



SUPPLY CHAIN MANAGEMENT THIRUVANANTHAPURAM

SPECIFICATION

11 KV VACUUM CIRCUIT BREAKERS WITH CURRENT TRANSFORMERS

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(i) Document Approval & Control Status

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Date	01/05/2021	14/05/2021	31/05/2021
Signature	Sd/-	Sd/-	Sd/-

(ii) Amendments and History

Sec. #	Rev. #	Date	History of Change



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1. PURPOSE:

Purpose of this document is to document updates & history, upkeep and publish the specifications related to **11kV Vacuum Circuit Breakers with Current Transformers** in a professional manner

2. SCOPE:

The Scope of this document is to inform and alert all relevant stakeholders including KSEBL. Public, KSERC etc regarding the current specifications and historical changes adopted in specifications of **11kV Vacuum Circuit Breakers with Current Transformers** used in field by KSEBL

3. RESPONSIBILITY:

The Executive Engineer (T), Office of Chief Engineer, Supply Chain Management shall compile and take necessary steps to publish the specification in KSEBL website and shall inform relevant stakeholders regarding updates and revisions

4. PROCEDURE FOR REVISION:

Modifications if any, in the technical specification will be incorporated as **Revisions**. Any changes in values, minor corrections in pages, incorporation of small details etc. will be considered as Minor Modification. **The Revisions due to minor modifications will be assigned as Rev. No.0.1, 0.2 etc.**

A complete updation of the technical specification will be considered as Major modification. **The Revisions due to major modifications will be assigned as Rev. No.1.0, 2.0 etc.**

All the details of regarding the revisions (both minor and major) will be incorporated in **“(ii)-Amendments and history”** above.

The concerned officers, in consultation with the Technical Committee will review and suggest changes required and the revision suggestion will be approved by **Chief Engineer (SCM)**. Those who notice any discrepancy or have any suggestion regarding revision, may bring the matter to the attention of Chief Engineer (SCM) in writing or through e-mail id:**cescm@kseb.in**



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TECHNICAL SPECIFICATION FOR 11 KV VACUUM CIRCUIT BREAKERS WITH CURRENT TRANSFORMERS.

1) Scope:-

- 1.1 This specification covers design, engineering, manufacture, testing, inspection before dispatch packing, forwarding, transportation, insurance during transit, delivery to site/ stores of 11 KV Outdoor Vacuum Circuit Breakers with CTs for use at 33/11KV primary substations under the Distribution networks of KSEBL.
- 1.2. All vacuum circuit breakers must be manufactured by ISO 9000 certified Organization and shall have been type tested at CPRI or any NABL Accredited laboratory/PHELA/KERI/KEMA/CESI laboratory within five years as on the date of bid opening and in satisfactory operation for a period of not less than three years. The Bidder shall demonstrate compliance with this requirement by supplying with the bid, copies of the type test certificates together with performance Certificates from purchasers/ users.
- 1.3. The scope of supply includes the provision of type tests at CPRI or any NABL Accredited laboratory/PHELA/KERI/KEMA/CESI laboratory within last five years.
- 1.4. The scope also includes the circuit breaker, current transformers, potential transformers supporting structures, operating mechanism, local/ remote control cabinet, relay control panel, foundation bolts, all the accessories and auxiliary equipment mandatory spares and special tools for satisfactory installation and operation of 11kV VCB as outdoor feeder protection control.
- 1.5. The circuit breakers shall conform in all respects to the highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the purchaser shall have the power to reject any work or materials, which, in his judgment, is not in full accordance therewith.

- 2) **Standards:-** Expect where modified by this specification, the circuit breakers and the accessories shall be designed, manufactured and tested in accordance with latest editions of the following standards.

IEC/ISO/BS	IS	Subject
IEC: 56 IEC:62271-100& 200	IS:13118	High voltage alternating current circuit breakers general requirement.
IEC: 694	IS:12729	Common clauses of high voltage

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		switch-gear and control gear standards (for voltage exceeding 1000 V).
EC: 60	IS:9135	High Voltage testing techniques
IEC: 427	IS:13516	Method of synthetic testing of HV .A.C circuit breakers
IEC: 1233		HV. AC. Circuit breakers- inductive load switching.
IEC: 17A/CD:474		HV. AC. Circuit breakers- capacitive switching.
IEC: 529	IS:13947	Degree of protection provided by enclosure.
IEC: 137	IS:2099	Insulating bushing for A.C. voltages above 1000V
IEC: 233	IS:5621	Hollow insulators for use in electrical equipment & testing
IEC: 273	IS:5350	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC: 815	IS:13134	Guide for selection of insulators in respect of polluted conditions.
IEC: 34	IS:996	A.C motors
ISO: 1460 BS: 729	IS:2629	Hot dip galvanizing
	IS: 2633	Method of testing uniformity of zinc coated articles.
	IS: 5	Colour for ready missed paints and enamels

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	IS: 6005	Code of practice for phosphating or iron and steel
IEC: 227	IS:1554	P.V.C Insulated cables for voltages up to and including 1100 Volt.
IEC: 269	IS:13703	Low voltage fuses for voltages not exceeding 1000volt.
ISO: 800	IS:1300	Phenolic moulding materials.
	IS: 13118	Guide for uniform marking and identification of conductors and apparatus terminals.
IEC: 185 IEC:186	IS:2705	Current transformers. Potential Transformers
IEC: 296	IS:335	Specification for unused insulating oil for transformer and switchgear.
CBIP Technical Report No. 88 revised July, 1996 read with amendment issued (April, 99, September, 99 and also any other amendment thereafter)	Specification for AC Static Electrical Energy Meter.	
IEC:6100, IEC:60068, IEC:60529, IEC:61010-1	IS:3231	Electrical Relays for Power System Protection
	IS:8686	Static Protections Relays
IEC:60265		Numerical Relays
IEC:61850		Communication network and System in Substation

This list is not to be considered exhaustive and reference to a particular standard or recommendation in this specification does not relieve the Supplier of the necessity of providing the goods and services complying with other relevant standards or recommendations.

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3) REQUIREMENTS:- The circuit breakers to be supplied against this specification shall be required to control the secondary side of 33/11 KV power transformers in the primary sub-stations or Bus coupler or the outgoing feeders in these sub-stations. The circuit breakers shall be suitable for 3 phase 50Hz solidly grounded neutral system and shall have normal current carrying capacity and The required 11 KV Vacuum Circuit Breakers suitable for outdoor installations are to be quoted by Manufacturers only with a valid ISO 9000 certification.

3.1 BASIC TECHNICAL REQUIREMENTS:- The vacuum circuit breakers are required to meet the following basic technical requirements. (Reference standards IEC: 56,IEC:62271-100&200, IS:13118 and associated standards listed in this specification.

Basic Technical Requirements:

Sl.No.	Particulars	Requirements
1)	Service type	Outdoor
2)	No. of Poles	3
3)	Nominal system voltage	11kV
4)	Highest system voltage	12kV
5)	Rated normal current at 500C	
i)	For Bus-bar of Circuit Breaker	800 A
ii)	For Interrupter	1250A
iii)	For Outgoing Feeders/Transformer	1250A
6)	Rated short circuit breaking current (rms)	25KA
7)	Rated short circuit making current (peak)	63KA
8)	Rated short time current withstand capability for 3 sec.	25KA
9)	Rated insulation level:	
i)	One minute power frequency withstand voltage to earth (wet and dry) rms	28kV
ii)	Impulse withstand voltage to earth with 1.2/50µsec, wave of +ve and -ve polarity (Peak)	75kV
10)	First – pole – to clear factor	1.5

11)	Rated operating sequence (for auto reclosing)	O-0.3 Sec- CO-3 min-CO
12)	Maximum break time	3 cycles
13)	Rated out of phase breaking current	25% of the symmetrical short circuit breaking current
14	Maximum pole scatter	10 mille seconds
15	Rated Auxiliary supply for spring charge motor, lamp & heater circuit.	230V A.C
16	Rated supply voltage for trip/close coil	110V DC
17	Minimum creepage distance (mm)	350 mm
18	Minimum protected creepage distance (mm)	280 mm

4) Climatic Conditions:- The climatic conditions at site under which the equipment shall operate satisfactorily, are as follows:

- i. Peak ambient temperature in shade : 50°C
- ii. Maximum average ambient temperature over a 24-hour period in shade. : 40°C
- iii. Maximum temperature attainable by an object exposed to sun. : 70°C
- iv. Minimum temperature of air in shade : 17°C
- v. Maximum relative humidity : 100%
- vi. Average number of thunderstorm days per annum. : 50
- vii. Average number of dust storms per annum : 10
- viii. Average number of rainy days per annum : 90
- ix. Average annual rainfall : 3000mm
- x. Number of months of tropical monsoon conditions per annum : 5 months
- xi. Maximum wind pressure : 100 kg/sq.m

For the purpose of this specification, the reference ambient temperature would be 40 deg.C.

5) 11 KV VACUUM CIRCUIT BREAKERS:-

5.1. General:- The circuit breakers shall be structure mounted open type with vacuum as interrupting media incorporating separate interrupters of 1250 A rating for each phase mounted

on single frame. There shall be a common drive mechanism actuating the interrupters, which must work in synchronism. These breakers shall be provided with suitable local control while provision shall be made for remote control.

The circuit breakers shall be fitted with spring mechanism. The inherent design of these circuit breakers shall be such that they shall satisfactorily perform all test duties and interrupt out-of- phase current and produce very low over voltage (<2.0p.u.) on all switching circuits, capacitive and inductive to IEC:56, IS:13118 and other associated standards mentioned in the clause of this specification.

The terminal pads shall have silver-plating of at least 50 micron thickness. The design of the circuit breakers shall be such that inspection and replacement of contacts, coils, vacuum bottles and any worn or damaged components can be carried out quickly and this ease. The contact gaps shall be adjustable to allow for wear.

The mechanism and the connected interrupters shall satisfy the mechanical endurance requirements of IEC: 56, IS: 13118 and all additional requirements specified herein.

- 5.2. **Porcelain Insulator:-** External parts of the circuit breakers, which are under continuous electrical stress, shall be of hollow porcelain. The creepage and flashover distance of the insulators shall be dimensioned and the type and profile designed in accordance with IEC:815 or IS:13134 and shall be suitable for the worst environmental conditions specified in this specification. The creepage distance across the interrupting chambers shall suite the outdoor service conditions mentioned in the relevant standards for heavily polluted atmosphere and shall be not less than 350 mm with minimum protected creepage distance 280 mm. Internal surfaces of hollow insulators shall also be glazed. The insulators shall comply with IS:5621 and tested in accordance with IEC:233.

All porcelain whether, used on the interrupting chamber or on the support insulator shall have the following properties:

Higher strength, homogeneity, uniform glaze, free from cavities and other flaws and high quality uniform finish porcelain components and shall withstand the maximum expected static and dynamic loads to which the circuit breakers may be subjected during their service life.

- 5.3. **Interrupting media:-**

- 5.3.1. **Vacuum:-** In vacuum circuit breakers, facilities shall be provided for monitoring the contact erosion and any change in contact gap. The vacuum bottles shall be easily replaceable on site and the Mechanism shall be conveniently adjustable to permit resetting the contact gap. Vacuum interrupters of the Circuit Breaker shall be completely encapsulated in epoxy housing.

The Circuit Breaker shall be suitable for E1, M2 & C1 class. The offered Circuit Breaker should be valid type test certificate to support the afore-mentioned duty class.

The vacuum circuit breaker poles shall be sealed to prevent contamination of the spaces surrounding the interrupters. The Bidder shall demonstrate how this is achieved by supplying technical details with the bid

5.4. **Auxiliary contracts:-** 12 auxiliary contacts (6N.O.+ 6N.C.) of 24 Volt D.C grade and 10 amps DC rating shall be provided in each circuit breaker.

5.5. **Indication:-** A mechanically operated circuit breaker position indicator of non corroding material shall be provided in a location visible from the operating side of the breaker without the necessity to open the mechanism door. The word „OFF“ in white letter on green background shall be used to indicate that the breaker is in the opening position and the word „ON“ in white letters on a red background to indicate that the breaker is in the closed position. The drive for the device shall be Positive in both directions and provision shall be made for local and remote electrical indication.

Indication of spring charging condition shall be provided as mentioned in this specification. Mechanical counters to record the number of closing operations shall be provided for each circuit breaker mechanism.

5.6. **Operation and controls:-** **The breaker shall normally be operated by remote electrical control with electrical tripping by**

Shunt trip coil. Provision shall be made for local electrical operation and mechanical operation.

The following facilities shall be provided in the circuit breaker local control cabinet:

- **LOCAL/ REMOTE selector switch of stay put type. The selection of “local” operation shall inhibit the operation of the breaker from any remote source.**
- **ON/NEUTRAL/ OFF control switch or ON and OFF push buttons. The push buttons shall be momentary contract type with rear terminal connections. The close push button shall be of green colour and the open push button red colour.**
- **MECHANICAL EMERGENCY TRIP DEVICE:** suitable for manual operation in the event of failure of electrical supplies. The device shall be accessible without opening any access doors and distinctly labelled. It shall be shrouded and protected against Inadvertent operation.
- Means shall be provided for manual operation of these circuit breakers during failure of Auxiliary power in addition to electrical operation.

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- 6) **CURRENT TRANSFORMERS:-** Current transformers, three per circuit breaker, shall be of outdoor, single phase oil immersed dead tank type and shall comply with IEC:185 and IS:2705, suitable for operation in hot and humid atmospheric conditions described in service condition. They shall be mounted on the racket. The CT tank should be Hot Dip galvanized as per relevant ISS to prevent corrosion of all exposed metal parts.
- 6.1. **Core:-** High grade non- ageing cold rolled grain oriented (CRGO M4 or better grade) silicon steel of low hysteresis loss and permeability shall be used for the core so as to ensure specified accuracy at both normal and over currents. The flux density shall be limited to ensure that there is no saturation during normal service. The instrument security factor of the core shall be low enough so as not to cause damage to the instruments in the event of maximum short circuit current.
- 6.2. **Windings:-** The secondary windings shall be made of electrolytic copper with suitable insulation. The conductor shall be of adequate cross- section so as to limit the temperature rise even during short circuit conditions. The insulation of windings and connections shall be free from composition liable to soften coze, shrink or collapse during service.
- Polarity shall be indelibly marked on each current transformer and at the lead and termination at associated terminal blocks. CTs with multi ratio winding shall be clearly tabulated to show the connections required for different ratios. Similar numbers shall be marked on terminal block arrangement and wiring diagram. Apart from the above marking and those to be provided as per IEC 185 or IS 2705, other markings shall be provided in consultation with owner.
- The continuous current rating of the primary winding shall be one hundred and fifty percent of the normal rated current. Secondary windings of current transformers shall be used for metering, instrumentation and protection and shall be rated for continuous current of one hundred and fifty percent of normal rated current of primary winding.
- 6.3. **Construction:-**The current transformer enclosures shall be made of high quality steel and shall be hot dip galvanized and shall be able to withstand and stresses occurring during transportation and the terminal and mechanical stresses resulting from maximum short circuit current in service. The primary winding and terminals shall be in a tank and supported by a hollow porcelain insulator. The secondary connection shall be conducted through the hollow insulator and terminated in a terminal box mounted on the base plate.
- 6.4. **Hermetic sealing:-** Each current transformer shall be supplied filled with insulating oil complying with IEC: 296 or IS: 335 and shall be hermetically sealed to prevent atmosphere coming in contact with oil, avoiding frequent filtration and change of oil. Nitrogen or any oil

inert gas above the oil level shall be provided to permit expansion and contraction of oil without any contact with the atmosphere.

The current transformers shall have provision for draining and re-filling insulation oil after drying.

6.5. **Insulating oil:-**The current transformer shall be complete with new insulating oil. The quantity of insulating oil for first filling of the equipment and complete specification of oil proposed to be used shall be stated in the bid. The oil shall conform to the requirements of latest issue of IEC: 296 or IS: 335.

6.6. **Fittings and accessories:-** Fittings and accessories listed below shall be supplied with each current transformer:

- Oil level gauge;
- Oil filling hole and cap;
- Pressure relief device;
- HV terminal connectors;
- Two earthing terminals and strips with necessary nut, bolts and washers;
- Name and rating plate;
- Terminal box with LV terminal connections;
- Mounting nuts, bolts and washers;

Any other fittings deemed essential by the Supplier shall also be supplied with each current transformer.

The oil level gauge shall be mounted in such a way that the oil level can be clearly seen from ground level.

A dust, vermin and weather proof terminal box shall be provided at the lower end of the current transformer for terminating the secondary windings. The box shall have a bolted cover plate complete with gaskets. The terminal box shall have terminal blocks, cable gland plate and cable glands with shrouds suitable for different sizes of PVC insulated control cables 650/1100V grade as per IEC:227 or IS:1554. The terminal blocks shall have covering of moulded insulation materials complete with brass studs, washers, nuts and lock nuts suitable for termination of 2X2.5 sqmm wires. The termination shall be made by crimping lugs or bare wire with insulating sleeves at ends.

The terminal box enclosure shall have protection as per class IP 55 as defined in IEC: 529 or IS: 13947.

- 6.7. **CT Junction Box/Console Box:-** Each set of 3 current transformers for three phase shall be provided with a common junction box mounted on the circuit breaker supporting structure at a convenient position to accommodate the secondary wire of CT and other control cables of Purchaser. Separate terminals for testing the relays and instruments and short circuiting of each current transformer secondary wires shall be provided in it. The junction box enclosure shall have the same protection features as for the terminal box. It shall be provided with terminal blocks, gland plates and glands suitable for different sizes of cables. Facilities shall be provided for earthing the CT secondary wires in the junction box.
- 6.8. **Hollow porcelain insulators:-** The insulators of the current transformers shall conform to latest edition of IS: 5621 and shall be subjected to and successfully pass the tests listed in this standard and in IEC: 233. The hollow porcelain insulators shall be brown glazed and shall meet the requirements indicated in this specification. The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.
- 6.9. **Insulation level:-** The current transformers shall be designed to withstand impulse test voltages and power frequency test voltages as specified in this specification.
- 6.10. **Terminal connections:-** The CTs shall be provided with bi-metallic solderless clamp and rigid type terminal connectors on the top tank for connection to the HV terminals. The other requirements shall be same as for the terminal connectors of the circuit breaker described in this specification. They shall be universal type suitable for both horizontal and vertical connections.

Two earthing terminals complete with necessary hardware shall be provided on each CT for connecting to earth continuity conductor to be provided. The earthing terminals shall be identified by means of appropriate symbol marked in a legible and indelible manner adjacent to the terminals. The terminals shall be adequately sized to meet the full earth fault current envisaged.

6.11. **Basic technical requirement:-**

Ratings:- The CTs shall conform to the following ratings and other particulars of the circuit breakers:

Technical Requirements:-

Sl. No	Description	Requirements
1)	Rated voltage	12 kV
2)	Insulation level	

a)	Impulse withstand voltage	75 kVpp		
b)	One minute power frequency with voltage on			
i)	Primary winding	28kV rms		
ii)	Secondary winding	3kV rms		
3)	Frequency	50Hz		
4)	Rated Continuous Thermal Current	120% of rated Primary Current		
5)	Short time thermal rating and its duration	25kA for 3 Sec.		
6)	Transformation ratio of CTs			
i)	Category-B – 800-400/5-5-1	Core-I III	Core-II	Core - III
a)	Rated Output	15VA	15VA	PS
b)	Class of Accuracy	5P	0.5S	-
c)	Accuracy Limit Factor	10		
d)	Purpose	Protection Protection	Metering	
e)	Max. Of Instrument security factor	-	10	-
7)	Type	Single Phase, Outdoor, Dead Tank, Oil filled & Hermetically sealed.		
8)	Knee point Voltage	250V @ 800/1A		

6.12. **Tests and inspection:-**The CTs shall be tested in accordance with the requirements of the type tests and routine tests as per the latest issues IEC: 185 or IS: 2705.

The tests to be conducted shall include:

6.12.1. **Type Tests:-**

- Lightning impulse voltage:
- Power frequency wet withstand voltage;

- Temperature rise;
- Short time current;

6.12.2. Routine Tests:-

- Verification of terminal marking and polarity;
- Power frequency dry withstand test on Primary windings;
- Power frequency dry withstand test on Secondary windings;
- Power frequency dry withstand test between section;
- Over voltage inter-turn test;

6.13. Potential Transformers:- Potential Transformer as per the specifications shall be provided on the cable side on each incomer. Since there is no structure, PT shall be suitable for mounting on the panel. Fuses shall be provided in primary and secondary windings. The PT Primary and secondary neutrals are to be earthed separately and brought out through isolating links for testing purpose. The primary neutral earth shall get firm earth connection before phase connections are made, when pushed into service. The PT secondary circuit from the PT shall be routed through the auxiliary contact of the incomer to avoid any chance of the back feeding when the incomer is switched off. The PT shall be of resin cast type with insulation class of E or better. The wiring shall be as per standard procedures with proper ferruling and colored wires. There shall be permanent engraved marking for primary and secondary terminals polarity, core identification etc. Ratio (11kV/ $\sqrt{3}$ / 110/ $\sqrt{3}$ Volts):-

• Parameters	• Requirements
• No. of Cores & Ratio	• 1 Core, 11kV/ $\sqrt{3}$ / 110/ $\sqrt{3}$ Volts
• Purpose	• Metering
• Class	• 0.5
• Type	• Shall be cast resin type with insulation class of E or better
• Rated Burden (Max)*	• 100VA
• Mounting	• a) It shall be mounted on a withdrawable carriage. Mounting of PT on the breaker truck is not acceptable. In case it is mounted on the panel rear top, access to the PT and the reinforcement in the panel stand, should be provided for manual inspection/ testing. Safety shutters shall be provided and closed on live side while PT is in draw out condition.

	<ul style="list-style-type: none"> b) Draw out type Potential Transformer is specified for easy isolation during testing and maintenance. If the bidder can provide crank operated switch for isolating the PT primary side, then fixed type can be accepted.
<ul style="list-style-type: none"> Neutral 	<ul style="list-style-type: none"> The HV Neutral connection to earth shall be easily accessible for disconnection during HV test
<ul style="list-style-type: none"> *Burdern calculation to be provided as per the metering and relay requirement during detailed engineering. 	

Section - C

7) PROTECTIVE RELAY & CONTROL PANEL:-

Approved make of Relays:-ABB/Alstom/GE/Siemens/SEL/Schneider MicomFor 3 O/C+1 E/F + 1 SEF Relay AEGIS F of CGPISL is also acceptable

Outdoor control panels with protective relay and meter shall be provided by the supplier suitable for above breakers. The equipment shall have protection scheme with the following relays:

- (i) Triple pole IDMTL type combined over current (2Nos) & Earth fault (1No) relay (Draw out type) preferably Non-communicable numerical relay. Plug setting range of the over current and earth fault relays shall be 5% to 250%.
- (ii) 3 elements auxiliary relay for transformer fault, trip for Buchholz, winding temperature & oil temperature.
- (iii) Master trip relay for inter tripping. (iv) Differential relay.
- (v) REF relay
- (vi) One alarm bell scheme with bell (110 V DC).

N.B:- The relays should be Areva, Easun Reyrolle, ABB or of any reputed make (subject to approval during technical evaluation)

8) METERS:- The following meters shall be provided.

- i) Ammeter:- 1No., 0-300-600 A/ 1 Amp Preferable Make- IMP/ AE (Dial type).
- ii) Volt meter:- 1No., 0- 15 KV (size:144mmx144mm), make IMP/AE(Dial type).
- iii) Ammeter selector switch - 1 No. Make – Kaycee or any other reputed make.
- iv) Volt meter selector switch - 1No. Make- Kaycee or any other reputed make.
- v) 40 watt lamp with switch - 1 No.
- vi) Plug & Socket- 1 No.

vii) Fuses & Links - 1 No.

9) OTHER EQUIPMENTS:-

9.1. Out Door Control-Relay Panel:-

9.1.1. General:- The electrical controls, relays, instruments, meters, annunciation scheme shall be provided in a sheet steel enclosure conforming to IEC: 298 or IS: 3427 mounted on support base on the floor. The panel shall be free standing, dust, moisture and rodent and vermin proof suitable for outdoor installation. The panel shall have a high degree of protection for outdoor installation with relevant standard.

Each panel shall comprise of rigid welded structure frame enclosed completely by metal sheet of thickness not less than 2mm. The sheets shall be cold rolled with smooth finish leveled and free from flaws. The structural frame and all load bearing members of the enclosure shall have minimum thickness of 2.5mm.

The control & relay panel board shall consist of panel, vertical independent, structure mounted with equipment mounted & wiring access on front and having double door protection (inside door to be glass covered) to prevent water entry inside the panel. Doors shall have handles with built in locking facility. All door panels and removable covers shall be gasketed all round with neoprene bonded gasket. Ventilating louvers shall be provided to limit the temperature rise as provided in IEC: 694 and 298 or IS: 12729 and 3427. They shall be provided with filters encased in fine wire screens for non-ferrous metal or stainless steel unaffected by moisture and rain water. A 230V AC heater with auto temperature control shall be provided in the cabinet to prevent moisture condensation.

The housing shall be surface treated and painted in accordance with the clause on Surface Treatment of this specification.

9.1.2. Panel wiring and accessories:-

9.1.3. Wiring:- Each panel shall be supplied with all internal wiring complete.

Panel wiring shall be suitably bunched and clamped for neat appearance. The conductors used for wiring purpose shall be PVC insulated 650/1100 volt grade semi-flexible heat resistant, flame retardant and vermin proof electrolytic copper cable conforming to IEC:227, 502 or IS:1554. The wiring shall be securely supported and taken through PVC troughs. Each wire shall be continuous from end to end without any joint in between. All panel wiring shall be capable of withstanding a voltage of 2KV AC 50Hz for one minute.

Cable and wire for connections within the switchgear and between the switchgear and terminal blocks shall have a minimum temperature rating of 90 degree Celsius. The size of the conductors for panel wiring shall be not less than 4.0mm². For CT secondary wiring, two such wires shall be used in parallel. 2.5mm² for PT, DC & AC Circuit and all other controls

1.5 mm² PVC Cable used shall be FRLS with 1.1kV rating and with tinned electrolytic copper wire.

- 9.1.4. **Panel wiring protection:-** The panels shall be equipped with links and HRC cartridge fuses conforming to IEC:269 or IS:13703 in 650 Volt grade phenolic moulded fuse holder consisting of fuse carrier and base or miniature circuit breakers conforming to IEC:947-2 or IS:13947-2 at appropriate locations. The carriers and bases shall be made of high grade flame retardant and non hygroscopic phenolic moulded material with hard glass surface. Each fuse or MCB shall be identified with engraved plastic label.

In general, fuses and MCBs shall be limited to the minimum required for safety. The protection scheme shall include fuses for VT secondary circuits and DC supply to each panel and fuses for MCB for spring charging motor and incoming AC supply.

- 9.1.5. **Terminal blocks:-** Terminal blocks of brass studs rated for 10 amps continuous current, 650 volt DC grade covered by moulded insulating materials with adequate electrical clearances shall be provided for terminating the panel wiring and outgoing connections. The termination shall be made by crimping lugs or bare conductor with insulating sleeves at ends. The arrangement can be horizontal or vertical as per standard practice adopted by the manufacturer. All terminals must be numbered and wire termination provided with numbered ferrules for identification. All numbering and marking including those in wiring diagram shall follow the guidelines provided in IS: 11353. All circuit breaker auxiliary contacts including spare contacts shall be wired to the terminal blocks. Ten percent spare terminals shall be provided.

- 9.1.6. **Colour and numbering:-** The wiring used for 230V AC supply for illumination lamp, panel heater and other devices shall be coloured red for phase wire and black for the neutral. The colour of wires connecting directly to Earth shall be black. All other panel wires shall be of one colour to be approved.

Engraved core identification plastic ferrules marked to correspond with the panel wiring diagram shall be fixed at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from the terminal block. Numbers 6 and 9, shall not be used.

- 9.1.7. **Circuit diagram:-** A durable copy of the circuit wiring diagram shall be affixed to the inner side of the door of the switchgear compartment. Labels shall be provided inside the compartment to describe the functions of the various items of equipment.

The scope of the supply shall include the panel mounting base plate and all special equipment, bolts, nuts and washers necessary for making the supporting.

- 9.1.8. **Fuse protection:-** The cabinet shall be equipped with links and HRC cartridge fuses in 650 volt grade fuse holders consisting of fuse carrier and base. The holders shall be made of high

grade, flame retardant and non hygroscopic phenolic moulded material of dark brown colour with hard glass surface. Each fuse shall be identified with engraved plastic labels.

- 9.1.9. **Terminal blocks:-** Terminal blocks rated for 10 amps continuous current, 650 volt grade covered by moulded insulating materials with adequate electrical clearances shall be provided for terminating the panel wiring and outgoing connections. The termination shall be made by crimping lugs or bare wire with insulating sleeves at ends. The arrangement can be horizontal or vertical as per standard practice adopted by the manufacturer. All terminals must be numbered and wire termination provided with numbered ferrule for identification. All numbering and marking include those in wiring diagram shall follow the guidelines provided in IS:11353. Ten percent spare terminals shall be provided.
- 9.1.10. **Colours:-** The wiring used for AC supply for illumination lamp and heater shall be differently coloured from control wiring so that these can be distinguished from each other. The colour of all earth wire shall be black.
- 9.1.11. **Circuit diagram:-** A durable copy of the circuit wiring diagram shall be affixed to the inner side of the control cabinet. Labels shall be provided inside the cabinet to describe the functions of the various items of equipment.
- 9.1.12. **Cable Entry:-** A removable gland plate shall be provided at the bottom of the cabinet for entry of Purchaser's control and auxiliary power cables in the cabinet. Required number of electroplated brass cable glands of appropriate sizes with shrouds shall be provided in consultation with the Purchaser in the gland plate for the control and power cables. Provision shall be made for earthing of the cable armours in the gland.

10. INDICATING INSTRUMENTS:-

10.1. Indicating instruments shall meet following requirements:

Meters	
Mounting	Flush Mounted
Ammeter	Taut band, moving coil type, 240° Scale
Size	96 X 96 mm
Accuracy class	1.0
Voltmeter	Digital
Size	48 X 96 mm
Accuracy class (min)	1
Range	0-12kV (up to a minimum of 2 decimal places)
Display	20mm super bright LED display 3 1/2 digit

Voltmeter has to display R-Y, Y-B, B-R and R-N, Y-N, B-N voltages in incomers (for incomer VT supply) and bus coupler (for selected VT supply) panels.

10.2. TOD Energy meter:-

Type	:	ToD type Bi-directional 3phase,4 wire, 11/√3 kV/110V3V, 5A
Frequency	:	50 Hz +/- 5%
P.F.	:	0.5 PF Lag - Unity - 0.5 P.F Lead
Burden	:	0.2VA max. per Volts/Amp. Input 3VA max.
Accuracy class	:	0.5S
Display	:	Multifunctional meter with LCD display for parameters like kW, kWh, kVAh, kVArh, MD, I, V, pf & Hz shall be available by scrolling. There can be 1, 2, or 3 mode of display, which facilitate more parameters. More accurate reading of power etc up to 6 decimal place shall be provided in the mode 3. Retains the last ordered reading even under power failure. Default setting for any parameter say kWh shall be given. Shall display import & export. Shall have data retrieval & logging facility and Load Survey Feature Necessary software for feeding settings, commissioning, testing etc and required inter facing cables shall be supplied with each set of Panel.
Data communication	:	RS 485 port with MODBUS RTU protocol shall be provided. Data communication port with DLMS protocol shall be provided.

Energy meter RS 485 MODBUS connection is to be wired up to terminal block for Automated Meter Reading purpose.

11. TEST TERMINAL BLOCK:- For Energy meters Switch board type, back connected semi flush mounting type test blocks with contacts suitably rated shall be provided with links or other device to enable of a series device into circuit without causing open circuit in the CT secondary or to enable short circuiting of the CT Secondary.

- a) Test block covers shall be removable from the panels and shall be provided with suitable sealing arrangement to prevent unauthorised access to the test studs.

- b) A 3 phase 4 wire Link type TTB with back connection for Energy meter and shall be placed near to the meter.
- c) All terminals, shorting links and screws shall be of brass and nickel plated to prevent corrosion.
- d) Meters shall be connected after TTB for testing their accuracies and also for Energy meter calibration.

12. INDICATING LAMPS:- Indicating lamps (with bunched LEDs) shall be of miniature switchboard type, **Metallic**, suitable for panel mounting with rear terminal connections. The lamps should be mounted in such a way that it can be replaced easily. Lamps shall be provided with suitable protection preferably built on the lamp assembly to avoid short-circuiting of control supply in the event of short-circuiting of lamp. These lamps shall be of screwed on type, unbreakable and moulded from heat resisting material. They shall be translucent to diffuse light. Integral inscription plates engraved with their function shall be provided. Unless otherwise stated, the lamp covers shall be coloured as follows:

1	Mounting	Flush mounted
2	Type	Metallic
3	Lamps	High intensity, clustered LED type
4	Breaker ON	Red
5	Breaker Off	Green
6	Spring Charged	Blue
7	DC Control supply fail	Yellow
8	Auto trip	Amber
9	Service position	Blue
10	Test Position	White
11	Heater circuit healthy	Yellow
12	Trip circuit healthy	White
13	PT supply as applicable	R, Y, B
14	Capacitive Voltage indicator for monitoring whether the Cable is Live or Dead	By LED indication for R,Y,B Phase through bushing mounted Capacitive type feedback

13. PUSH BUTTONS:-

- a) Push buttons of suitable colours shall be housed in metallic case, momentary contact type, semi flush mounted with rear terminal connection.

- b) These shall be suitably shrouded to prevent inadvertent operation.
- c) Integral inscription plates engraved with their function shall be provided.
- d) All push buttons shall have two normally closed and two normally open contacts comprising rivets of pure silver.
- e) **The contacts shall be able to make and carry 5A and break 1A Inductive load at 250 V DC.**

1	Mounting, Type	Flush mounted, momentary contact type
2	Casing	Metallic
3	Emergency trip push button	Red color with stay put (shrouded)
4	Accept push buttons	Black color – trip alarm / DC fail alarm
5	Reset push buttons	Yellow color – trip alarm / DC fail alarm
6	Test push buttons	Blue color
7	Rating	5 A

14. CONTROL AND SELECTOR SWITCH:-

- a) They shall be of rotary operated type preferably with silver to silver contacts adequate making, carrying and breaking current rating.
- b) They shall be provided with easily removable protective terminal covers and escutcheon plates clearly marked to show operating position and shall be suitable for flush mounting with only switch front plate and operating handle projecting out.
- c) The connection shall be from the back.
- a) The contact assembly at the switch shall be enclosed in dust proof removable covers.
- e) The control springs shall be strong and robust enough to prevent inadvertent operation due to light touch.

1	Switches mounting	Flush mounted on LV compartment door, with shrouded terminals
2	Circuit Breaker Control Switch	Pistol grip lockable robust handle spring return to normal position, Trip- Neutral-Close, 16A (Handle or base of breaker Control switch shall have Red Colour)
3	Rotary ON/Off switches	For heater & spring charging circuits

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4	Selector Switches	Stay put type
5	Local Remote Selector Switch	Two Position, with three set of contacts. Suitable to give status input for SCADA controls.

15. TRIP CIRCUIT SUPERVISION RELAY:- The trip circuit of CBs shall be supervised by separate electromechanical / Static / Numerical relays. This scheme shall continuously monitor the trip circuit before and after closing of the circuit breaker. This scheme shall detect

- (1) Failure of trip supply
- (2) Open circuit of trip circuits wiring

The relays shall have necessary contacts to be connected to either the alarm bell or to the annunciator available in the panel for visual and audible indication of the failure of trip circuit with sufficient spare contacts. One bunched type LED bulb indication shall be provided for "Trip Circuit Healthy" continuously. It shall not be possible to close during trip circuit faulty condition.

15.1. DC SUPPLY SUPERVISION RELAY:- DC supply supervision scheme shall be provided in each panel using Electro-mechanical / Static type DC under voltage relay. In the event of failure of DC supply to annunciator, a bell operated by AC supply shall be energized. The alarm should be acknowledged through the alarm acknowledge push button of the panel.

15.2. High Speed Tripping Relay

Following shall be the main features of tripping relays :

- i) Be instantaneous (Operating time not to exceed 10 ms)
- ii) Reset within 20 ms
- iii) Shall be high impedance type
- iv) Be DC operated - 110 V DC
- v) Have adequate contacts to meet the requirement of scheme, and minimum 2nos NO & NC contacts shall be provided as spare.
- vi) Be provided with flag indicator
- vii) All contacts shall be reset with a single reset.
- viii) All tripping relays shall be high speed high burden type.

- ix) Normally closed contacts in series with the relay operating coil, shall be delayed for a period which will allow series flag relays to operate satisfactorily. All other tripping contacts should be instantaneous. i.e no intentional time delay.
- x) Work satisfactorily for an operating voltage range from 70% to 120% of rated voltage of the auxiliary voltage.
- xi) High speed tripping relays shall prevent closing of the associated circuit breakers until reset. All tripping relays shall have inbuilt hand resettable flag indication.
- xii) Be immune to capacitance discharge currents, which can result at the inception of an earth fault on DC wiring and immune to subsequent leakage current.

15.3. Auxiliary Relays: Shall be electro mechanical type to meet the scheme requirements.

16. ANNUNCIATOR:-

16.1. Annunciator System

Alarm annunciation system shall be provided for the Panels by means of visual and audible alarm in order to draw the attention of the operator to the abnormal operating conditions or the operations of some protective device. The annunciation shall be divided into the following two categories.

- i) Emergency annunciation.
- ii) Warning annunciation.

The annunciation equipment shall be suitable for operation on DC supply as specified in the specification.

17. SPACE HEATERS:-

- a) 240V, 50HZ Tubular Space Heaters suitable for connection to the Single Phase A.C. shall be controlled by a suitably rated single pole miniature circuit breaker compartment to be mounted on an insulator.
- b) These shall not be mounted close to the wiring or any panel mounted equipment.
- c) The Watt loss per Unit surface of heater shall be low enough to keep surface temperature well below sensible heat but should be capable to keep 10°C above

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average ambient temperature in the rainy season but temperature shall not under any circumstances damage the insulation of wiring of the panel / other mounted equipments.

- d) A thermostat control unit with variable temperature shall be installed to control the heater.
- e) **Wiring connected to space heaters in the cubicle shall have porcelain beaded insulation over a safe length from heater terminals.**

18. **Supporting Structure:-** The supply of the material shall be complete with mounting structures of mild steel sections conforming to IS: 226 or equivalent ISO. The supporting structure shall be designed and constructed to withstand the maximum combined effects of the circuit breaker dead weight, its maximum dynamic load and maximum effect of wind loading. The supporting structure shall be hot dip galvanized as per IS 2629.

19. **CT mounting bracket:-** The supporting structure shall be fitted with a bracket for supporting three oil filled 11 KV single phase current transformers as per enclosed GA drawing. The support bracket shall be provided opposite the circuit breaker poles and shall ensure adequate clearance between the breaker poles and the CTs as well as between the CTs. The CTs shall be supplied by the Supplier as per specification above and is included in the scope. The drawings of the structure with bracket shall be subject to Purchaser's approval before fabrication.

20. **Local control cabinet:-**

The operating mechanism, local controls and monitoring shall be provided in a metal clad control cabinet fitted to the same structure supporting the breaker and mounted at a convenient height for safe operation from ground level or from platform to be supplied under the contract.

The cabinet shall be made of minimum 2.00mm sheet steel and shall be constructed as a dust, weather and vermin proof outdoor housing with protection of IP-54 class as defined in IEC:529 or IS:13947. It shall have single door and transparent windows for reading the circuit breaker ON or OFF position and spring charge position without opening the door. The door and any removable covers shall be gasketed all round with neoprene bonded gaskets. A ventilating louver shall be provided with fine wire non-ferrous metal or stainless steel screen and filter. A 230V AC heater with auto temperature control shall be provided in the cabinet to prevent moisture condensation and also a 230 volt lamp for internal illumination with door operated switch.

The local control cabinet shall be subjected to surface treatment and painting as per clause on surface treatment of this specification.

21) OPERATING MECHANISM:-

21.1. General:- The operating mechanism of the circuit breaker shall be motor wound spring charged type. It shall be electrically and mechanically trip free with anti pumping device (as per IEC: 694 definitions). All working parts in the mechanism shall be of corrosion resistant material Self lubricating, wearing resistant bearings shall be provided in the mechanism.

The mechanism shall fully close the circuit breaker and sustain it in the closed position against the forces of the rated making current and shall fully open the circuit breaker without undue contact bounce at a speed commensurate with that shown by tests to be necessary to achieve the rated breaking capacity in accordance with IEC:56 or IS:13118. The mechanism shall be capable of being locked in either the open or closed position. The mechanism shall be capable of fully closing and opening again after the auto-reclose time interval specified as 0.3 second in this specification.

21.2. Spring mechanism:- The spring operating mechanism shall be with spring charging motor, opening and closing springs with limit switches and all accessories necessary for automatic charging. In normal operation, recharging of the operating springs shall commence immediately and automatically upon completion of the closing operation so that a complete sequence of closing and opening operation should be possible.

It shall be possible to hand charge the operating spring with the circuit breaker in either the open or closed position conveniently from the ground level. Closure whilst a spring charging operation is in progress shall be prevented and release of the springs shall not be possible until they are fully charged.

The state of charge of the operating springs shall be indicated by a mechanical device showing "SPRING CHARGED" when closing spring is fully charged and operation is permissible and "SPRING FREE" when closing spring is not fully charged and the operation is not possible. Provision shall be made for remote electrical indication of "Spring Charged" and "Spring Free" conditions.

The operating mechanism shall be such that the failure of any auxiliary spring shall not cause tripping or closing the circuit breaker but shall not prevent tripping against trip command.

Closing action of the circuit breaker shall charge the opening spring ready for tripping. From the close position with spring charged, one open-close-open operation shall be possible without recharging the spring.

21.3. Motor:- The motor for spring charging shall be single phase 230 Volt A. C motor. Continuous motor rating shall be at least ten percent above the maximum load demand of the driven equipment. It shall remain within its rated capacity at all operating points that will arise in service. It shall be protected by H.R.C cartridge fuses or MCB. The motor shall comply with IEC: 34 or IS: 996.

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22) AUXILIARY POWER SUPPLY:-

The operating mechanism shall be suitable to operate with the following auxiliary power supplies.

- a) 230V, 50Hz Single phase A.C - For spring charging motor.
- b) DC supply 110V DC - For close and open coils, indication & Alarm (Power pack input supply: 230V & 110V AC and Output:24V DC)

The DC supply shall be from a Power Pack. The Input to Power Pack is 110V from PT and 230V from main supply. The power pack should be capable for minimum 3 Trippings even if input to power pack is failed.

The mechanism shall be designed to operate satisfactorily despite fluctuations of auxiliary power supplies as under:

- AC supply: Voltage - From 115% to 85% of normal voltage
- Frequency - From 105% to 95% of normal frequency
- Combined voltage and frequency variation - From 115% to 85% of normal
- DC supply: Voltage - From 120% to 70% of normal voltage.

23) INTERLOCKS:- The circuit breaker shall be capable of being mechanically and electrically interlocked with the associated line isolator so that the isolator cannot be operated with the breaker in the closed position.

All doors or shutters which give access to live parts shall be interlocked in such a way that these cannot be opened unless the circuit breaker is in the open position.

Other interlocks shall be provided as deemed necessary for safety.

24) TERMINAL CONNECTOR:-

Suitable terminal connectors of bi-metallic type suitable for both horizontal and vertical connection shall be provided on the terminal pad both on the incoming and the outgoing side for connection of jumpers of ACSR conductor. The size of the conductor may vary between 50mm² and 232mm² depending upon the location of the circuit breaker. The terminal connection drawing and details are to be approved by the Purchaser before fabrication. The terminal connectors shall be bi-metallic type to avoid bi-metallic corrosion.

25) INSULATION AND CLEARANCE:-

- a) The insulation to ground, the insulation between open contacts and insulation between phases of the circuit breaker shall be capable of satisfactorily withstanding dielectric test voltages.
- b) The minimum clearance in open air shall be as follows:
- **Phase to phase spacing in switchyard i.e. interpole spacing for Breaker (min) - 320 mm**
 - **Ground clearance from the lowest line terminal if both the terminals are not in same horizontal plane (min) - 2700mm**

26) TEMPERATURE RISE:-

The temperature rise and the maximum temperature of any part of the circuit breaker under continuous load condition and exposed in the direct rays of the sun shall not exceed the permissible limits as provided in Table V of IEC publication 694 or table 4 of IS:12729. These limits shall not be exceeded when corrected for the difference between the ambient temperature at site and the ambient temperature specified in the standard. The correction proposed shall be stated in the tender.

27) TESTS:-

27.1. Type and routine tests:- The circuit breakers shall be subjected to routine and type tests in accordance with the standards listed in this specification including the following IEC and IS standards with the latest amendments:

- Circuit breaker
- Porcelain insulator

The tests shall include but not limited to the following:

27.2. Short circuit tests:- The circuit breaker shall satisfactorily perform the out of phase and short circuit duties specified in IEC:56, IEC:17A(Sectt.) and IEC:17A/CD/474, IS-13118 and IS:13516.

The circuit breaker shall be capable of performing at least twenty five (25) open operations at the rated short circuit current before maintenance or inspection is required.

27.3. Capacitive current switching:- Capacitive switching tests shall be performed in accordance with IEC:56 or IS:13118 and IEC:17A/CD/474 at 1.3U preferably by direct test method or alternatively using synthetic method to IEC:427 or IS:13516. The test circuits shall simulate the most onerous site conditions.

27.4. **Reactor Switching:-** In addition to the capacitive current switching tests to IEC:56 or IS:13118 and IEC:17A/CD/474, the circuit breakers shall be tested for shunt reactor switching in accordance with IEC:1233, Examination of the interrupter after the tests shall not show any evidence of Surface tracking or erosion of contacts.

27.5. **Dielectric tests:-** At zero gauge loss of vacuum inside the interrupter chamber, the open contacts shall withstand continuously, the rated phase to ground voltage and it shall be possible to break normal current in these conditions. During the dielectric type tests, no flashover external or internal shall be acceptable.

The circuit breakers shall be subjected to a power frequency AC voltage test for one minute in dry and wet conditions and there shall be no external flash over to earth.

27.6. **Mechanical endurance:-** In addition to the requirements of IEC:56, an extended mechanical endurance test is required to show that the circuit breaker is capable of at least 10,000 operations at no load in accordance with IEC:17A/474/CD. Between the specified test series in IEC: 17A/474/CD, some maintenance such as lubrication and mechanical adjustment is allowed and shall be performed in accordance with manufacturer's instructions. Change of contacts is not permitted.

27.7. **Low current switching:-** The circuit breakers shall produce very low over voltage (<2.0 pu) on all switching circuits inductive current including reactor switching to IEC-1233 and capacitive current switching to IEC:17A (Secretariat) 438 and IEC 17A/CD/474 the circuit breaker shall be re-ignition or re-strike free for all duties.

27.8. **Duty requirement tests:-** Apart from auto-reclosing and the other duties mentioned above, the breakers shall be able to perform the following duties for which type tests are to be conducted as per IEC:56 or IS:13118.

- 1) Breaking the steady and the transient magnetising current of the transformer.
- 2) Breaking 25% of rated fault current at twice the rated voltage as per IEC/IS.
- 3) Cable charging breaking current.
- 4) Back-to-back capacitor bank breaking current.
- 5) Single capacitor bank breaking current.
- 6) Capacitor bank in rush making current.

Test for the resistance of the main circuit shall also be conducted.

27.9. **Temperature rise test:-** Temperature rise test is to be conducted on the circuit breaker and the accessories in accordance with IEC:56 or IS:13118. The temperature rise shall be limited as per this specification.

28) PERFORMANCE REQUIREMENTS:-

The supplier shall declare the circuit breaker opening and closing times at 120 percent, 100 percent and 70 per cent of the rated voltage of the opening and closing devices when

measured at the terminals of the trip and closing coils. The minimum make break time at rated voltage and total break time of the CB shall be stated. The total break time must not exceed 60m. sec.

29) EARTHING:-

All metal parts not intended for carrying current or not alive shall be connected to duplicate earthing system and suitable electroplated brass earthing terminals shall be provided on each circuit breaker in conformity with IEC:56 or IS:13118. Suitable identification mark for the earth terminals shall be provided adjacent to the terminal.

Earth continuity conductors shall be provided down to the ground level for earth connection to purchaser's earthing grid. It shall have sufficient cross sectional area to afford a low resistance path for the full fault current envisaged. Such conductor shall also be provided for the CTs up to the ground level.

The size of the earth continuity conductor (50*6mm electrolytic tinned copper flat) shall be large enough to reduce the potential rise of the metal frame of the breaker in the event of fault to minimum but in any case not more than 10V. The size of the conductor shall also be adequate to restrict the temperature rise without causing any damage to the earth connection in the case of fault. No riveted joints in the earth conducting path shall be permissible and only bolted joints of adequate size shall be provided with nuts, bolts and plain and spring washers. The surfaces to be jointed shall be perfectly flat without any unevenness to ensure that there is no contact resistance.

An earth bus bar of copper strip shall be provided inside the local control cabinet to which all earthing connections must be made. The earth bus bar shall be terminated into two electroplated brass earthing terminals of adequate size with nuts, bolts and washers for connecting to earth continuity conductor mentioned above.

30) Mandatory Spare Parts for 11 KV VCB:-

The supplier shall provide the mandatory spares as follows for every 9VCB Sets , FREE OF COST without any extra price for these spares Parts. How ever , where part quantity has been offered spare parts will be varied proportionately.

Sl. No.	Description	Qty. required (Nos.)
1)	Complete pole assembly of the circuit breaker	1
2)	Vacuum interrupter bottle (for vacuum type only)	3
3)	Tripping coils	2
4)	Closing coils	2

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5)	Insulated drive rod	3
6)	Spring charging motor	1
7)	Set of spring charging limit switches	3
8)	Set for gaskets complete for one circuit breaker	1
9)	Upper Housing assembly	1
10)	Lower Housing assembly	1

Sd/-
Chief Engineer (SCM)

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ANNEXURE II

TECHNICAL SCHEDULE FOR 11 KV OUTDOOR VACUUM CIRCUIT BREAKER

Sl.No.	Description	As per Specifications	Units	Bidders Offer
1)	GENERAL			
a)	Name of manufacture			
b)	Manufacturer"s type designation	Out-Door type		
c)	Governing standards	IS : 13118, IEC-62271-100		
d)	No. of poles of circuit breaker	3	No.	
e)	No. of breaks per phase	1	No.	
f)	Type – Vacuum	Vacuum		
2)	NOMINAL VOLTAGES			
a)	Rated voltage	11	KV	
b)	Maximum (continuous) service rated voltage	12	KV	
3)	RATED NORMAL CURRENT			
a)	Under normal condition	800	Amps	
b)	Under site condition	800	Amps	
4)	SHORT CIRCUIT PERFORMANCES			
	Rated short circuit breaking current:			

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	Symmetrical, rms	25	KA	
	Asymmetrical including DC component	30	KA	
	Rated short circuit making current; peak	62.5	KA	
	Short time current withstand capability:			
	Peak value	62.5	KA	
	Rms value	25	KA	
	Duration	3	Sec	
5)	MAX. TEMP. RISE OVER AMBIENT OF 500C			
	- At normal continuous current	As Per IS	0C	
	- After performing the operating sequence		0C	
6)	MAKE AND BREAK TIMES			
	Total break times			
	- At 10% rupturing capacity voltage	< 60	milli-sec	
7)	RATED INSULATION LEVEL			
	Dry and wet power frequency withstand test voltage for one minute, rms:			

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	- Between live terminals and grounded objects	28	KV	
	- Between terminals with breaker contacts open 1.2/50 μ s full wave impulse withstand voltage +ve and - ve polarity, peak	28	KV	
	- Between live terminals and grounded object	75	KVp	
	- Between terminals with breaker contacts open	75	KVp	
	- One minute power frequency voltage of auxiliary wiring	2	KV	
8)	HOLLOW INSULATOR HOUSING for Breaker			
	Type and make of insulators.			
	Power frequency withstand test voltage for one minute:			
	- Dry	28	KV	
	- Wet	28	KV	
	Flash over value			
	- Dry	75	KVp	
	- Wet	75	KVp	

	Creepage distance total	>300	mm	
	Creepage distance protected	>280	mm	
	Weight of assembled housing	Kg		
9)	SUPPORT INSULATOR			
	Type and make of insulators			
	Power frequency withstand test voltage for one minute:			
	- Dry	28	KV	
	- Wet	28	KV	
	Flash over value			
	- Dry	75	KV	
	- Wet	75	KV	
	1.2/50 impulse voltage withstand capability			
	- positive polarity	75	KVp	
	negative polarity	75	KVp	
	Creepage distance, total	>300	mm	
	Creepage distance, protected	>280	mm	
	Weight of assembled housing	Kg		

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	Corona shield provided or not	Yes / No		
10)	CONTACTS			
	- Type of main contacts			
	- Type of auxiliary contacts			
	- Material of auxiliary contacts	Copper		
	- Type of plating, if any	Silver		
	- Thickness of plating	20	Micron	
	Frequency limits for proper operation			
	Maximum	105%	Hz	
	Minimum	95%	Hz	
	- Normal control circuit voltage	24	Volts	
	- DC Voltage limits for proper operation			
	Maximum	120%	Volts	
	Maximum	70%	Volts	
	- Power required for trip coil	300	Watts	
	- Power required for closing coil	300	Watts	
11)	OPERATING MECHANISM			

	Opening type	Shunt Trip		
	Closing type	Motor / Manual spring charge, Shunt/Magnetic actuator operation		
	Force applied by charged spring for closing	Kg / N		
	Time taken by motor for charging the spring form fully Discharged to fully charged position	<30	sec	
	Full sequence of operation	0-0.3sec-CO-3min- CO		
	Whether limit switches are provided with spring	Yes/No		
	Whether spring limit switches start stop the motor	Yes/No		
	Type and material of spring employed			
	Whether trip free	Yes/No		
	Whether anti pumping device provided	Yes		
12)	AUXILIARY AND CONTROL POWER SUPPLY			
	- Normal auxiliary A.C	230	Volts	

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	supply voltage			
	- Voltage limits for proper operation			
	Maximum	115%	Volts	
	Minimum	85%	Volts	
	- Frequency limits for proper operation			
	Maximum	105%	Hz	
	Minimum	95%	Hz	
	- Normal control circuit voltage	24	Volts	
	- DC Voltage limits for proper operation			
	Maximum	120%	Volts	
	Maximum	70%	Volts	
	- Power required for trip coil	300	Watts	
	- Power required for closing coil	300	Watts	
13)	LOCAL CONTROL PANEL			
	- Material			
	- Degree of protection			
	- Vermin proof provisions	Yes/No		
	- Weather proof provision	Yes/No		
	- Dust proof provision	Yes/No		

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	- Ventilation provision	Yes/No		
	- Thickness of sheet materials used	3	mm	
	- Overall dimensions	mm		
	- Total weight	Kg		
	- Mounting arrangement			
14)	TERMINAL CONNECTOR			
	- Material			
	- Bi-metallic or not	Yes/No		
	- Weight	Kg		
	- Dimensions	mm		
	- Size and type of conductor it can accommodate	100	sq mm	
	- Terminal pads silver plated or not	Yes/No		
	- Thickness of silver plating	microns		
15)	CORROSION PREVENTION SYSTEM FOR CIRCUIT BREAKER AND CONTROL CABINET			
	- Surface preparation			

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	- Rust inhibition			
	- Zinc thickness/paint thickness	Microns		
	- Treatment of fasteners			
16)	CORROSION PREVENTION SYSTEM FOR SUPPORT STRUCTURE	Hot Dip Galvanized		
	Surface preparation			
	Rust inhibition			
	Zinc thickness			
	Treatment of fasteners.	Microns		
17)	VACUUM CIRCUIT BREAKER SEALING			
	Degree of protection of circuit breaker pole enclosure (IEC 529, IS 13947).			
	Method of sealing the circuit breaker pole enclosure.			
18)	CURRENT TRANSFORMER			
	1) Category A; 800-400/5-5-1A			

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	Make and type of transformer	Out type, 1 ph, Oil cooled, Dead Tank		
	Ratio	800-400/5-5-1A		
	Core1. VA burden	15	VA	
	Accuracy class	0.5 S		
	Saturation factor			
	Instrument security factor	10		
	Accuracy limit factor			
	Core 2. VA burden	15	VA	
	Accuracy class	5P		
	Saturation factor			
	Accuracy limit factor	10		
	Core 3. Accuracy class	PS		
	Saturation factor			
	Accuracy limit factor			
	Knee point voltage (Vk)	250	Volts @ 800/1A	
	Magnetizing current at $V_k/2$	< 30 mA at 0.5 V_k	Milli Amps	
	Secondary resistance Rct	Ohms		
	Short time current rating, time	25 KA for 3 sec	KA / Sec.	
	Impulse voltage withstand level	75	KV	

	Power frequency voltage withstand level			
	Primary winding	28	KV	
	Secondary winding	3	KV	
	Weight of CT complete	Kg		
19)	INSTRUMENTS & METERS (Ammeter, Volt Meter & Energy Meter)			
A. 1)	Type & make of Ammeter & voltmeter	Analogue type ,AE make		
2)	Size	144x144		
3)	Whether magnetically shielded or not	Yes		
4)	Limits or error in the effective range	± 2 %		
5)	Scale length	90 Deg.		
6)	Whether Tropicalised			
7)	Short time overload rating	200%		
8)	V A Burden.			
	i) Current coil	VA		
	ii) Potential coil	VA		
9)	Power consumption current & potential coil	Watt		

B.	Energy Meter	(3 Ph,4 wire with Alpha numerical display)		
	Type: Conforming 10.2 Specification			
	Make	Secure meter/ L&T		
C.	BACK UP RELAYS			
1	Type of relay	2 O/C +1 E/F, self actuated ,1 Amp, Aux. Volt-110 V DC/ Numerical & Non Communicable Type		
	Make	AREVA/ABB/ Siemens/CG make		
2	Current coil rating	1	Amp	
3	Tap range	5% to 250 %		
4	V A Burden Highest tap & lowest tap	3		
5	Power consumption Highest tap & lowest tap	Watt		
6	Time of operation at maximum time dial setting at			
7	5 times tap setting current	1.6-1.9	Sec	
8	10 times tap setting current	1.3	Sec	
9	Type of characteristic	IDMTL		

10	Whether draw out type or not	Yes		
11	Trip contact ratings Amps.	5 A continuous	Amp	
12	Whether seal in contacts provided or not	Yes/No		
13	No. of contacts	2 NO+2 NC		
14	Flag/LED	Required		
D.	Three element voltage operated Aux. Relay			
	Type & make of the Relay	AREVA/ABB/ Siemens make		
	Voltage coil rating	110 V DC	Volts	
	No. of elements	3	No.	
	Mounting	Flush		
	Aux. Contact on each pole	1 NO + 1 NC		
	Flag	Required		
	Purpose	Trf protection		
E.	High speed Tripping Relay			
	Type & make of the Relay	AREVA/ Siemens/ CG make		
	Voltage coil rating	110 V DC	Volts	
	Contact(Hand reset)	3 NO +1 NC		

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	Flag	Required		
20	11 KV VOLTAGE TRANSFORMER			
a.	GENERAL.			
	- Make	Out type, Oil cooled, 1 ph, Dead Tank		
	- Rated normal voltage	11 / $\sqrt{3}$	KV	
	- Rated maximum voltage	12 / $\sqrt{3}$	KV	
	- Rated primary voltage	11 / $\sqrt{3}$	KV	
	- Rated secondary voltage	110/ $\sqrt{3}$ / 110/ $\sqrt{3}$	Volts	
	- V A burden	100 /100	VA	
	- Accuracy class	0.5 / 3P		
	- Ratio error			
	- Phase displacement positive or negative	Min		
	- Saturation factor			
	- Instrument security factor			
	- Short time current rating			
	Rms value	KA		
	Period	Sec		
	Peak value	KA		

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	- Impulse voltage withstand level	75	KVp	
	- One minute power frequency voltage withstand level of primary winding	28	KV	
	- Weight of core and winding	Kg		
	- Total weight	Kg		
	- Overall dimensions	Mm		
	- Rated voltage factor			
	Continuous	1.2		
	For 30 seconds	1.5		
	- Temperature rise above the ambient of 500C	40	0C	
	- Correction factor			
	- Partial discharge level	pC		
b.	CORE			
	- Material composition (CRGO-M4 or better)			
	- Flux density at normal voltage and frequency	<1.2	Telsa	
	- Lamination thickness	0.27	mm	
c.	WINDINGS			

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	- Purity of copper used	Electrolytic	Percent	
	- Type of insulation			
	- Power frequency withstand level			
	Secondary winding to earth	3	KV	
	Primary winding to earth	28	KV	
d.	SECONDARY TERMINAL BOX			
	- Degree of protection	Yes/No		
	- Vermin proof provision	Yes/No		
	- Weather proof provision	Yes/No		
	- Dust proof provision	Yes/No		
	- Thickness of metal used	3	mm	
	- Overall dimensions	mm		
	- Mounting arrangement			
e.	H V TERMINAL			
	- Material			
	- Bi-metallic or not	Yes/no		
	- Dimensions,	mm		
	- Size and type of conductor it can accommodate	100	Sq. mm	