible alarm alone but the facia window shall remain steadily lighted till the supply to annunciation system is restored.
- 9) A separate voltage check relay shall be provided to monitor the failure of supply (240V AC) to the scheme mentioned in Clause above. If the failure of supply exists for more than 2 to 3 seconds. this relay shall initiate visual and audible annunciation. Visual and audible annunciation for the failure of AC supply to the annunciation system shall be provided and this annunciation shall operate on Annunciation DC and buzzer shall sound.

Switches

- 1) Control and instrument switches shall be rotary operated type with escutcheon plates clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out.

2) The selection of operating handles for the different types of switches shall be as follows :

Breaker, Isolator control switches	:	Pistol grip, black	
Synchronising switches group of synchronising	:	Oval, Black, Keyed handle (one common removable handle switches or locking facility having common key).	for a
Selector switches	:	Oval or knob, black	
Instrument switches	:	Round, knurled, black	
Protection Transfer switch	:	Pistol grip, lockable and black.	

- 3) The control switch of breaker and isolator shall be of spring return to neutral type. The switch shall have spring return from close and trip positions to "after close" and "after trip" positions respectively.
- 4) Instrument selection switches shall be of maintained contact (stay put) type. Ammeter selection switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondary when changing the position of the switch. Voltmeter transfer switches for AC shall be suitable for reading all line- to-line and line-to-neutral voltages for non effectively earthed systems and for reading all line to line voltages for effectively earthed systems.
- 5) The contacts of all switches shall preferably open and close with snap action to minimise arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver or silver alloy. Springs shall not be used as current carrying parts
- 6) The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme.

Indicating Lamps

- 1) Indicating lamps shall be of LED type panel mounting type with rear terminal connections. LED shall have translucent LED covers to diffuse lights coloured red, green, amber, clear white or blue as specified. The LED cover shall be preferably of screwed type, unbreakable and moulded from heat resisting material.
- 2) The supply for these LED shall be from DC station batteries unless stated otherwise.
- 3) The indicating lamps shall withstand 120% of rated voltage on a continuous basis.

Position Indicators

- 1) Position indicators of "SEMAPHORE" type shall be provided when specified as part of the mimic diagrams on panels for indicating the position of circuit breakers, isolating/earthing switches etc. The indicator shall be suitable for semi-flush mounting with only the front disc projecting out and with terminal connection from the rear. Their strips shall be of the same colour as the associated mimic.
 - 2) Position indicator shall be suitable for DC Voltage as specified. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic busbars, and at right angles to them when the object is in the open position. When the supply failure to the indicator occurs, the pointer shall take up an intermediate position to indicate the supply failure.
 - 3) The rating of the indicator shall not exceed 2.5 W.
 - 4) The position indicators shall withstand 120% of rated voltage on a continuous basis.
-

RELAYS

- 1) All relays shall conform to the requirements of IS:3231/IEC-61850 or other applicable standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear. All relays should be of Numerical type.
- 2) All protective relays shall be in draw out or plug-in type/modular cases with proper testing facilities. Necessary test plugs/test handles shall be supplied loose and shall be included in contractor's scope of supply.
- 3) All AC operated relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1/5 amp CT secondary. All DC operated relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.
- 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 suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme, contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.
- 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.

- 6) All Numerical relays shall have facility for networking and communication with Station Monitoring and Control system preferably on fibre optic communication, necessary hardware to communicate on optical link shall be part of the relay offered i.e., in case of relays without optical port necessary electrical to optical converter modules/cards shall be supplied along with the relays.
- 7) No control relay which shall trip the power circuit breaker when the relay is de-energised shall be employed in the circuits.
- 8) Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.
- 9) Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured :
 - 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.
 - 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.
- 10) All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.
- 11) The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.
- 12) Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/ additional equipment shall lie with the PURCHASER.
- 13) **The bidder shall include in his bid a list of installations where the relays quoted have been in satisfactory operation.**

TRIPPING RELAY

High Speed Tripping Relay shall

- (a) be instantaneous (operating time not to exceed 10 milli-seconds).
- (b) reset within 20 milli seconds
- (c) be D.C. operated
- (d) have adequate contacts to meet the requirement of scheme

FLAG RELAYS

These shall have

- (a) hand reset flag indication

- (b) have minimum two contacts (NO or NC or combination as required) for each relay

TRIP CIRCUIT SUPERVISION RELAY

- (a) The relay shall be capable of monitoring the healthiness of each 'phase' trip-coil and associated circuit of circuit breaker during 'ON' and 'OFF' conditions.
- (b) The relay shall have adequate contacts for providing connection to alarm and event logger.
- (c) The relay shall have time delay on drop-off of not less than 200 milli seconds and be provided with operation indications for each phase.

DC SUPPLY SUPERVISION RELAY

- (a) The relay shall be capable of monitoring the failure of D.C. supply to which, it is connected.
- (b) It shall have adequate potential free contacts to meet the scheme requirement.

Numerical full scheme distance protection terminal suitable for use with any communication scheme (Permissive underreach, overreach, blocking) and have facility for connection to substation control system.

CONTROL & RELAY PANEL (for 33kV System)

Various types of control panels shall consist of the following

a)	Ammeter	3 Set	for each Line, BC Bus Section, and Transformer
c)	Wattmeter with transducer	1 set	For each line, transformer
d)	Varmeter with transducer	1 set	For each line , transformer
f)	CB Control switch	1 No.	For each Circuit Breaker
g)	Isolator control switch	1 No.	For each isolator
h)	Semaphore	1 No	For each earth switch
i)	Red indicating lamp	1 No	For each Circuit breaker
j)	Red indicating lamp	1 No.	For each isolator
k)	Green indicating lamp	1 No.	For each circuit breaker
l)	Green indicating lamp	1 No.	For each isolator
m)	White indicating lamp (DC Healthy lamp)	2 Nos.	For each feeder
n)	Annunciation windows with associated annunciation relays	12 Nos.	For each feeder
o)	Push button for alarm Accept/reset /lamp test	3 Nos.	For each control panel
p)	Synchronising socket	1 No.	For each Circuit Breaker if required
q)	Synchronising selector	1 No.	For each circuit breaker switch if required

r)	Protection Transfer	1 No.	For each breaker in case of DMT/DM/SMT schemes (Except TBC and BC Breaker – with by pass isolator)
s)	Mimic to represent SLD	Lot	In all control panels
t)	Voltmeter with selector Switch	1 No.	For each line, transformer, bus reactor
u)	IDMTL 3 phase O/C E.F Protection relay	1	For each line
v)	3 phase Trip Relay	1	For each line

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF 33KV 110VOLT P.T. ALONGWITH STRUCTURE AND JUNCTION BOX.

- 1- Type : Outdoor, single phase, oil immersed, self Cooled.
- 2- Rated Voltage : 33 KV
- 3- Max. operative voltage : 36 KV
- 4- (a) Rated primary voltage : 33 KV / $\sqrt{3}$
(b) Rated secondary voltage : 110 V / $\sqrt{3}$
- 5- Transformer ratio : 33KV / $\sqrt{3}$, 110V / $\sqrt{3}$
- 6- Rated Burden : 50 VA – 100 VA
- 7- Class of accuracy : 0.5 – (3P)
- 8- 1.2/50 micro second impulse withstand test voltage (kv rms) : 170 KV (Peak)
- 9- One minute power freq. dry Withstand test voltage on primary : 3 KV (on earthed transformer)
- 10- One minute power freq. dry Withstand test voltage on secondary : 3 KV
- 11- Confirming to ISS : 3156/1992
- 12- Porcelain bushing
 - (a) Total creepage distance : 900 mm (Min.)
 - (b) Type : Hollow cylindrical
 - (c) Make : CJI/Jaipur glass/IEC/other standard make.
- 13- Mounting details : 350x250 mm approx.
- 14- Rated voltage factor : 1.2 continuous & 1.5 for 30 sec.
- 15- Junction box : 36KV, 3 phase, junction box of size 400x350x190 mm of MS sheet of 2 mm with mounting arrangement & cable gland for secondary cable with 15 nos. connector suitable 3 phase meter.
- 16- Details of mounting structure : 2.2 m legs alongwith angle of 75x75x6 mm by bracing of 50x50x5 mm MS angles.

1.3 36 KV OUTDOOR ISOLATOR

1.3.1 APPLICATION

Normally these are to be used for

- Breaker isolation
- Line connection

1.3.2 TYPE AND CONSTRUCTION

- Triple pole, **double break**, gang operated (Motorised) suitable for outdoor installation in open yard under the specified site condition.
- Two post type with double break and with contacts coming in horizontal plane preferred.
- Common actuating mechanism for all three poles.
- Single pole units shall be interchangeable
- Switch blades shall be of copper and of one solid piece construction
- Inter phase clearance shall be about 2.1 meters and mounting height not less than 3 meters
- Speed of operation during opening or closing shall ensure minimum arcing.
- 36 kV isolator shall be horizontal double break type mounted on structure.

1.3.3 TECHNICAL PARTICULARS

- | | | |
|----|---|---|
| a) | Nominal system voltage | 33 kV |
| b) | Highest system voltage | 36 kV |
| c) | Rated frequency | 50Hz |
| d) | Type | Outdoor station type, double break, triple pole double throw with turn and twist mechanism (Motor operated). With/without earth switch. |
| e) | Continuous current rating | 800A |
| f) | Short time rating 1 sec | 25 kA |
| g) | Rated peak withstand current | 62.5 kA Peak |
| h) | Insulation level of | |
| | i) Impulse withstand voltage (1.2/50 micro sec.) | |
| | Between poles to earth | 170 kV |
| | Across isolating distance | 195 kV |
| | ii) One min. power freq. Withstand voltage (both dry & wet) | |
| | Between poles to earth | 70 kV |

	Across distance	isolating	80 kV
i)	Min. creep age distance		2.54 cm/kV
j)	Operating mechanism		Gang Operated, manual
k)	Termination		ACSR Moose Conductor Both sides
l)	Earthing switch		Mechanically inter locked with isolator Rating of earthing. Switch shall be same as isolator
m)	Auxiliary contacts		3 No + 3 NC
n)	Installation		Pole structure with padlocking facility
o)	Castle key interlock		i) With upstream circuit breaker / isolator. ii) Mechanical interlock with earthing switch for correct sequence of operation.
p)	Control voltage		220 V DC / 240V AC
q)	Temperature rise above 50 ° ambient		45 ⁰
r)	Close and open indication lamp		To be provided in relay & control panel for 33 kV isolator (sufficient auxiliary contacts to be provided for the same).

- Disconnecting blades shall be capable of carrying rated current continuously as well as the specified short circuit current for the duration indicated above without causing mechanical damage to any part and temperature rise damaging the insulation.
- The switches shall be capable of making on to faults specified and withstanding the dynamic stresses involved.
- Shall also be suitable for interrupting small inductive and capacitive currents such as those which occur while disconnecting lines at no load, bus bars or voltage transformers under energized condition.

1.3.4 CONTACTS

- High pressure self aligning adjustable type
- Shall be well protected all round by a metal cover to provide not only electrostatic screening but also to prevent coarse dust from entering between the contacts.
- Sufficient wiping action to make contacts self cleaning.
- Contacts shall be of high grade high conductivity heat resisting copper and shall be silver plated.

1.3.5 OPERATING MECHANISM

- Shall be suitable for manual operation.
- Operating mechanism and its controls shall be so designed that under no circumstances the travel of the switch blades is interrupted before its reaches the fully closed or open position.
- Provision for padlocking the mechanisms in either the open or closed position.

- Housing for the operating mechanism and its control shall be of sheet steel weather and dust proof construction with rubber gaskets conforming to enclosure protection class IP – 55.

1.3.6 EARTHING SWITCHES FOR LINE ISOLATORS

- Disconnecting switches shall be provided with earthing switches on the line side forming integral part.
- Rating of earthing switch shall be same as that of the main isolator / disconnecting switch with respect to rated short time current and dynamic peak withstand current.
- Earthing blade shall be operated by a separate mechanism but interlocked so that it can be closed only when the main disconnecting switch is open and vice-versa.

1.3.7 TERMINAL CONNECTION

Shall be provided with high conductivity terminal connection suitable for ACSR conductors.

1.4 36 KV LIGHTNING ARRESTORS

1.4.1 GENERAL

Standard Lightning Arrestors shall strictly confirm to IS-3070 part-3 (1993) and IEC – 99/4 with latest amendment.

- Station class, 10 kA, heavy duty, non-linear resistance, metal oxide type gapless lightning arrester for 33 kV systems.
- Self-supporting type in single pole assembly.
- Suitable for pedestal mounting.
- Outdoor type suitable for installation in open yard.
- Shall be designed to provide maximum protection against lightning and switching surges.

1.4.2 TECHNICAL PARTICULARS

- | | | | |
|----|------------------------------------|---|-------|
| a) | Nominal system voltage | : | 33 kV |
| b) | Highest system voltage (rms) | : | 36 kV |
| c) | Rated arrester voltage (rms) | : | 30 kV |
| d) | Continuous operating voltage (rms) | : | 24 kV |
| e) | Frequency | : | 50 Hz |
| f) | Power frequency with stand | : | 70 kV |

	test voltage		
g)	Impulse voltage	: 170 kV peak	75 kV peak
h)	System neutral connection	: Solidly Earthed	Solidly Earthed
i)	Nominal discharge current for 8/20 micro Sec.	: 10 kA peak	5 kA peak
j)	Long duration discharge class as per IEC 99-4	: 2	
k)	Maximum residual voltage at nominal discharge current of 8/20 micro sec. wave kV peak	: 100 kVP	
l)	Maximum steep current impulse (1/20 micro sec.) residual voltage at nominal discharge current (kVp)	: 110 kVP	
m)	Arrester Housing		
	a) One minute power frequency withstand voltage kV (rms)	: 70	
	b) Lightning impulse withstand voltage (kVP)	: 170	
n)	Prospective symn. fault current for pressure relief test kA (rms)	: 40	
o)	Disconnecting device	: Disconnecting devices IS : 3070 (Part-II) shall be connected in series with ground lead.	
p)	Minimum creeping distance of porcelain housing (mm)	: 900	300

1.5 CURRENT TRANSFORMER

1.5.1 TYPE

- 33kV outdoor type suitable for installation in open yard.
- Oil bath type and epoxy molded dry type for 33kV.

1.5.2 TECHNICAL PARTICULARS

a)	Standard	: IS - 2705 (1992)
b)	Nominal system voltage	: 33 kV
c)	Highest system voltage	: 36 kV
d)	Rated frequency	: 50 Hz, $\pm 3\%$
e)	System neutral earthing	: Solidly earthed.
f)	Short time thermal current rating for 1 sec. duration	: 25 kA (rms)
g)	Class of insulation	: B
h)	Insulation level	

-	Peak impulse withstand voltage	:	170 kV
-	Rated one minute power frequency wet and dry withstand voltage	:	70 kV
i)	Accuracy class	:	PS & 0.2
j)	Output burden	:	30 VA
k)	Knee point Voltage	:	1200 V/ 600 V
l)	Excitation current	:	40 mA
m)	Secondary resistance	:	< 5Ω
n)	Terminal	:	Suitable for ACSR conductors / Aluminium pipe for 33kV.
o)	Marshalling Box	:	IP – 55 enclosure
p)	For rating, ratio, class of	:	Refer Bill of Quantities.

1.5.3 TECHNICAL PARTICULARS

a)	Nominal system voltage	:	33 kV
b)	Nominal current rating	:	800/400/1 A
c)	Bus conductor	:	ACSR Moose Conductor
d)	Short time current rating for 3 (three) seconds	:	25 kA
e)	Deflection of bus-bars supported on post insulators shall not exceed	:	Half the diameter of busbar or L/14.4 cms (where L is the span in meters)

1.5.4 CLEARANCES

The net clearance in air for bus bars, Jumpers etc. shall not be less than that given in CBIP manual.

1.5.5 ACSR Conductor

• CONSTRUCTION

- Conforming to IS 398 (Part-II), 1996.
- Aluminium wire made from at least 99.5% pure electrolytic aluminium rods of EC grade with copper content less than 0.04%.
- Steel wires uniformly coated with electrolytic high grade, 99.95% pure zinc.
- Steel strand hot dip galvanized with minimum coating of 250 gm/sq.m. after standing.
- No joints permitted in the individual aluminium wires and steel core of the conductor.
- Standard length of conductor shall be 2500 mtr. with a tolerance of $\pm 5\%$

• **TECHNICAL PARAMETERS**

Sl. No.	Description	Type of Conductor	
		Moose	
1.	Wire diameter Aluminium (mm)	54/3.53	
	Steel (mm)	7/3.53	
2.	Sectional area of Aluminium (sq. mm.)	528.5 Sq mm	
3.	Total sectional area (sq. mm.)	597.0 Sq mm	
4.	Overall diameter	31.77 mm	
5.	Approximate weight (kg. / km.)	2004	
6.	Maximum calculated D.C. resistance at 20 ⁰ C (ohms/km.)	0.05552	
7.	Ultimate tensile strength (KN)	161.2	
8.	Final modulus of elasticity (GN/sq.m.)	69	
9.	Coefficient of linear expansion x 10 ⁻⁶ per ⁰ C	19.3	
10.	Technical particulars of aluminium and steel strands	<i>Steel</i>	<i>Al</i>
a.	Diameter		
	Nominal (mm)	3.53	3.53
	Maximum (mm)	3.60	3.57
	Minimum (mm)	3.46	3.49
b.	Cross-sectional area of nominal diameter wire (mm ²)	8.814	9.787
c.	Weight (kg./km.)	68.75	26.45
d.	Min. breaking load (KN)		
	Before stranding	10.67	1.57
	After stranding	10.14	1.49
e.	D.C. resistance at 20 ⁰ C (ohm/km)	-	2.974

Accessories for compression, twisting joints, repair sleeve shall form part of ACSR conductor. Clamps and connector for connecting of ACSR conductor shall be made of alloy casting.

Bi-metallic connectors shall be used for connecting equipment terminals made of copper or brass, bolts, nuts and washers for connector shall be made of mild steel and shall be electro-galvanized and passivated to make them corrosion resistant conforming to requirements of BS 1706.

1.5.6 H.T. INSULATORS

The insulators shall conform to the relevant latest IS standards (IS 2544,731,1248) and made of hard porcelain. Creepage distance shall be adequate for polluted outdoor atmosphere. Glazing of the insulator shall be uniform brown color, free from blisters, burns and other similar defects.

The insulators shall have technical particulars as detailed below:

33kV

i)	Type	70 KN Disc(11 kV, 4 disc in strings)
ii)	Nominal system voltage kV (rms)	33
iii)	Highest system voltage kV (rms)	36
iv)	Wet power frequency one minute withstand voltage (kV, rms)	75

v)	Power frequency puncture kV (rms)	1.3 times the actual voltage dry flash over voltage
vi)	Impulse withstand voltage kV (Peak)	170
vii)	Visible discharge voltage kV (rms)	27
viii)	Creepage distance in mm (minimum)	580
ix)	Minimum failing load	10 KN (45KN for Disc Insulators)

1.5.7 H.T. INSULATORS

The insulators shall conform to the relevant latest IS standards (IS 2544,731,1248) and made of hard porcelain. Creepage distance shall be adequate for polluted outdoor atmosphere. Glazing of the insulator shall be uniform brown color, free from blisters, burns and other similar defects.

The insulators shall have technical particulars as detailed below:

33kV

i)	Type	Post/Disc/Pin
ii)	Nominal system voltage kV (rms)	33
iii)	Highest system voltage kV (rms)	36
iv)	Wet power frequency one minute withstand voltage kV (rms)	75
v)	Power frequency puncture kV (rms)	1.3 times the actual voltage dry flash over voltage
vi)	Impulse withstand voltage kV (Peak)	70
vii)	Visible discharge voltage kV (rms)	27
viii)	Creepage distance in mm (minimum)	580
ix)	Minimum failing load	10 KN

1.6 HT POWER CABLES

1.6.1 APPLICABLE STANDARDS

The materials shall conform to the latest editions of the following Indian/ International Standards:

IS 7098 Part 2 : 1985	XLPE insulated PVC sheathed cables for working voltages from 3.3 kV up to and including 33 kV.
IS 5831 : 1984	PVC Insulation and Sheath of electric Cables
IS 8130 : 1984	Conductors for insulated electric cables and flexible cords
IS 613 : 1984	Copper rods and bars for electrical purposes
IS 3975 : 1988	Mild steel wires, formed and tapes for armoring of cable
IS 10810 : 1984	Method of tests for cables
IEEE – 383 :1974	Standard for type test of class IE electric cables, field splices and connections for nuclear power generating stations
ASTM-D2843, 1993	Standard test method for density of smoke from

	burning or decomposition of plastics
ASTM-D2863, 1981	Standard test method for measuring minimum oxygen concentration to support candle – like combustion of plastics (oxygen index)
NEMA-WC5, 1992	Thermoplastic Insulated Wire and cable for the transmission and distribution of Electrical Energy
IEC-754 (Part-I) : 1994	Test on gases evolved during combustion of electric cables. Determination of the amount of halogen acid gas evolved during combustion of polymeric materials taken from cables
IEC:332 (Part-I):1993	Test on electric cables under fire conditions. Test on a single vertical insulated wire or cable.
IS 3961 (Part-II):1967	Recommended current rating for cables. PVC insulated and PVC sheathed heavy duty cables
IS 10418:1982	Drums for electric cables

1.6.2 GENERAL REQUIREMENTS

- All cables shall be suitable for high ambient, high humid tropical Indian Climatic conditions. Cables shall be designed to withstand the mechanical, electrical and thermal stresses under the unforeseen steady state and transient conditions and shall be suitable for proposed method of installation.
- Aluminum Conductor shall be uniform, of good quality, and free from defects.
- Insulation shall be Cross Linked Polyethylene (XLPE).
- For cables, conductor screen and insulation screen shall both be extruded, semi-conducting compound and shall be applied along with XLPE insulation in a single operation by triple extrusion process. Method of curing of cables shall be “Dry curing/ Gas curing/ Steam curing”.
- Cables shall be provided with copper metallic screen suitable for carrying earth fault current. For single core armoured cables the armouring shall constitute the metallic part of the screening.
- Inner sheath – All armoured and multi-core un-armoured cables shall have distinct extruded inner PVC sheath of black color.
- Armouring - Material for armour for Single Core Cable shall be Aluminum wire. For Multi core cable it shall be GS wire/ flat. Armouring shall be as per relevant IS and it shall have minimum 90% coverage.
- Outer Sheath – It shall be of black colour PVC (type ST2 as per IS 5831) with Cable size and Voltage grade embossed on it. Sequential marking shall be at every 1 Meter distance. Word “FRLS” shall also be embossed on it at every 5 meter distance.
- FRLS Properties – All cable shall be Flame Retardant, Low Smoke (FRLS) type. Outer sheath shall have the following properties.
- Minimum bending radius shall be 10 D

- Repaired cables shall not be acceptable.

1.6.3 CURRENT RATING OF CABLES

- Normal current rating shall not be less than that covered by IS 3961. Tenderer shall submit data in respect of all cables in the prescribed format.
- Tables given de-rating factors for various conditions of cable installation including the following, for all types of cables shall be furnished.
 - Variation in ambient air temperature.
 - Cables laid in trench
 - Grouping of cables
- The value of short circuit withstand current ratings of all cables shall be indicated for a short circuit for 3 second duration and should also specify the maximum temperature during short circuit.
- The following factors shall also be accounted for, while specifying the maximum short circuit withstand of the cables.
 - Deformation of the insulation, due to thermo-mechanical forces produced by the short circuit conditions, can reduce the effective thickness of insulation.
 - Conductor and core screens can be adversely affected with loss of screening effect. Likewise the thermal properties of the outer sheath material can be the limitation.
- It is essential that the accessories which are used in the cable system with mechanical and/ or soldered connections are suitable for the temperature adopted for the cables.
- Formula for calculating short circuit current for different duration or curve showing short time current v/s time for different sizes of cables shall be furnished by the Tenderer.

1.7 ILLUMINATION SYSTEM

1.7.1 LIGHTING SYSTEM

All outdoor switchyard, substation/control room shall be properly illuminated by tenderer. The following details are given below :

Sl. No.	Area	Lux level	Type of fittings
1.	Out-door Switchyard	100 lux.	250/W, HPSV

Lighting system shall be complete with hangers, Clamps, junction boxes, conductors, cables and all accessories to make the lighting installation complete in all respect.

1 No. 1400 mm sweep ceiling fan with electronic regulator, Two nos. 15A plug – sockets etc. shall be provided in office room, exhaust fans will be provided for toilet room with control devices. At least 2 Nos. of pedestal fans shall be provided in the substation control room.

1.7.2 LIGHTING DISTRIBUTION BOARD

Lighting distribution board shall have following features:

- Sheet steel enclosed, wall mounted, hinged neoprene gasket door, slotted opening for the operating handle / knob of switch / miniature circuit breaker.
- Incoming power supply 415V, 3 phase, 4 wire 50 Hz, neutral solidly earthed Board shall have short circuit capability of 10kA.
- Incoming MCB (Isolator type) without release and outgoing 20 A, SP, MCB, 9KA channel mounted type.
- 30% spare outgoing circuit to be provided in the LDB for future use.
- Complete pre-wired up to terminal block for external connection.

1.7.3 COLOUR CODE

Following colour codes shall be followed for electrical equipment :

Sl. No.	Equipment	Colour	Paint shade No. as per IS-5, 1991	Equivalent. RAL Code
1.	Outdoor structures, nuts, bolts etc.	MS	-	-
2.	Transformer and Outdoor equipment	Dark admiralty gray,	632	7012
3.	HT Switchgear panels	Light Gray	631	7042
4.	LT Switchboard charger etc.	Light admiralty Gray	697	6010
5.	Panels, DBS etc.	Light admiralty Gray	697	7001
6.	Junction Boxes	Light Gray	631	7042
7.	Earthing	Black	-	-

Painting of all equipment shall be as per relevant IS, manufacturer's practice to ensure long lasting, without causing rust, peeling off Any touch-up painting as required shall be done by tenderer including supply of paints etc. at no extra cost.

B- ERECTION DOCUMENT

1.0 GENERAL

- All electrical installation shall conform to the Indian Electricity Act, IE Rules and Regulation in force, in the state, by electrical inspectorate.
- All works under this contract including the installation of the equipments shall be got inspected and approved by the relevant authorities like Electrical Inspectorate etc.
- The circuit breaker, current transformers, lightning arresters, power transformers etc., shall be examined on receipt for damages. The contractor shall assemble, install and connect the equipment wherever necessary as per manufacturer's recommendations. The assembly of the unit including their operating mechanism, site adjustments shall also be carried out as per guiding instructions from the manufacturer. The equipment shall be placed and levelled carefully on their respective structures. All the preparatory works such as civil foundations, any concrete channels etc., shall be completed prior to this.
- The operating mechanism and control circuit of the equipment shall be tested for proper opening, closing and position indication. The opening and closing tests shall be made from control points as in service operation.
- Earthing of supporting structures and metal parts of operating mechanism operating cabinets, operating handles at ground potential shall be ensured. Where moving parts are involved, flexible copper conductors shall be used.
- Before charging the equipment, contractor shall submit the completion report for each equipment indicating rectifications / modifications carried out during erection, site test certificates with observations, rectifications carried out. Contractor shall also indicate the correctness of operational and safety interlocks. Site test certificates shall also indicate the corresponding values obtained in the factory test.
- The conductor/jumpers shall be correctly and effectively connected to the terminals of equipment. The faces shall be cleaned with fine cloth and lightly coated with petroleum jelly before use. However, if contacts are silver plated, they shall not be cleaned with emery paper. The connection shall be flexible to withstand stresses during switching operation.
- The control cabling shall be effectively crimped to the cable lugs which shall be bolted tight after ensuring that the contact faces are clean. Small wiring that is necessary between units in accordance with the diagram of connection shall be made complete.
- In outdoor switchyard, the structure required for 33 kV renovated equipment shall match with the existing system.

2.0 INSTALLATION OF 33 KV SF-6 CIRCUIT BREAKER

2.1 GENERAL

- The circuit breakers shall be assembled and erected on the support structures as per the manufacturer's instructions and drawings and shall be aligned accurately and levelled on the support structures.
- Perfect operation of the circuit breaker shall be ensured after erection by manual operation. Each bearing of the operating mechanism shall be properly lubricated.
- The contractor shall follow the following sequence of erection of SF-6Circuit Breaker
 - Transportation to the place of installation from contractor's stores.
 - Unpacking the cases and physical inspection of the components for breakages, missing parts or damage as compared with the packing list.
 - The foundation must be plane and horizontal so that the Circuit breaker rest firmly on foundation.
 - Assembly and erection of the circuit breaker shall be done strictly as per the instruction and drawings from the manufacturer. Corresponding part of each pole marked in the packing list shall be strictly adhered to. Breaker installation shall be checked for proper leveling and alignment.
 - Adjust the operating rods between poles and the operating mechanism as directed by manufacturer, before closing the breaker at full speed. Check the "indicating distance" by operating the breaker slowly to the closed position.

2.2 WIRING OF THE CIRCUIT BREAKER OPERATING CUBICLE

- Laying, meggering, termination, dressing and clamping of control cables, bus-bars, jumpers etc.
- Testing and marking of cables.
- Cleaning of all insulating surfaces with dry cloth or as indicated by the manufacturer.
- Functional tests on the circuit breaker.
- Painting of all accessories, structures etc.
- Earthing of all the metal parts and structures not intended to be live.
- Submission of site test certificates, completion report etc., in the proper format.
- Handing over to engineer/owner.

3.0 INSTALLATION OF ISOLATOR/DISCONNECTING SWITCH

- The poles of the disconnecting switches shall be aligned accurately and leveled on the supporting steel structures. Sequence of installation of disconnecting switch parts shall be carried out as recommended by manufacturer.
- Perfect operation of disconnecting switch, earthing switches shall be ensured after erection by manual operation. Working clearance between adjacent structures and switch blades in open position shall be checked.

- The switches shall be adjusted so as to permit operation with ease by one man. Each bearing of the operating mechanism shall be properly lubricated.
- Laying, termination of power and control cables, checking of internal wiring connections.
- The contractor shall also check for the key interlocking of the earthing switch with the main disconnect switch. Earthing between units, earthing terminals to structure, operating handle to structure and ground mat should be effective and neatly taken through structures and foundation. Ground mat shall be positioned right below the operating handle of the disconnect switch, visible at all times.

4.0 INSTALLATION OF CURRENT TRANSFORMER

- Current transformers shall be mounted on the steel supporting structure with secondary terminal boxes in pre-determined position so that cable can be conveniently taken without much bends and twisting.
- Interconnection wiring should be kept as short as possible, both for economy and to produce low burdens. The cable shall be taken neatly through suitable galvanised iron conduits to trench sections wherever required.
- Apart from general earthing, one terminal of secondaries of current transformers shall be earthed solidly through adequate section of solid copper conductor.

5.0 INSTALLATION OF LIGHTNING ARRESTERS

- The lead connecting lightning arrester with line should be direct without any splice or other joint and the connection should be effective to carry the lightning discharge currents. The lightning arrester shall be positioned in such a way that short and straight leads can be run from the earthing terminal of the arrester to the earth electrode specifically provided for this purpose. The arrester exhaust ports should be directed away from the equipment and other arrester.

6.0 INSTALLATION OF CONNECTING MATERIALS IN SWITCHYARD

- The arrangement of connections shall be such that the connected apparatus are not subjected to any mechanical stress due to expansions, contractions etc., of the connections.
- The connections shall ensure good electrical contact. The connector and joints shall be rigid to withstand all mechanical and electrical stresses. Suitable bi-metallic clamps shall be used for all the connections between the conductors of different materials.
- All live parts shall have sufficient practical clearances from earthed parts and ground. The clearances of strung busbar shall be decided considering the effect of sag. In applying clearance an allowance shall be made to cater for variation in making foundation and in the dimensions of structures and buildings.

- The contractor shall be responsible for supplying and installing the various conductors required for connection of the various equipment. The tenderer's scope shall include all bolts, nuts and washers required for installation. All connections etc., shall be so made that stress between connecting terminals will be reduced to the minimum.
- The physical layout of the system shall be such that the system extension or conversion can be carried out with minimum changes and easy methods. Further, it shall be ensured that all civil works for the foundations are completed by the contractor before taking up erection of structure.

7.0 INSTALLATION OF SWITCHGEAR PANELS

- The base frame of all panels shall be welded to the structures or to the civil inserts provided on the floor. Fabrication of support / frames , wherever required shall be done by the contractor.
- The shipping section shall be placed in position before removing the protective covering to eliminate scratch / damage. The shipping section shall be moved by using rollers under the shipping skids wherever lifting cranes are not available. The contractor shall do the assembly at site as per the manufacturer's General Arrangement drawings and installation instructions. While assembling a complete board comprising several unit type cubicles, the board as a whole shall be aligned. The panels shall be properly levelled prior to grouting the holding down bolts or welding the panels to the inserts. All interconnection of the bus-bars and wiring between the panels shall be done as per manufacturer's instructions and drawings. Welding work on the panels shall only be carried out after consultation with the purchaser. Damage to the paint during welding shall be rectified by the contractor.
- After mechanical installation of the board is completed loose instruments shall be installed wherever required, and wires shall be connected to the instruments. The wiring of intermediate terminal strips between two panels, wherever disconnected for transport, shall also be connected.

8.0 INSTALLATION OF GROUNDING/EARTHING

- Entire system shall be earthed in accordance with the provisions of the relevant IEC recommendations / IS code of practice IS 3043-1987 and Indian Electricity Rules, so that the values of the step and touch potentials in case of faults, are kept within safe permissible limits.
- The principal requirements of the grounding are :
 - a) Low resistance and adequate current carrying capacity.
 - b) Uniform and near uniform ground potential on all structural metal work on all metal enclosures and/or supports of equipment and apparatus.
- The resistance of earthing network shall be less than 1 ohm for the network of outdoor yard under all conditions. The earthing network shall be as per actual site conditions.
- The contractor's scope of installation will also include all the civil work associated with complete earthing network.

- All earth connection shall ensure a permanent low resistance contact. Earth connections required to be removed for the purpose of testing of equipment/earthing network shall have bolted connection and joints fastened. All earthing connections shall be visible for inspection.
- Switchyard fencing and all equipment located at switchyard, shall have 2 separate distinct earth connections.
- Lightning arresters and transformer neutrals shall be connected to two independent earth electrodes as per IS 3043.
- Air termination rods of lightning protection systems shall be connected to earthing network as per IS 3043.
- The grounding connection to the lightning arresters, air termination points of lightning protection system shall be as short as possible. Sharp turns in these conductors shall be avoided.
- It has to be ensured that main earth bus in the installation as well as earth buses in individual sections/areas shall form complete ring and they shall be interconnected.
- Duplicate earthing (two separate and distinct connections with earth) shall be employed for all equipments.
- Wherever burying of earth conductors are specified, they shall be buried as per approved drawings.
- Wherever earth conductor crosses the road, it shall be taken through GI pipes.
- At all terminations of earth conductors on equipments, sufficient length shall be left for easy movement of the equipment from its position for alignment purposes.
- Wherever not detailed, the route of the conductor and location of the earth pit shall be arranged, so as to avoid obstructions, crossing etc., according to convenience at site and shall be got approved by the owner's representative in-charge of the work.

9.0 INSTALLATION OF EARTH PITS

- The arrangement of earth electrode/pit shall be as shown in IS 3043. Termination arrangement of interconnecting earth strips is included in the scope of earth pit. Interconnecting earth flats shall be jointed by welding to the termination arrangement on the electrode. Electrode will be 50 mm dia pipe of 3 m length, medium class, in a single piece.
- The distance between two pits shall not be less than 6 meters.
- All accessories required for the earth pits such as electrodes, charcoal, salt, clamps, clips, bolts/nuts, washers, GI pipes, funnel cast iron cover and also the masonry works of the pits including supply of necessary materials, bricks, cement and excavation of earth for providing earth pit shall be part of rate quoted for earth pit.
- The electrodes shall be well packed with earth, charcoal and salt mix up to the level of connections.

- Masonry work of the earth pit shall be carried out only after well ramming of riddled soil and complete settling of loose soil. As such electrodes shall be fixed in the ground before commencing of any other work of the installation and masonry work shall be taken only at the end after completion of all other works in the installation.

10.0 JOINTS/TERMINATIONS OF EARTH STRIPS

- All joints of bare galvanised earth strips shall be welded so as to form rigid earth ring. All such welded joints shall be given necessary coating of cold galvanised paint as per relevant standards and a coat of suitable bitumen compound to prevent corrosion. Welded joints shall form part of laying of earth conductors and they shall not be considered as terminations for payment purposes. No extra costs shall be applicable for joints of all the earth conductors.
- In case the joints are made by using suitable connectors the entire joint shall be fully sealed by suitable compound so that no metallic part is exposed.
- The contractor shall make his own arrangements for the necessary crimping tools, soldering equipments, drilling machines and other tools and tackles which are necessary for completing the installation.

11.0 ERECTION AND COMMISSIONING, TOOLS AND TACKLES

- The contractor shall provide all tools/tackles, jigs and fixtures, winches, alignment tools, welding sets, testing kits, testing meters/instruments, breaker, handling devices, all consumable items and construction equipment as required in installing the work, complete in all respects and shall include but not be limited to bolts, nuts, rivets, welding rods, shims, wedges, packing sheets, packing compounds, oil, flushing oil, protective greases and oils, all materials required for proper installation and protection of individual equipment in storages, and during erection, testing and commissioning.
- This shall also cover proper alignment, tack welding, tagging, laying, marking of and connection of cables, fabrication, supply and installation of all support structures for installation of various electrical equipments and cables.
- Supply and installation of first aid boxes, shock treatment charts, rubber mats, keyboard.
- The rubber mats shall be provided in front of all control panels/switchgears to comply with Indian Electricity Act.
- Erection, testing and commissioning of various equipments shall be done strictly as per manufacturer's instructions.
- All plant and equipment the painting of which has been damaged during transportation/erection or by corrosion shall be given two coats of paint after removal of scales, rust, oil etc.
- All iron frame work erected shall be provided with one under coat of primer and one top coat of finish paint.
- Cable shall be always laid in conduit upto 2 meter of height in case of vertical run to avoid mechanical damage.

- Cable shall be laid in separate racks according to voltage levels and between two cables horizontal clearance equal to diameter of cables shall be provided in the hooks.
- Maximum cross section areas of cable passing through conduit shall not exceed 60% of cross section of conduit.
- Approved type of danger boards, boards inscribing 'EARTHED', 'DO NOT CLOSE', 'MEN AT WORK' etc, shall be provided in sufficient numbers.
- Special care shall be taken to make the enclosed equipment protected against entry of rats, lizard, and creeping reptiles which may create electrical short circuits.

12.0 STAGES OF COMPLETION OF WORKS

- The stages of completion of various works shall be as follows :

12.1 COMPLETION OF ERECTION

- Equipment shall be considered to be completely erected when the following activities have completed.
 - Moving of all equipment to the respective foundations.
 - Aligning the equipment
 - Fixing of anchor bolts or tack welding as required
 - Drying of equipment as required and testing of oil for dielectric strength.
 - Assembling of all accessories such as relays, CTs, PTs, meters, instruments etc. as described in job document.
 - Filtration and filling of oil as required.
 - Cable laying termination with continuity checking.
 - Applying of finish coat of paint
 - Completion of earthing system.
 - Removing of unwanted materials and covering of all openings including cable openings, conduits etc.
- In other words, erection shall be considered to be complete where the equipment is ready for testing with all other associated equipments required for commissioning. In this matter the opinion of Purchaser/Consultant shall be final.

12.2 COMPLETION OF TESTING

- Testing of equipment shall be considered as complete after the following operational tests.
 - Testing/commissioning of all panels and equipments as specified.
 - Checking of all circuits/ schemes for correct connections and continuity.

- Reworking as required during testing and retesting.
- Charging of the equipments.

12.3 CABLE INSTALLATION

12.4 Mode of Cable Installation

- Straight through joints shall not be permitted in cables.

12.5 TRENCHES

- The maximum depth of all trenches shall normally be 1.0 meters, the maximum soil cover above the protective slabs shall be 75 cms, unless otherwise agreed. The back filling of the excavation shall be carried out without disturbing the cover slabs or damaging the cables.

12.6 CABLE LAYING IN TRENCHES

- The cables shall be laid on 80 mm of riddled sand and covered with 100 mm riddled sand and covered with approved protective slabs of reinforced concrete.
- Unless agreed otherwise, all power cables shall be spaced at a distance of 15 cms horizontally.

12.7 MARKERS

- Approved cable markers of reinforced concrete shall be provided and fixed to mark each and every deviation of all buried cable routes. A marker shall also be placed every 50 meters along straight portions of each route.
- A concrete cable marker shall also be provided and fixed to mark the position of every buried joint.

12.8 SUPPORTING STEEL WORK FOR OUTDOOR SWITCH YARD EQUIPMENT

- All supporting steel work shall be free from dirt, rust or scale and shall be painted.

12.9 CABLE SUPPORTING STRUCTURE

- Cable supporting structures shall use angle of minimum size of 50 x 50 x 6 mm
- The structure shall be painted. For laying cable in the substation and switch yard existing cable structure may have to be extended or few cable structures shall be provided.
- Fixing to concrete and brick work
- The cable supporting material shall be fixed to concrete and brick work by the use of anchor bolts. Fibre plugs shall not be used.

13.0 CABLE IN PIPE

- Cable pipes, kick guards shall be provided to protect the cables, where the cables rise through holes at ground level.

- Not more than one cable shall be drawn into one pipe unless agreed otherwise.
- After the cable has been drawn in, the pipe shall be sealed by an approved means.

13.1 CABLE TERMINATIONS

- The cable shall be terminated in accordance with the relevant diagrams.
- The cable cores from the sealing box or gland, to the terminals of the apparatus shall be neatly dressed & arranged, and shall be of sufficient length to prevent the development of tension or local pressure on the insulation. They shall be suitably supported wherever required.

13.2 IDENTIFICATION AND MARKING

- End of each core of every control cable shall be fitted with tight ferrules of approved make and white non-inflammable plastic insulation material, having the marking engraved in black to correspond with the relevant diagram. Where the ends of one conductor have different markings, each end shall also have white ferrules engraved in red with the remote marking.
- Distinguishing labels of non-corrodible material marked in accordance with the cable numbers of the cabling diagram shall be permanently attached to each end of every cable.
- The phase or polarity of each power cable core at the cable ends shall be identified as follows :
AC system : Phase - Red, Yellow and Blue painted discs
Neutral - Black painted disc

13.3 CONNECTION TO TERMINALS

- Power cable connections shall be made with cable lugs of approved type and materials, taking into account the bimetallic actions
- All control circuit connections shall be made with the bare conductor with the use of washers, crimped lugs etc.
- The ends of all stranded conductors shall be twisted tightly together.
- Solid or stranded conductors shall be connected to terminal studs by taking one complete turn around the stud between the flat washers.
- Connections to an easy wiring terminal shall be made with a straight end conductor.

13.4 PROTECTION OF CABLES

All cables shall be installed such that the risk of subsequent damage is minimised. Steel guards shall be provided where necessary.

13.5 SEALING

All cables passing from one electrical premises to other i.e basement to cable trench, basement to cable tunnel, spare ducts etc. to be sealed properly to prevent seepage of water.

13.6 GUIDELINES FOR CLEARANCE IN ELECTRICAL PREMISES

All the substation building sizes shall be decided as per the following guidelines :

- All equipment/ panels shall have minimum 1250 mm back clearance all around them.
- The front to front clearance of switch boards / panels shall be minimum 2500 mm.
- Clearance between two panels installed in a row shall be minimum 1000 mm.
- Clearance between wall and end of the panels shall be minimum 1000 mm.

13.7 CABLE CHANNELS

- The cable channels shall have removable covers for the full width.
- Minimum working passage of 500 mm shall be provided between cable racks or between cable rack and wall.
- Shall have suitable drainage facility to avoid accumulation of seepage water.

13.8 SAFETY PARTITIONS AND ENTRIES

- Doors shall be provided for electrical buildings.
- All the cable openings on the equipment floor shall be sealed.

14.0 CIVIL WORKS

14.1 SCOPE OF WORK

The contractor's scope for civil engineering works shall include complete engineering and construction inclusive of

1. Any other drawing and execution works not mentioned specifically but required for overall completion and handing over of the system as a whole.
 2. Supply of all construction materials, tools and tackles, labourers and execution of works complete as required for electrical buildings, equipment foundations and associated facilities for 33 kV Power sub-stations.
- Removal of debris, micro leveling of the site up to 20m all around buildings and premises within the scope of contract prior to completion of work.
 - The Contractor shall undertake, within the battery limits, any change in the location of units/ items and / or building numbers/ parameters, sizes etc which may be necessary during engineering/ execution from those indicated by the Contractor in their contract drawings at no additional cost to the purchaser.
 - All other civil works that will be necessary to complete the work in all respects for smooth functioning of the system.
 - The contractor shall not make any additional claim if the total concrete quantity or quantity of any other civil engineering items required for completion of the entire

package as per terms of contract exceed the quantity / Nos indicated by the contractor in BOQ of this section or for supply and execution of any other quantity/items beyond BOQ.

- Broadly the civil works pertains to the following works in general but are not necessarily limited to the same.
 - 33 kV outdoor switchyard
 - Equipment foundation
 - Gravel pitching for outdoor equipments
 - Cable Channel
 - Yard fencing with 1.8m wire mesh fencing.
 - Inside the periphery, 1.5 meter wide stone aggregate path of 100mm thickness shall be provided with 20mm aggregate to size for walking.
 - Grouting electric poles etc. wherever, required.
- Apart from the broad scope the following shall also be included in the scope of work.
 - i. Area shall be gently slopped outwards for draining rain water.

14.2 MATERIAL AND WORKMANSHIP FOR CIVIL WORKS

14.2.1 EARTHWORK

- Earthwork and blasting of rock/ hard strata shall be carried out generally as per stipulations laid down in BIS codes and as directed by the Engineer The Contractor shall adopt a suitable dewatering system for carrying out earthwork concrete and shuttering work and other underground work .The Contractor shall carry out compaction of sub-grade necessary to achieve the design criteria of floors and foundations taking into consideration the settlement limits. Method of compaction shall depend upon the materials to be used and verified by the contractor by site testing at his own cost. Surplus and unsuitable materials shall be disposed suitably at locations within a lead indicated by the Purchaser. If required the backfilling material shall be brought to the site by the contractor at no additional cost. Availability of dumping yard and borrow pit may be within or outside the plant boundary. Dozing and spreading of the dumped earth, if necessary, shall be done by the Contractor at no additional cost to the Purchaser.
- Apart form shoring and temporary supports all other necessary measures shall be provided, if necessary for protection of existing underground services at no additional cost to the Purchaser.
- The checking and correctness of al min centre lines is the responsibility of the Contractor irrespective of any checking by Purchaser.
- Backfilling shall be done withe selected earth in layers to fill up the left out portion after concreting, walling etc. so as to achieve the required compaction. All materials being used shall be confirming to relevant BIS code.

14.2.2 CONCRETE AND REINFORCED CONCRETE STRUCTURE

- The ingredients to be used in the manufacture of concrete shall consist solely of Portland cement, clean said natural coarse aggregate, clean water and admixtures, if conditions at site warrant its use.
- All concrete and reinforced concrete structures shall be constructed as per structures shall be constructed as per stipulations of BIS codes and as directed by the Engineer.
- The mix design adopted shall be suitable for proper strength workability and service condition of the structure. Minimum cement content and maximum water cement ratio shall be normally as per stipulation of BIS codes. However in case of exposure to aggressive environments, the mix design adopted shall be suitable to ensure durability of the concrete under that condition.
- Unless specifically approved by the Engineer the maximum nominal size of coarse aggregates for concrete under that condition. Steel reinforcement to be used shall be as per BIS Codes.

14.2.3 SERVICE LINES AND PLUMBING

- All service pipelines, water supply, plumbing and other utility pipelines within the buildings of RC / masonry construction shall be concealed within the masonry, Concrete work etc or by removable wooden panels.
- All buildings with toilets/ drinking water facilities shall be provided with water storage tanks at roof of the buildings.
- Reference grid point and bench marks shall be made available to the contractor.
- The Contractor shall do other necessary work for controlling reference grid.

14.3 GENERAL SUB-SOIL CONDITIONS

The tenderer shall visit the site and collect all relevant data regarding site, soil sub-soil etc before quoting the price quoted by the contractor shall be firm and no additional payment will be allowed on account of variation in subsoil condition.

The successful tenderer shall make his own arrangement for soil investigation in consultation with the consultant and submit the reports with out without additional cost to the Purchaser. The investigation work shall be (both field & Laboratory) shall be carried out following relevant IS: codes through approved agency and will be supervised by the Purchase The scope of soil investigation work, data and recommendation derived from the soil investigation (carried out by the Contractor) shall have to be approved by the Purchaser before implementation in design and / or construction.

14.4 SITE CONDITIONS

- Site clearance of muck debris etc. and disposal of the same shall be included in the scope of contractors work.

The Contractor shall be deemed to have visited and carefully examined the site and surroundings to have satisfied himself about the nature of all existing structures foundations etc existing underground services general site conditions the site for disposal of surplus materials debris etc and all other matters affecting the work. Claims and objections and objections due to ignorance of site conditions shall not be considered after submission of the

14.5 TECHNICAL RULE FOR CIVIL ENGINEERING WORKS

14.5.1 GENERAL

- This Technical Rule is meant for civil Engineering works included in the scope of work in the package .It includes loading standards permissible stress functional requirement quality standards architectural guidelines norms etc to be adopted as a basic for preparation of designs and drawings and drawings by the contractor.
- The design prepared by the contractor shall not only provide for the requirements indicated in this Technical Rule but also consider the overall process requirements service conditions and provisions to be made for future expansion the designs shall be compatible with the operating conditions in the plant and the atmospheric conditions prevalent at locations of project site.

14.5.2 STANDARDS

- The design criteria for civil engineering work shall be in according with this Technical Rule. Detailed instructions on such aspects as are not indicated herein Shall be as per the latest standards codes and recommendations of the Bureau of Indian standards (BIS) documents

14.5.3 DESIGN

PERMISSIBLE STRESSES

Allowable stresses for all reinforced concrete structures shall be as per IS:459 and for pre-stressed concrete structures as per IS:1343

FOUNDATIONS

- Foundations for structures and equipment shall be proportioned to resist the worst conditions of loadings and shall be generally designed as per the provisions of IS:1904.
- The depth of foundation shall be determined based on loading on foundations level constructional and technological requirements the maximum allowable bearing pressure for design of foundation shall correspond to values confirmed by results of detailed soil investigation taking into account limits of allowable settlement considered for design of

structures and equipment generally the foundation shall be taken down to at least 600mm below natural ground level in case of soil with approval of Purchaser.

- Generally foundation for buildings & equipment shall not be structurally connected ground floor slab the top level of the stem for building column foundations shall be so provided that no part of the steel column base assembly protrudes over finished floor level the column base assemblies shall be encased with concrete up to floor level.
- Foundations of equipment subjected to dynamic loading shall be isolated from adjoining floors foundations to prevent propagation of vibration to adjoining structures.
- Supporting structures and foundations for equipment which may cause vibration shall be designed for the dynamic effect of equipment together with the direct loads the dynamic loads and other relevant data required for analysing the dynamic effect shall be taken as per manufacturers data and recommendations.
- Structures and foundations supporting vibrating equipment shall be proportioned to avoid resonant frequencies the dynamic analysis shall be done as per the stipulations as recommended by respective Is codes as well as the stipulations recommended by Equipment manufacturer.

UNDERGROUND STRUCTURES

- Based on the data on subsoil and underground water adequate precautions shall be taken for design of foundational and under ground structure all underground structures such as sumps pits trenches etc shall be designed considering soil water and surcharge pressure from the surrounding areas Adequate precautions against floatation shall be taken.
- Water tightness of expansion and construction joints shall be ensured by provision of PVC water bars of approved type & suitable joint soiling compound.

14.5.4 CHEMICAL PROTECTION TO STRUCTURES AND FOUNDATION

Concrete structures floors and foundation coming in contact with acid/ alkalies /other chemical shall be provided with acid Proof treatment/ lining as stipulated under finishing details separately.

14.5.5 CONCRETE AND REINFORCED CONCRETE FOR STRUCTURES AND FOUNDATIONS

- Concrete work shall secure a dense homogeneous smooth mass including required finishes possessing required strength and resistance to weathering and abrasion for the structures and foundations
- Design of all reinforced concrete structures shall be as per the IS: 456 and of pre-stressed concrete structures as per IS:1343 The structural safety of all foundations on soil shall in general be based on IS:1904 The design of water retaining structures shall be according to IS:3370

- For calculation purpose Working Stress Design or Limit State Design methods may be adopted but design shall be consistent throughout.
- Unless other wise specified minimum grades of concrete to be used shall be as follows

Plain cement concrete M15

General Reinforced M20

14.5.6 EXTERNAL CLADDING INTERNAL PARTITIONS AND FINISHES

- This section deals with cladding internal partitions and finishes.
- External cladding for all buildings including auxiliary buildings an service buildings where specified shall be constructed of brick masonry having minimum 230 mm Design of masonry walls shall conform to IS:1905.
- Masonry walls of thickness 200mm or more shall be constructed in cement sand mortar not leaner than 1:6 Partition walls of half brick walls shall be constructed in 1:4 cement sand mortar with suitable reinforcement.
- All brick shall be plastered on both sides. Thickness of plaster shall be minimum 20 mm for unfair faces and for all external surfaces and 15mm for internal walls with fair faces. Thickness of plaster for ceiling shall be minimum 6mm.
- Cement sand mortar mix for plasters shall be 1:6 20 mm thick plastering shall be done in two layers.
- All outside & inside plastered surfaces of masonry walls shall be applied with Snowcem or equivalent cement based paint and to be applied as per manufacturer's document.
- Painting on ceilings shall be done with Snowcem or equivalent cement based paint matching with wall finish.
- Walls in toilets shall be provided with mat finish ceramic wall tiles 100 mm x 200mm x 6mm (approx) thick dado of approved make and colour up to a minimum height of 2.1 m walls above dado shall be coated with two coats of oil bound distemper over a coat of primer
- 100 mm high skirting shall be provided in all rooms except where there is a provision for dado

14.5.7 CABLE AND PIPE TRENCHES

- All cable/ pipe trenches etc inside various premises shall be made of reinforced water tight concrete and shall be covered with chequered plate suitably designed taking into account loading conditions. The out-door trenches shall be covered with pre cast RCC slabs with necessary lifting arrangement.

- All electrical cables at road crossing shall be taken through conduit pipes or cable ducts as per electrical document

14.5.8 DRAINS

- All drains shall be made of RCC or PCC depending on depth and discharge volume and provided with pre-cast RCC covers with lifting arrangements as per requirement.
- Generally minimum earth coverage of one metre shall be provided over underground drainage sewer pipe lines.

15.0 LIST OF RELEVANT IS CODES

<u>IS CODE NO.</u>	<u>TITLE</u>
IS:269-1989	Document for 33 grade ordinary Portland cement.
IS: 383-1970	Document for coarse and fine aggregates from natural sources for concrete.
IS:432 (PART-1)- 1982	Document for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement mild steel and medium tensile steel bars.
IS:432 (PART-20)- 1982	Document for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforced hard drawn steel wire
IS:455-1989	Document for Portland slag cement
IS:456-1978	Code of practice for plain and reinforced concrete -
IS:458-1988	Document for pre-cast concrete pipes with or without reinforcement
IS:651-1992	Document for salt glazed stone ware pipes and fittings
IS :783-1985	Code of practice for laying of concrete pipes
IS: 814-1991	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel
IS:816-1969	Code of practice for use of metal arc Welding for general construction in mild steel
IS:875-(PART- 1)1987	Code of practice for design loads 9 other than earthquake) for buildings and structures dead loads.
IS:875-(PART- 2)1987	Code of practice for design loads other than earthquake) for buildings and structures imposed loads
IS:875-(PART- 3)1987	Code of practice for design loads other than earthquake) for buildings and structures wind loads
IS:875-(PART- 5)1987	Code of practice for design loads other than earthquake) for buildings and structures special loads & load combinations
IS: 1003 (PART-1) 1991	Document for timber panelled and glazed shutters windows and ventilator shutters
IS: 1003 (PART-2) 1993	Document for timber panelled and glazed shutters windows and ventilator shutters
IS:1038-1983	Document for steel doors windows and ventilators
IS:1080-1986	Code of practice for design and construction of shallow foundations on soil (other than raft ring and shell)

IS:1081-1960	Code of practice for fixing and glazing of metal (steel and aluminum) doors windows and ventilators.
IS:1172-1993	Code of basic requirement for water supply drainage and sanitation.
IS:1346-1991	Code of practice for water proofing of roofs with bitumen buildings
IS:1361-1978	Document for steel windows for Industrial buildings
IS:1786-1985	Document for high strength Deformed steel bars and wires for Concrete reinforcement
IS: 1893-1984	Criteria for earthquake resistant design of structures
IS:1904-1986	Code of practice for design and construction of foundation in soil General requirement
IS:1905-1987	Code of practice for structural use of un-reinforced masonry
IS: 2062-1992	Structural Steel(Fusion welding quality) Structural steel (fusion welding quality)
IS:2191(PART-1) – 1983	Document for wooden flush door shutters (cellular and hollow core type)-plywood face panels
IS:2191(PART-2) – 1983	Document for wooden flush door shutters (cellular and hollow core type)-practical board and hard Board face panels
IS:2202(PART-1) – 1981	Document for wooden flush door shutters (solid core type plywood face panels)
IS:2202(PART-2) – 1983	Document for wooden flush door shutters (solid core type particle board and hard board face panels
IS:2470(PART-1) – 1985	Code of practice for installation of septic tanks design criteria and construction
IS:2470(PART-2) - 1985	Code of practice for installation of septic tanks secondary treatment and disposal of septic tank effluent
IS: 2751 -1979	Welding of mild steel plain and deformed bars for reinforced concrete construction
IS:2950-(PART-1) – 1981	Code of practice for design and construction of raft foundations design
IS:3006-1979	Document for chemically resistant glazed stone ware pipes and fittings
IS: 3114 -1985	Code of practice for laying of cast iron pipes

16. INSPECTION AND TESTING

16 INSPECTION

16.1 GENERAL

Inspection & testing of equipment covered under the Technical Document shall be carried out by the Purchaser / Consultant at the manufacturers' works/ premises prior to despatch to ensure that their quality & workmanship are in conformity with the contract documents and approved drawings.

16.1.2 RESPONSIBILITY FOR INSPECTION

Any inspection by the Purchaser/ Consultant does not relieve the responsibility of quality assurance and quality control functions, as expected of the contractor to be performed by him for supply of plant & equipment as part of the contractual obligations.

16.1.3 Extent of Inspection

Routine test as per BIS for 100% equipment.

Type test shall be carried out on each type of equipment for which the tenderer fails to produce Type Test Certificates carried on similar type of equipment within 3 years period

16.1.4 TESTS, TEST CERTIFICATES AND DOCUMENTS

For each of the items being manufactured, following test certificates and Documents (as applicable for each of the equipment) in requisite copies shall be prepared and submitted to the Inspection Engineer for scrutiny & records.

Routine / type / calibration / acceptance / special test certificates for electrical items

Certificates from competent authority for the items coming under statutory regulations.

Should the result of tests not come within the margin specified, the tests shall if required be repeated at Contractor's cost without any liability to the Purchaser.

16.1.5 METHODS OF GIVING INSPECTION CALLS

Inspection calls shall be given by the contractor with ten days notice period as per proforma (11.20 (DQM) F05/2 Rev.0).All calls shall accompany two sets of relevant test certificates and inspection report of the Contractor /sub- contractor after satisfactory completion of internal inspection and tests by them as per approved QAP .Inspection calls without enclosing relevant test certificates & internal inspection report shall not be entertained .

16.2 TESTING

Test of all equipment shall be conducted as per latest BIS.

The site tests and acceptance tests to be performed by contractor are detailed below.

The contractor shall be responsible for satisfactory working of complete integrated system and guaranteed performance.

16.2.1 SITE TESTS AND CHECKS

All the equipment shall be tested at site to know their condition and to prove suitability for required performance .

Following tests shall be conducted after installation. All tools, accessories and required instruments shall have to be arranged by the Tenderer.

Any other tests which is considered necessary by the manufacturer of the equipment has to be conducted at site.

The tests to be carried out on the equipment at pre-commissioning stage shall include but not limited to the following

16.2.2 SF-6 CIRCUIT BREAKER /

1. IR test on each pole by Meggar (Between poles and lower poles to ground)
2. IR tests on control circuits.
3. Functional check of breaker operation on minimum and maximum specified control voltages.
4. Checking of interlocks with isolators & earthing switches.
5. Measurement of contact resistance.
6. Checking of operation and tripping of protection release .
7. Checking tightness of termination connectors and earthing connections.
8. Checking of insulators for cracks etc.
9. Check for closing and opening time and simultaneous closing of all poles through oscillograph.
10. Tripping of circuit breaker at reduced or over voltage i.e. at 60% & 110%

16.2.3 ISOLATOR/ DISCONNECTING SWITCHES

1. IR test by HV Meggar on main poles.
2. IR test on control circuits.
3. Measurement of contact resistance for all three phases.
4. Functional checking for manual operation.
5. Checking of interlocking with earth switch
6. Checking of earth switch operation.
7. Checking tightness of earthing connections.
8. Checking of insulators for cracks.

16.2.4 LIGHTNING ARRESTOR

1. Continuity check (for metal oxide type only)
2. Check for connection to ground.
3. Check insulators for cracks.
4. HT and IR test of each element.
5. Check reading of leakage current

16.2.5 CURRENT TRANSFORMER

1. IR test on each winding, winding to earth and between windings.
2. Checking of winding ratios by primary injections set.

3. Polarity check on each winding.
4. Continuity check for all windings
5. Check for connections to correct taps.
6. Checking of oil level
8. Checking of continuity and IR values for cables from CT to Marsh Box.
9. Checking tightness of earthing connections.
10. Checking of insulator for cracks.
11. Check output after loading of the main circuit

16.2.6 POTENTIAL TRANSFORMER

1. IR test on each winding, winding to earth and between windings.
2. Polarity check on each winding.
3. Continuity check for all windings
4. Turns ratio test
5. Check for connections to correct taps.
6. Checking of oil level
7. Checking tightness of earthing connections.
8. Checking of insulator for cracks.

16.2.7 INSULATORS

1. Checking tightness of connections.
2. Check for minor damage/ cracks after cleaning.
3. Verification of number of disks as per drawings.
4. Check heating at termination point during shut down.

16.2.8 ACSR CONDUCTOR

1. Check for continuity
2. Check for tightness of connections for all the termination points.
3. Check for phase sequence marking and for their correctness.
4. Physical verification

16.2.9 CONTROL & RELAY PANELS

1. IR Value test by meggar
2. Checking of control cable connection.
3. Operational test of all components mounted on control & relay panel .
4. Testing and calibration of indicating meters.
5. Testing of all relays including auxiliary relays for their pick up, drop out values , operation at all taps etc with the help of relay testing kits
6. Setting of relays as per approved setting table and checking its operation for one below and one upper settings in the scheme.
7. Measurement of current and voltage in relay operating coils by secondary injection in CT and PT circuit .
8. Measurement of current and voltage in relay and meter circuits during loading of the primary circuit / system.
9. Testing of al schemes for their functions as per approved drawings.
10. Check operation of relays at minimum/ maximum control voltage as per the document.
11. Integrated testing of protective relays for operation of master trip relay and tripping of breakers from operation of master trip relay

12. Check earthing connection of panels, fixing of panels and opening from side and bottom.
13. Testing of TVM meters.
14. Checking and adjustment in TVM meters as per the manufacturer's instructions.

16.2.10 CABLES

1. Checking of continuity/ phasing and IR values for all the cables before and after HV test.
2. HV test and measurement of leakage current after termination of cable kits (for HT cables)
3. Checking of continuity for Armour and fourth core (if applicable)

16.2.11 EARTHING

1. Check tightness of all each connections
2. Check earthing of all metallic equipment, busbar supporting structures, yard Fencing steel structures of yard, rails, gates, building column (if steel) all elect. equipment water pipe lines etc. as per the drawing/ document.
3. Measurement of earth resistance for each electrode.
4. Measurement of total earth resistance.

16.2.12 LIGHTNING PROTECTION

1. Check continuity of all the earth strips/ shield wire .
2. Check tightness of all connections.
3. Measure earth resistance of each electrode and combined system.

16.2.13 MISCELLANEOUS

1. Checking of continuity of the system .
2. Checking of phase sequence from overhead line to consumer end.
3. Checking safe accessibility of all operating points .
4. Check availability of control/ aux. supply.

GUARANTEED TECHNICAL PARTICULARS

The following Guaranteed Technical Particulars shall be submitted by the Tenderers.

Sl. No.	Descriptions	Details
1	2	3
1. SF-6 CIRCUIT BREAKER		
1.	Rated voltage kV	
2.	Rated continuous voltage for rated MVA	
	a) Maximum kV	
	b) Minimum KV	
3.	Type of quenching medium	
4.	No. of Poles	
5.	Whether all 3 poles are ganged mechanically.	
6.	Pole to Pole spacing	
7.	Continuous current	
	a) Under site conditions, Amps.	
	b) Rated time, secs.	
8.	a) Rated short time current kA rms	
	b) Rated time, secs.	
9.	Maximum rise of temperatures over ambient for current rating.	
10.	Rated operating duty.	
11.	Interrupting capacity based on duty cycles	
	a) Symmetrical at rated voltage in KA & MVA.	
	b) Asymmetrical at rated voltage, kA	
	c) Symmetrical at service voltage, kA	
12.	Rated short time current of breaker IS(KA) and dynamic current (KAp)	
13.	Rated restriking voltage	
	a) Amplitude factor	
	b) Rated-of-rise at natural frequency	
	c) Type of devices used to limit the rate of rise of restriking voltage.	
14.	Making capacity, kA peak	
	a) At higher rated voltage	
	b) At lower rated voltage	
15.	a) Partial discharge level	
	b) Noise level of equipment db measured at meter	
16.	Insulation level of the breaker	
	a) One-minute power frequency withstand voltage kV rms.	
	b) Switching surge withstand test voltage kV (peak)	
	c) Impulse withstand test voltage kV (peak)	
17.	Corona and visual discharge	
	a) Radio interference voltage at KV, micro volts	
	b) Visual discharge voltage for falling power frequency voltage kV	

18.	Insulator		
	a)	Insulation class	
	b)	One minute dry power frequency withstand kV (rms)	
	c)	10 seconds wet power frequency withstand kV (rms)	
	d)	Flashover voltage, kV	
	e)	Full wave impulse withstand voltage, kV (peak)	
	f)	Switching surge withstand voltage kV(peak)	
	g)	Corona discharge voltage kV	
	h)	Nature of the dielectric medium employed in the bushings	
	i)	Ionized Creepage distance mm	
		Total	
		Protected	
	j)	Volume of insulating medium per bushing liters.	
	k)	Permissible safe cantilever loading on installed bushing.	
19.	Time difference between pre-insetion of resistance and closing of main contact.		
20.	Make Time (ms)		
21.	Break Time (ms)		
2.	36 kV Isolator (Outdoor)		
1.	Manufacturer's name		
2.	Manufacturer's type designation		
3.	Standards applicable		
4.	Type		Double break Horizontal type
5.	Rated voltage kV		
6.	Rated frequency		
7.	Current rating		
	a.)	Continuous A (at design temp.)	
	b)	Current rating at site condition A	
	c)	Dynamic through fault kA	
	d)	3 second rating kA	
	e)	Making current A	
8.	Design ambient temperature (° C)		
9.	Maximum temperature of current carrying parts when carrying rated current at specified ambient temperature, ° C		
10.	Maximum temperature of current carrying parts when carrying short circuit current for 3 seconds, °C		
11.	One minute power frequency dry & wet withstand voltage		
12.	1.2 / 50 micro sec. Impulse withstand voltage.		
13.	Switch contact particulars		
	a)	Type of main isolating contacts	
	b)	Area & material of contacts.	
	c)	Thickness of silver facing	
	d)	Blade material	
14.	Number of auxiliary contacts on disconnecting switch		
15.	Rating of auxiliary contacts		
	a)	Continuous A	

	b) Breaking current at 220 V DC.	
16.	Type of interlock between earthing blade and isolator	
17.	Particulars of isolator operating mechanism	
18.	Duty	Outdoor/Indoor
19.	No. of operations, the disconnecting switch can withstand without deterioration of contacts.	
20.	Clearance	
	a) Between phases, mm	
	b) Between live parts & earth, mm	
	c) Between fixed contacts and blade in open position, mm	
21.	a. Capacitive current that can safely be interrupted by the switch, A	
	b. Magnetizing current that can safely be interrupted by the switch, A	
22.	Type and make of insulator	
23.	No. of insulators per stack	
24.	One minute dry & wet withstand voltage per stack, kV(rms)	
25.	Impulse withstand voltage of insulator stack at 1.2/50 micro seconds positive full wave, kV(peak).	
26.	Creepage distance	
	a) Total mm	
	b) Protected mm	
27.	Total weight, Kg.	
28.	Dimensions of switch LxBxH(mm x mm x mm)	
29.	Shipping dimension of largest package	
30.	Provision of earthing switch	One side/both side
31.	G.A. drg. Of disconnect switch along-with support structure	Submitted/not submitted
32.	Supporting structures	
	a) Material	
	b) Total weight/Isolator, kg.	
	c) Thickness of galvanizing, micron	
	d) Total height of structure in mm	
33.	Power and control power supply voltage.	
34.	Confirm that all particulars given in technical particulars are acceptable to tenderer	Yes/No
35.	If answer is 'NO' in above then indicate point wise deviation	
3. 36 kV Current Transformers (Outdoor)		
1.	Name of manufacturer	
2.	Manufacturer's types designation	
3.	Type	
4.	Standards followed.	
5.	Rated Voltage(kV)	
6.	Rated primary current/voltage	
7.	Rated secondary current/voltage	

8.	Number of cores	Rated out put	Class of accuracy	Accuracy limit factor
	Core I			
	Core II			
	Core III			
9.	Short time current rating			
	i) 1 second, kA (rms)			
	ii) 3 seconds, kA(rms)			
10.	Dynamic current kA(peak)			
11.	Temperature rise over max. site ambient °C			
	i) Oil at top of housing(° C)			
	ii) Winding (° C)			
12.	Class of insulation			
13.	Current/voltage and phase errors at rated burden and frequency			
14.	Confirm that all particulars given in technical data sheet are acceptable.	Yes/No		
15.	If answer is 'NO' in 14, indicate point wise deviation.			
4. 30 KV Lightning Arrester (Outdoor)				
1.	Manufacturer's name			
2.	Manufacturer's type designation			
3.	Applicable standard(s)			
4.	Arrestor class and type			
5.	Rated arrester voltage kV (rms)			
6.	Nominal system voltage, kV (rms)			
7.	Rated frequency, Hz			
8.	Nominal discharge current (8/20 micro sec. wave) kA (peak)			
9.	Max, 100% 1.2/50 micro sec. Spark over voltage, kV (peak)			
10.	Max. front of wave spark over voltage, kV(peak) & front steepness kV/sec.			
11.	Max. residual voltage at rated nominal discharge current kV(peak)			
12.	Impulse current withstand			
	a) High current short duration (4/10 micro sec. Wave), kA (peak)			
	b) Low current long duration, Amps.(peak)			
13.	Wet and dry power frequency withstand voltage for the housing, kV (rms)			
14.	Impulse withstand strength of arrester housing, with 1.2/50 micro-sec. Wave kV (peak)			

15.	Total creepage distance of the arrester housing, mm	
16.	Protected creepage distance of the arrester housing, mm	
17.	Total weight of material included for Supporting structures	
	Thickness of galvanizing, micron	
	Total height of structures in mm	
18.	Suitable for outdoor duty.	Yes/No
19.	Confirm that all particulars given in tech. Part sheet are acceptable.	Yes/No
20.	If answer is 'NO' in 19 indicate point-wise deviation	
5. Insulators.		
1.	Make	
2.	Type	
3.	Material of insulator	
4.	Colour	
5.	Insulation level: Dry (PF)	
	Wet (PF)	
	Impulse	
6.	Creepage distance	
	a) Total (mm)	
	b) Protected (mm)	
7.	Power freq. Puncture test	
8.	Visible discharge test volt	
9.	Suitable to connect	
10.	For support insulators minimum height of base from ground	
11.	Number of disc in string insulators.	
12.	Rated voltage for disc in kV	
13.	Deviation if any from the data sheet.	
6. ACSR Conductors/Aluminum Bus		
1.	Make	
2.	Type	
3.	Size	
4.	Nominal current rating at maximum site ambient	
5.	Short time rating for 3 sec. (in kA)	
6.	Rated dynamic stability current kA (peak)	
7.	Weight per mtr in kg	
8.	Clearance	
	Phase to phase	
	Phase to earth	
7. Supporting Structures		

1.	Make	
2.	Type	
3.	Material used	Steel/RC
4.	Thickness of galvanizing (for GI)	
5.	Designed for wind load	
6.	Designed for earth quack load	
7.	Matching with equipment arrangement	Yes/No
8.	Design calculations for sizing	Will be as per approved calculations for each structures
9.	Scope of work	Support for the equipments bus wires etc. as per approved equipment layout
10.	Foundation bolts and base bolts (bolts shall be projected. Min. 75 mm above the base plate)	Included
11.	Standard followed for fabrication (for steel structures)	
12.	Approach ladder provision	
13.	Deviation if any on technical data sheet	
8. Control & Relay Panel		
1.	Make	
2.	Type	
3.	Reference Standard	
4.	Construction	
	a. Degree of protection	
	b. Sheet metal thickness mm	
	c. Floor channel sills, vibration damping pads and kick plate furnished?	
5.	Equipment Mounting	
	a. All relays, meters and switches are flush mounted?	
	b. Relays furnished in draw out cases with built-in test facilities?	
6.	Name plate	
	a. Material	
	b. Thickness	
	c. Size for: -	
	Equipment Panels	
7.	Internal illumination	
	a. Volt	
	b. Watt	
	c. Door switch controlled	
8.	Space Heater	
	a. Volt	
	b. Watt	
	c. Thermostat Controlled?	
9.	Plug Socket	

	a. Type	
	b. Rating	
10.	Panel illumination, space heater and plug socket circuits provided with individual switch fuse units?	
11.	Internal Wiring	
	a. Wire type	
	b. Voltage grade	
	c. Conductor material	
	d. Conductor size for: -	
	i. Current /control circuit	
	ii. Voltage circuit	
	e. Wires identified at both ends with ferrules?	
12.	Terminal block	
	a. Make	
	b. Type/ Catalogue No.	
	c. 20% spare terminals furnished?	
13.	Ground Bus	
	a. Materials	
	b. Size mm	
14.	Painting	
	a. Type of finish	
	b. Colour shade Inside/Outside	
	c. Details of painting procedure furnished?	
15.	Breaker Control Switch	
	1. Make	
	2. Type	
	3. Reference Standard	
	4. Contact Rating	
16.	a. Make & continuous Amp	
	b. Break (inductive) Amp	
17.	Meter Selector Switch	
	1. Make	
	2. Type	
	3. Reference Standard	
	4. Contact rating	
	a. Make and continuous Amp.	
	b. Break (inductive) Amp.	
18.	Push Button	
	1. Make	
	2. Type	
	3. Reference Standard	
	4. Contact rating	
	a. Make and continuous Amp.	
	b. Break (inductive) Amp.	

	5. No. and type of contacts provided per button	
19.	Lamps	
	1. Make	
	2. Type	
	3. Reference Standard	
	4. Rating	
	a. Volt	
	b. Watt	
	c. Series resistance	
20.	Indicating instruments	A V TVM F PF
	1. Make	
	2. Type	
	3. Reference Standard	
	4. Type of movement	
	5. Accuracy Class	
	6. Scale in degrees.	
	7. VA Burden:	
	a. Current Coil	
	b. Voltage Coil	
	8. Size	
	9. Range	
	10. Rated input	
	11. Overload capacity without loss in accuracy (%)	
a) Continuous		
b) Short time		
12. Burden on CT/PT		
21	Annunciator	
	1. Make	
	2. Type	
	3. Reference standard	
	4. No. of Annunciator groups furnished ?	
	5. No. of Windows per group.	
	6. Overall dimension of a group mm	
	7. Details write-up on scheme furnished ?	
22.	Illumination Status Indicators for Isolators	
	1. Make	
	2. Type	
	3. Rating	
	a) Volt	
	b) Watt.	
23.	Semaphore Indicators	
	1. Make	
	2. Rating	
	a) Volt	

	b) Watt	
24.	Fuses	
	1. Make	
	2. Type	
	3. Fuse bases provided with imprints of fuse rating and voltage	Yes/ No
25.	Relays	
	1. Catalogue of all relays submitted with bid:	
	2. Whether tenderers agree to conduct all site tests as asked	Yes/No
	3. If 'No' indicate deviations	
	4. Whether quality assurance plan is acceptable	Yes/No
	If 'NO' indicate deviations.	
	5. Whether tenderer agree to provide No. of aux. Relays timers, range of relays/meters terminal blocks, control switches, wiring etc as per approved drawings	
	6. Minimum clearance between Relay /meter/ casings Horizontal Vertical	
	7. Deviation if any on technical design parameters for control protection- metering and alarm system.	
8. Any additional protection metering, control features, if necessary/ desirable from tenderer's point of view		
9.	Illumination System	
	Outdoor Lighting	
	No. of poles/ tower envisaged	
	Type of poles/tower envisaged	
	Type of fittings envisaged	
	Make of fittings	
	Lux level to be obtained	
	Provision of escape lighting	
	Location of main and sub DBs	
	Control of lighting	Manual and automatic
	Automatic	Photo cell / clock type
	Cable laying in ground	Buried/conduit
	Cable laying above ground	
	Cables laying for light fittings to pole	Flexible steel conduits of through poles
	Deviations if any on technical data sheet	
10.	Earthing and Lighting Protection	
	Earthing	
	Size of earth strip for the yard	
	Gap between earth mat conductors	
	Size of main outer strip	

	Galvanizing content on above	
	Value of earthing resistance (proposed to be achieved)	
	Standard to be followed for galvanizing	
	Type of electrodes	
	Construction of earthing pit as per IS	Included
	Deviations if any on technical data sheet Cable Identification Tag Material Thickness Binding wire material	
	Buried cable markers/covers Applicable Standards Material of Protective Covers HV Cables LV Cables	
	- Conduit & floor openings sealing compounds	
	Material & composition for:	
	i.) Water proofing	
	ii) Fire proofing	
	- Grounding for cable armour/sheaths	
	i) Material of conductor	
	ii) Size	
	- Structural Steel	
	a) Painting of fabricated Steel	
	i) Type of paint and no. of coats of primer	
	ii) Type of paint, no. of coats and colour of finish paint.	
	- Tools provided.	
	i) All necessary tools, tackles, crimping tools etc.	Yes/No
	ii) Welding equipment	Yes/No
	iii) H.V. Cable Testing Equipment	Yes/No
11. Lightning Protection		
	Whether shield wires or lightning conductors have been envisaged for the lightning protection	
	Angle of protection	
	Whether s/s building is also protected	Yes/No
	Numbers of electrodes provided	
	Earthing resistance value	
	Size of down conductors	
	Standard followed	
	Deviations if any on technical data sheet	
12. Cables		
1.	Manufactures Name & Address	
2.	Country of manufacturer	
3.	Type of cable	
4.	Applicable standards for manufacturing	
5.	Applicable standards for testing	
6.	Rated voltage	kV

7.	Maximum service voltage	kV
8.	Maximum continuous current carrying capacity per cable when lain in air at an ambient air temperature of 50 ° (single core cables solid bonded)	A
9.	Maximum continuous current carrying capacity per cable when lain in ground at a depth of 1.0 m (ground temp. 40 °C and soil thermal resistivity of 150 % watt/ cm max. Conductor temp. 90 °C)	A
10.	Maximum continuous current carrying capacity per cable when drawing into duct./ pipes (single core cables solid bonded)	A
11.	Maximum continuous current carrying capacity per cable when lain in covered RCC trenches at an ambient temperature of 50 Deg. C laying conditions to be specified (Single core cables solid bonded)	A
12.	Short circuit withstand capacities for 1 second of (With a conductor temperature of 90 Deg. C at the commencement	
	i) Conductor	kA
	ii) Screen	kA
	iii) Armour	kA
13.	Conductor	
	i) Material & Grade	
	ii) Nominal cross – sectional area	Sq.mm
	iii) No. of strands	
	iv) Diameter of each strand (Nominal)	mm
	v) Max. DC resistance of conductor at 20 Deg. C	Ohm/km
	vi) Max. AC resistance of conductor at 90 Deg. C	Ohm/km
	Reactance of cable at normal frequency (Approx.)	Ohm/km
	Electrostatic capacitance at normal frequency	Microfarads per km
	Charging current	mm
	Loss tangent at normal frequency at U ₀	
14.	Conductor screen	
	i) material	
	ii) Nominal thickness	mm
15.	XLPE Insulation	
	i) Composition	
	ii) Type of curing	
	iii) Thickness of insulation (nominal)	mm
	iv) Tolerance on thickness	
	v) Dielectric constant at normal frequency	
	vi) Specific insulation resistance at 20 Deg. C	ohm/km
	vii) Min. volume resistivity at 20 Deg. C	
	viii) Min. volume resistivity at 90 Deg. C	

	ix) Min. Tensile strength	kg/sq.mm
	x) Min. Elongation percentage	%
	xi) Identification of cores	
16.	1.2/50 microsecond impulse wave withstand voltage	kVp
17.	5 min. power frequency withstand voltage	kV
18.	Max. Dielectric stress at the conductor	kV/cm
19.	Max. Dielectric stress at the conductor screen	kV/cm
20.	Insulation screen	
	i) Material	
	ii) Extruded/ wrapped	
	iii) Nominal thickness	mm
	iv) Colour	
21.	Nominal diameter over metallic screen	mm
22.	Nominal radial clearance allowed under metal sheath	mm
23.	Type and material of filler	
24.	Armour	
	i) Material and type	
	ii) Dia	
25.	Outer sheath	
	i) Material	
	ii) Type	
	iii) Colour	
	iv) Minimum radial thickness	mm
	v) Tolerance on nominal thickness of sheath	
	vi) Minimum tensile strength	Kg/sq.mm
	vii) Minimum elongation percentage at rupture	
	viii) Oxygen index	
	ix) Temperature index	
	x) Accelerated water absorption	Mg/cm-sq
	xi) Dielectric constant after 24 hours for	XLPE insulation
	xii) Increase in capacitance for XLPE insulation	
	a. 1-14 Days	
	b. 7-14 Days	
xiii) Retention of dielectric strength of XLPE insulation		
xiv) Acid gas generation		
xv) Smoke density generation		
26.	Method of application	
	i) Insulation	
	ii) Inner sheath	
	iii) Outer sheath	
27.	Nominal overall diameter of completed cable	mm
28.	Nominal weight of complete cable	Kg/m
29.	Min. bending radius of the cable	m
30.	Standard drum length of cable	
31.	a) Approx. Drum Size (Flange die)	
	b) Approx. Shipping weight	

32.	Charts for de-rating factors enclosed	
	i) Variation in ambient temperature	
	ii) Variation in ground temperature	
	iii) Variation in ground resistivity	
	iv) Spacing factors	
	a. Cable laid in ground	
	b. Cables laid on racks in RCC trenches with covers	
	c. Cables laid in Air	
	d. Cable laid in pipes/ ducts.	
13.	CONTROL CABLES	
1.	Make	
2.	Type	
3.	Standard applicable	
	a) Voltage Grade	
	b) Suitable for service	
4.	Maximum conductor temperature	
	a) Continuous	°C
	b) Short time	°C
5.	Conductor (copper)	
	a) Material	
	b) Form of Conductor	
	c) Number of cores	
	d) Number and diameter (Stranded/ Solid) of wire per core	
6.	Insulation	
	a) Material Insulation	
	b) Thickness	
	c) Average dielectric strength	
	d) Dielectric constant	
7.	Suitability with regard to temperature moisture, ozone	
8.	Thickness of sheath over conductor, if any	mm
9.	Material of sheath over cable	
10.	Thickness of sheath over cable	mm
11.	Electrical/ Performance	
	a) Conductor resistance at 20°C per KM	
	b) Maximum conductor temperature permissible	
	c) Under full load	
	d) Under transient conditions	
	e) Maximum operation voltage	Volts
	f) Insulation resistance of 1 Km of cable at 20°C Mega ohms	
	g) Power factor or loss angle	
	h) Tan delta of dielectric material	
	i) Dielectric loss per km at rated voltage	
	j) Power frequency with-stand voltage kV rms	
	k) Current loading data for the cable for specified operating temperature	
	i) In air in cable trays	

	ii) In cable channels	
	iii) In clewed ducts	
	iv) In cable conduits and pipes	
13.	De-rating factors for	
a)	Ambient temperature	
b)	Grouping of 3 or 4 cables in air in trays, channels for different spacing, between cable and in closed ducts in touching position	
14.	Allowable short circuit current for one sec.	
15.	D.C. withstand voltage	
16.	A.C. 50 cycles/ second impedance	
17.	A.C. 50 cycles/ second reactance	
Mechanical Data		
18.	Weight of cable :-	
	a) Wt of conductor per Km	
	b) Wt of PVC compound per Km	
	c) Complete wt. per Km	
	d) Wt of Armour	
19.	Overall diameter	
20.	Maximum length per drum	
21.	Drum dimensions	
22.	Gross weight of cable and drum	
23.	Maximum pulling tension	
24.	Minimum bending radius	
25.	I.S.I. Certification No.	
26.	Whether agreeable to the type test at CPRI	State Yes/No