



TITLE
**SPECIFICATION FOR 36kV
OUTDOOR TRIPLE POLE
OPERATED VACUUM CIRCUIT
BREAKER**

Doc. No.	KP1/6C.1/13/TSP/11/115
Issue No.	1
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ANNEX B: **List of critical components of the 33kV VCB**

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0.1 Circulation List

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0.2 Amendment Record

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FOREWORD

This specification has been prepared by the Standards Department in collaboration with Technical Services Section, Nairobi and Central Construction Section both of The Kenya Power and Lighting Company Limited (Kenya Power) and it lays down requirements for 33kV Outdoor Triple Pole Operated Vacuum Circuit Breaker (VCB). It is intended for use by Kenya Power in purchasing the equipment.

The supplier shall submit information which confirms satisfactory service experience with products which fall within the scope of this specification for purposes of tender evaluation.

1. SCOPE

- 1) This specification is intended to cover the design, manufacture, assembly and testing at manufacturer's works of 36 kV, 50 Hz, 800 A and 1250 A, 25 kA Triple Pole operated outdoor-type 33kV VCB for efficient and trouble-free operation as specified hereunder.
- 2) The scope also includes the circuit breaker 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.
- 3) 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.
- 4) The circuit breakers in this specification shall be required to control the primary side of 33/11 kV power transformers in the primary sub-stations (incoming 33kV feeders) or Bus couplers in these sub-stations or feeders.
- 5) The circuit breakers shall be suitable for 3 phase 50Hz solidly grounded neutral system and shall have normal current carrying capacity and symmetrical short circuit current breaking capability as mentioned hereunder.
- 6) The required 36 kV VCBs suitable for outdoor installations are to be quoted only by Manufacturers with a valid ISO 9000 certification.

2. REFERENCES

The following documents were referred to during the preparation of this specification. In case of conflict, the provision of this specification shall take precedence.

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Unless otherwise specified, the latest revision, edition and amendments of the standards shall apply.

IEC 62271-100,
110 & 200:

High-voltage switchgear and controlgear --Part 100: High-voltage alternating-current circuit-breakers --Part 110: Inductive Load Switching --Part 200: AC metal enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV

IEC 60694:

Common clauses of high voltage switch-gear and control gear standards (for voltage exceeding 1000 V).

IEC 60060-1 & 2:

High-voltage test techniques --Part 1: General definitions and test requirements --Part 2: Measuring systems

IEC 60427:

Synthetic testing of high-voltage alternating current circuit-breakers

IEC 61633:

Guide for short-circuit and switching test procedures for metal-enclosed and dead tank circuit-breakers

IEC: 17A/CD: 474:

HV. AC. Circuit breakers- capacitive switching.

IEC TS 60815-1:

Selection and dimensioning of high-voltage insulators intended for use in polluted conditions - Part 1: Definitions, information and general principle

IEC 60137:

Insulated bushings for alternating voltages above 1 000 V

IEC/TS 62371:

Characteristics of hollow pressurised and unpressurised ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V

IEC 62155:

Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V

IEC 60273:

Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V

IEC 60034:

Rotating electrical machinery

IEC 60529:

Degree of protection provided by enclosure.

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ISO 1461: Metallic Coatings – Hot dip galvanized coatings on fabricated ferrous products – Requirements.

3. TERMS AND DEFINITIONS

For the purpose of this specification, the definitions in the references mentioned in clause 2 shall apply.

4. REQUIREMENTS

1) SERVICE CONDITIONS

4.1.1. Physical Service Conditions

The circuit breaker shall be suitable for continuous outdoor operation in tropical areas with the following atmospheric conditions.

- (a) Altitude: 2200m above mean sea level
- (b) Pollution: Heavy saline atmosphere
- (c) Humidity: up to 90%
- (d) Ambient temperatures of +30° C average, (+40° C Max. and -1° C Min).
- (e) Isokeraunic level: Up to 180 thunderstorm days.

4.1.2. System Conditions

The circuit breaker shall be connected to an overhead system which is generally unearthed (without aerial earth wire).The equipment shall be suitable for installation in supply systems of the following characteristics.

Table 1: System Operating Conditions

Particulars	Requirements
Frequency	50 Hz (5%)
Nominal System voltages	33kV
Maximum System Voltages	36 kV
Insulation Levels	200 kV (Peak)
Power frequency one minute withstand (wet and dry) voltage	95 kV (rms)
Site pollution severity (SPS) as per IEC/TS 60815:2008 – class e	Very Heavy
Specific creepage distance as per IEC/TS 60815:2008 – class e	31mm/kV

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4.1. DESIGN AND CONSTRUCTION**4.1.1. General**

- 4.1.1.1. The VCBs shall be designed, manufactured and tested to IEC 62271-100, 110 & 200, IEC 60694 and associated standards listed in this specification.
- 4.1.1.2. The construction shall include a fixed contact, moving contact and arc shield mounted inside a vacuum chamber - vacuum interrupters. The movable member shall be connected to the control mechanism by stainless steel bellows - a stored energy operating mechanism, necessary electrical controls and interlock devices, disconnect devices to connect the circuit breaker to both primary and control power and an operator housing. This shall enable a permanent sealing of the vacuum chamber so as to eliminate the possibility of leak.
- 4.1.1.3. A glass vessel or ceramic vessel (vacuum bottles) shall be used as the outer insulating body. The arc shield shall be suitable for preventing deterioration of the internal dielectric strength by preventing metallic vapours falling on the inside surface of the outer insulating cover.
- 4.1.1.4. The circuit breakers shall be structure mounted, open type with vacuum as interrupting media incorporating separate interrupters of **800A and 1250A rating** for each phase mounted on a 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.
- 4.1.1.5. 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 62271-110, IEC: 60056, IEC 61633, IEC: 17A/CD:474 and other associated standards mentioned in the clauses of this specification.
- 4.1.1.6. The terminal pads shall have aluminum alloy with smooth finishing. 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 with ease. The contact gaps shall be adjustable to allow for wear.
- 4.1.1.7. The mechanism and the connected interrupters shall satisfy the mechanical endurance requirements of IEC 62271-100 and all additional requirements specified herein.
- 4.1.1.8. The circuit breaker shall be particularly suitable for the following protection schemes:
a) Inter-tripping for simultaneous tripping of other circuit breakers.

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b) Auto reclosure

4.1.1.9. The manufacturer of the 33 kV VCBs in this specification shall be required to have at least 15 years' experience in manufacture of similar circuit breakers and the manufacture of the specified 33 kV VCBs. The particular 33 kV VCBs offered must have been in operation for at least 5 years and a proof of the same shall be submitted with the bid for tender evaluation.

4.1.2. Porcelain Insulator

4.1.2.1. External parts of the circuit breakers, which are under continuous electrical stress, shall be of hollow porcelain in accordance with IEC/TS 62371:2008.

4.1.2.2. The creepage and flashover distance of the insulators shall be dimensioned and the type and profile designed in accordance with IEC/TS 60815:2008 and shall be suitable for the worst environmental conditions specified in this specification.

4.1.2.3. 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 1116mm with protected creepage distance 50 percent of the total.

4.1.2.4. Internal surfaces of hollow insulators shall be glazed. The insulators shall comply with IEC/TS 62371:2008 and tested in accordance with IEC 62155:2003. 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.

4.1.3. Vacuum Interrupter Unit

4.1.3.1. Envelope Vacuum (degree of vacuum being in the range from 10^{-9} to 10^{-7} torr)

This shall offer mechanical support for the other components as well as electrical insulation when the contacts are in the open position. It shall be made of alumina or glass ceramic and must be capable of maintaining the vacuum over a long life of the interrupter at a pressure range from 10^{-7} to 10^{-5} torr.

4.1.3.2. End cups or plates and centre shell

This shall be made of stainless steel or Monel. They shall provide support to other components and must match the thermal expansion of the envelope if a direct seal is made.

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4.1.3.3. Stationary and Movable Rods

This shall be made of oxygen-free, high conductivity (OFHC) copper and shall form the main electrical contacts. One shall be fixed while the other moves to separate the contacts.

4.1.3.4. Metal vapour condensing shields

Shall be made from (OFHC) copper, nickel or stainless steel. They shall serve as a condensing surface for the metal vaporized arc. They shall be capable of preventing the metal from condensing on the insulating portion of the envelope.

4.1.3.5. Flexible metallic bellows

Their design shall permit the motion to be transferred into the interrupter without a loss of vacuum. The material of manufacture shall be stainless steel or Monel.

4.1.3.6. Electrical contacts

4.1.3.6.1. This shall be the most critical component of the entire interrupter; their failure may destroy the interrupter. The contact material shall be a binary alloy of copper-bismuth (Bismuth content < 1%) with peak current range of 14kA-32kA and weld breaking force range of 10kN- 40kN or equivalent with the following characteristics:

- a) They must have good electrical conductivity;
- b) They must exhibit good anti-welding properties
- c) They must not chop the current at high values

4.1.3.6.2. The various components shall be welded or silver-alloy brazed to form an airtight package. The interrupter shall therefore be evacuated to a pressure of about 10^{-9} torr.

4.1.4. Auxiliary contacts

4.1.4.1. 20 auxiliary contacts (10 N.O. + 10 N.C.) of 110 Volt D.C grade and 10 amps DC rating shall be provided in each circuit breaker.

4.1.4.2. The timing of the operation of one of each kind (make and break) of control and auxiliary contacts should be determined in relation to the operation of the main contacts, on closing and on opening of the circuit-breaker.

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4.1.5. Indication

- 4.1.5.1. 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.
- 4.1.5.2. The word "OFF" in white letter on green background shall be used to indicate that the breaker is in the open position and the word "ON" in white letters on a red background to indicate that the breaker is in the closed position.
- 4.1.5.3. 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.

4.1.6. Operation and controls

- 4.1.6.1. 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 and shall include:
 - a) **LOCAL/ REMOTE** selector switch of stay put type. The selection of local operation shall inhibit the operation of the breaker from any remote source.
 - b) **ON/NEUTRAL/ OFF** control switch or **ON** and **OFF** push buttons: The push buttons shall be momentary contact type with rear terminal connections. The close push button shall be of **GREEN** colour and the open push button **RED** colour.
 - c) **MECHANICAL EMERGENCY TRIP DEVICE**: This shall be suitable for manual operation in the event of failure of electrical supplies. The device shall be accessible without opening any access doors and distinctly labeled. It shall be shrouded and protected against inadvertent operation.
- 4.1.6.2. Means shall be provided for manual operation of these circuit breakers during failure of auxiliary power in addition to electrical operation.
- 4.1.6.3. Means shall be provided to prevent the mechanism from responding to a close signal when the trip coil is energized or to reclosing from a sustained close signal either opening due to a trip signal or failure to hold in the closed position.
- 4.1.6.4. The circuit breaker shall be able to perform 10,000 operating cycles at no load in accordance with IEC: 17A/474/CD for circuit breakers for auto reclosing duties.
- 4.1.6.5. The technical characteristic requirements for the 33kV VCB shall be in accordance with the manufacturing standards and Table 2 of this specification.

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Table 2: Technical Requirements for 33kV VCB as per IEC 62271-100 & 200

Sl. No.	Particulars	Requirements	
1	Service type	Outdoor	
2	No. of Poles	3	
3	Nominal system voltage	33kV	
4	Highest system voltage	36kV	
5	Rated normal current at 50°C		
	i) For Bus-bar of Circuit Breaker	800 A	
	ii) For Interrupter	1250 A	
	iii) For Outgoing Feeders/Transformer	1250 A	
6	Rated short circuit breaking current (rms)	25KA	
7	Rated short circuit making current (peak)	63KA	
8	Rated short time current withstand capability for 1 sec.	25 kA(Panel)/ 25 kA (Interrupter)	
9	Opening time	<35 ms	
10	Closing time	<100 ms	
11	Rated insulation level:		
	i)	One minute power frequency withstand voltage to earth (wet and dry) rms	Common value 80 kV Across isolating distance 95 kV
		ii)	Impulse withstand voltage to earth with 1.2/50 sec, wave of +ve and -ve polarity (Peak)
12	First – pole – to clear factor	Terminal fault	1.5
		Out-of-phase	2.5
13	Rated operating sequence (for auto reclosing)	O-0.3 Sec- CO-3 min-CO	
14	Maximum break time	3 cycles	
15	Rated out of phase breaking current	25% of the symmetrical short circuit breaking current	
16	Maximum pole scatter	10 mili seconds	
17	Class of circuit breaker as per IEC 62271-100	Electrical endurance	E2
		Mechanical endurance	C2
		Restrike performance	M1
18	Maximum contact resistance	35 μΩ	
19	Rated Auxiliary supply for spring charge motor, lamp & heater circuit.	230V A.C/ 110V D.C	
20	Auxiliary contacts as per IEC 60694, Table 16	Class	1
		Rated supply voltage for trip/close coil	110V D.C
		Rated continuous current	10A
		Rated short-time withstand current	100A/30ms
	Breaking capacity	440W	
21	Minimum Creepage distance (mm)	1116mm	
22	Minimum protected Creepage distance (mm)	780mm	

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4.2. OPERATING MECHANISM

4.2.1. General

- 4.2.1.1. 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 60694 definition). All working parts in the mechanism shall be of corrosion resistant material. Self-lubricating, wearing resistant bearings shall be provided in the mechanism.
- 4.2.1.2. 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 62271-100 & 200.
- 4.2.1.3. 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.

4.2.2. Spring mechanism

- 4.2.2.1. 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.
- 4.2.2.2. 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.
- 4.2.2.3. 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.
- 4.2.2.4. Provision shall be made for remote electrical indication of "Spring Charged" and "Spring Free" conditions.

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4.2.2.5. 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.

4.2.3. Motor

4.2.3.1. 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.

4.2.3.2. 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 as per IEC 60269 or 33kV VCB as per IEC 60898-1 & 2. The motor shall comply with IEC 60034

4.3. AUXILIARY POWER SUPPLY

The operating mechanism of the circuit breaker shall be suitable to operate with the following auxiliary power supplies as per Table 3:

Table 3: Auxiliary Power Supplies

DC supply 110V; and 230V, 50Hz, Single phase A.C supply	For spring charging motor (universal type)
DC supply 110 Volts	For close and open coils, indication & alarm (Power pack - Input supply: 230V AC & 110V AC and Output: 110 V 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 shall 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	From 115% to 85% of normal and frequency variation
DC supply	Voltage from 120% to 70% of normal voltage

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4.4. INTERLOCKS

4.4.1. The circuit breaker shall be capable of being mechanically and electrically interlocked with the associated line isolators so that the isolator cannot be operated with the breaker in the closed position. This shall be in accordance with sub-clause 5.11 of IEC 60694 in addition to provisions of sub-clause 5.11 of 62271-200.

4.4.2. 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.

4.5. TERMINAL CONNECTOR

4.5.1. Suitable terminal connectors of tinned bi-metallic type (minimum tinning thickness of 100µm 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 or AAAC conductors.

4.5.2. The size of the conductor may vary between 75 mm² and 300 mm² depending upon the location of the circuit breaker. The terminal connection drawing and details shall be submitted with the bid and approved by KPLC before fabrication. The terminal connectors shall be bi-metallic type to avoid bi-metallic corrosion.

4.6. INSULATION AND CLEARANCE

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. The minimum clearance in open air shall be as follows:

Table 4: Clearances as per IEC 60694:2003, Table 7

Particulars	Clearances
Between phase to earth	400mm
Between poles	460mm
Ground clearance for live parts	3700mm

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4.7. EARTHING

4.7.1. The frame of each switching device shall be provided with a reliable earthing terminal having a clamping screw or bolt for connection to an earthing conductor suitable for specified fault conditions. The diameter of the clamping screw or bolt shall be at least 12 mm. The connecting point shall be marked with the "protective earth" symbol, as indicated by symbol No. 5019 of IEC 60417-1:2000. Parts of metallic enclosures connected to the earthing system may be considered as an earthing conductor.

4.7.2. 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 62271-200:2003 clause 5.3. Suitable identification mark for the earth terminals shall be provided adjacent to the terminal.

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

4.7.4. The size of the earth continuity conductor 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.

4.8. PERFORMANCE REQUIREMENTS**4.8.1. Opening and closing**

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 33kV VCB shall be stated in the bid. The total break time must not exceed 60ms.

4.8.2. 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 3 of IEC 60694:2002. These limits shall not be exceeded when corrected for the difference between the ambient temperature at site and the

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ambient temperature specified in the standard. The correction proposed shall be stated in the tender for purposes of tender evaluation.

4.9. ACCESSORIES FOR THE CIRCUIT BREAKERS

Each circuit breaker shall be supplied with:-

- a) One (1) Manual springs charging handle or tool
- b) Support steel structure
- c) Mounting bolts and washers, etc.

4.10. QUALITY MANAGEMENT SYSTEM

4.10.1. The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the 33 kV VCB design, material, workmanship, tests, service capability, maintenance and documentation, will fulfil the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008.

4.10.2. The Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2008 certificate shall be submitted with the tender for evaluation.

4.10.3. The bidder shall indicate the delivery time of each type of 33 kV VCB, manufacturer's monthly & annual production capacity and experience in the production of the type and size of circuit breaker being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers outside the country of manufacture for exact or similar rating of circuit breaker sold in the last five years together with four customer reference letters shall be submitted with the tender for evaluation.

5. TESTS AND INSPECTION

5.1. The 33kV VCB shall be inspected and tested in accordance with the requirements of IEC: 62271-100, 110 & 200, IEC 60694 and associated standards listed in this specification. It shall be the responsibility of the supplier to perform or to have performed the tests specified and whatever other tests he normally performs at works.

5.2. The 33kV VCB shall be of design and construction which have been validated by the type tests specified in the applicable standards. Additional tests may be required to verify adequate over- voltage endurance and life for which the manufacturer may supply a certified test report.

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5.3. Copies of previous Type Tests Reports issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. The accreditation certificate to ISO/IEC 17025 for the same third party testing laboratory used shall also be submitted with the tender (all in English Language). The type tests shall include but not limited to:

A. Vacuum Circuit Breaker as IEC: 62271-100, 110 & 200, IEC 60694 and associated standards – All the tests shall be mandatory as recommended by IEC: 62271-100: 2003, Table 7.

- a) Dielectric tests
- b) Radio interference voltage tests
- c) Measurement of the resistance of the main circuit
- d) Temperature-rise tests
- e) Short-time withstand current and peak withstand current tests
- f) Tightness tests
- g) EMC tests
- h) Mechanical operation test at ambient temperature
- i) Short-circuit current making and breaking tests
- j) Capacitive current switching tests: line-charging current breaking tests
- k) Capacitive current switching tests: cable-charging current breaking tests
- l) Verification of the degree of protection
- m) Extended mechanical endurance tests on circuit-breakers for special service conditions
- n) Low and high temperature tests
- o) Humidity test
- p) Static terminal load tests
- q) Critical current tests
- r) Short-line fault tests
- s) Out-of-phase making and breaking tests
- t) Electrical endurance tests
- u) Single-phase and double earth fault tests
- v) Capacitive current switching tests:
 - (i) line-charging current breaking tests
 - (ii) cable-charging current breaking tests
 - (iii) single capacitor bank switching tests
 - (iv) back-to-back capacitor bank switching tests
- w) Switching of shunt reactors and motors as per IEC 61233

B. Insulators as per 62155:2003

- a) Pressure test
 - (i) Pressure test for hollow insulators or hollow insulator bodies intended for general use
 - (ii) Pressure test for ceramic hollow insulators or hollow insulator bodies intended for use with permanent gas pressure

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b) Bending test

- (i) Bending test for hollow insulators or hollow insulator bodies intended for general use
- (ii) Bending test for ceramic hollow insulators or hollow insulator bodies intended for use with permanent gas pressure

5.4. Routine tests on the 33kV VCBs shall be carried out by the manufacturer as per the latest edition of relevant IEC and associated international standards as mentioned in this specification. The complete routine test reports shall be submitted to KPLC for approval two (2) weeks before factory acceptance tests and inspection. Also two (2) sets of inspection packages (which shall include approved set of drawings, test procedures, copies of relevant standards, day wise test programme etc.) shall be submitted at least two (2) weeks before each inspection. The tests shall be as follows but not limited to:

A. Short circuit tests

- a) The circuit breaker shall satisfactorily perform the out of phase and short circuit duties specified in IEC 62271-100, IEC: 17A (Sect.) and IEC: 17A/CD/474.
- b) 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.

B. Capacitive current switching

Capacitive switching tests shall be performed in accordance with IEC 62271-100 and IEC 17A/CD/474 at 1.3U preferably by direct test method or alternatively using synthetic method to IEC 60427. The test circuits shall simulate the most onerous site conditions.

C. Reactor Switching

In addition to the capacitive current switching tests to IEC 62271-100 & 200 and IEC 17A/CD/474, the circuit breakers shall be tested for shunt reactor switching in accordance with IEC 62271-110; examination of the interrupter after the tests shall not show any evidence of surface tracking or erosion of contacts.

D. Dielectric tests

- a) At zero gauge loss of vacuum inside the interrupter chamber, the open contracts shall withstand continuously the rated phase to ground voltage and it shall be possible to break normal current in these conditions as per IEC 60060-1.
- b) 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.

E. Mechanical endurance

In addition to the requirements of IEC 62271-100 & 200, an extended mechanical

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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 Owner's instructions. Change of contracts is not permitted.

F. 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 61233 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.

5.5. All the manufactured 33kV VCB and their accessories shall be offered for factory acceptance tests and inspection in the presence of KPLC engineers. During inspection by KPLC engineers, at the manufacturer's works, the quantities of equipment etc., which will be ready and offered for inspection and tests, shall be considered already tested. The remaining components shall be subject to future tests whenever they will be ready. The mandatory acceptance tests to be witnessed in accordance with IEC 62271-100:2003 clause 7 shall include but not limited to:

- a) Dielectric test on the main circuit
- b) Dielectric test on auxiliary and control circuits
- c) Measurement of the resistance of the main circuit
- d) Tightness test
- e) Design and visual checks
- f) Mechanical operating tests
- g) Further tests and inspections shall be made to the complete equipment, namely:
 - Measurement of the resistance of heaters (if fitted) and of the control coils;
 - Inspections of the wiring of the control, heater and auxiliary equipment circuits and checking of the number of auxiliary contacts, in accordance with the order specification;
 - Inspection of control cubicle (electrical, mechanical, pneumatic and hydraulic systems);
 - Recharging duration(s);
 - Functional performance of pressure relief valve;
 - Operation of electrical, mechanical, pneumatic or hydraulic interlocks and signaling devices;
 - Operation of anti-pumping device;
 - General performance of equipment within the required tolerance of the supply voltage;
 - Inspection of earthing terminals of the circuit-breaker.

5.6. On receipt of the 33kV VCBs KPLC may perform any of the tests specified in the order to verify compliance with this specification. The supplier shall replace without charge to KPLC

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any equipment or component parts which upon examination, test or use, fail to meet any of the requirements in the specification.

6. PACKING AND MARKING

6.1 Packing

- 6.1.1 All 33kV VCBs and their accessories shall be supplied separately packaged in wooden boxes/crates suitable for seaworthy packing, transportation by rail/road storage etc.
- 6.1.2 These boxes/crates shall allow for access (by the KPLC acceptance personnel) so that the 33kV VCBs and accessories may be easily removed for inspection and then be easily repacked and sealed for holding in store.
- 6.1.3 The packing may be in accordance with the manufacturer's standard practice unless otherwise specified. The supplier shall however, ensure that the packing is such that the equipment reaches the destination locations without damages after transport by rail, road or sea. The packing shall stand unloading and inter stores transfer with reasonable care.

6.2 Marking

- 6.2.1 The marking shall be indelible, permanent and easily legible.
- 6.2.2 The nameplates shall be anodized aluminum for all the component parts and shall be located on the narrow side of every equipment. The 33 kV VCB, shall be provided with durable and clearly legible nameplates which shall contain the information in English language and in accordance with Table 1 of IEC 62271-200:2003 in addition to sub-clause 5.10 of IEC 60694 which shall also be applicable:
 - a) Manufacturer
 - b) Type designation
 - c) Serial number
 - d) Instruction book reference
 - e) Year of manufacture
 - f) Applicable standard
 - g) Rated voltage U_r kV
 - h) Rated frequency f_r Hz
 - i) Rated lightning impulse withstand voltage U_p kV
 - j) Rated power frequency withstand voltage U_d kV
 - k) Rated normal current
 - l) Rated short-time withstand current (for main and earthing circuits) I_k kA
 - m) Rated peak withstand current (for main and earthing circuits) I_p kA Hz and 2,6 for 60 Hz

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- n) Rated duration of short circuit (for main and earthing circuits) tk s
- o) Rated filling level for insulation Pa or kg
- p) Alarm level for insulation Pa or kg
- q) Minimum functional level for insulation Pa or kg
- r) Insulating fluid and mass kg
- s) Internal arc classification IAC
- t) Accessibility type (code) - A(F,L,R), B(F,L,R) or C
- u) Arc test current kA
- v) Arc test current duration s
- w) Words "PROPERTY OF KPLC".

6.2.3 Instructions for storage, handling and installation shall be provided, all in English language.

7. Mandatory Spare Parts for 33kV VCB

7.1. The supplier shall provide the mandatory spares for each of the 33 kV VCBs as per Table 5, **FREE OF COST** without any extra price for these spares parts.

Table 5: Spares for the 33kV VCBs

SI. No	Description	Qty. required
1	Complete pole assembly of the circuit breaker	4
2	Vacuum interrupter bottle (for vacuum type only)	4
3	Tripping coils	6
4	Closing coils	6
5	Insulated drive rod	6
6	Spring charging motor	4
7	Set of spring charging limit switches	4
8	Set for gaskets complete for one circuit breaker	4
9	Upper Housing assembly	4
10	Lower Housing assembly	4

7.2. In addition, each breaker shall be furnished complete with fittings and accessories as listed below (The list is illustrative & not exhaustive).

- a) Clamp-type terminal connectors for ACSR Conductor
- b) Base frame and foundation/anchor bolts.
- c) Auxiliary Contacts and Relays/Contacts.
- d) Local/Remote selector Switch and Close/Trip Control Switch.
- e) Manual close and trip devices.
- f) Mechanical ON/OFF indicators.
- g) Operation counter.

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- h) Weatherproof control cubicle and operating mechanism boxes, with locking arrangement.
- i) Set of Switch-Fuse/MCB/MC units for A.C. & D.C. Supply.
- a) Space heaters with thermostat and switch.
- b) Cubicle illumination Lamp with Switch.
- c) Terminal blocks and internal wiring.
- d) G.I. conduits and accessories for connection between Central Control Cubicle and operating mechanism boxes where applicable.
- e) Other standard accessories which are not specified, but are necessary for efficient and trouble free operation shall be supplied

8. DOCUMENTATION

8.1. The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation. The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

- a) Precisely filled Guaranteed Technical Particulars (GTP),
- b) Design drawings and construction details of the 33 kV VCBs,
- c) Quality Assurance Plan (QAP) that will be used to ensure that the 33 kV VCBs assembly design, material, workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations.
- d) Test Program to be used after manufacture,
- e) Marking details and method to be used in marking the 33 kV VCBs,
- f) Manufacturer's undertaking to ensure adequacy of the design, good workmanship, good engineering practice and adherence to applicable standards in the manufacture of the 33kV VCB for KPLC,
- g) Packaging details of all the components
- h) Manufacturer's failure data on previous three years' shipments for year of manufacture and following year.
- i) Certification of ability to pass 33 kV VCBs tests including over-voltage endurance as well as long-term life.
- j) The bidder shall furnish one set of the following drawings along with their bid to check the stability of their equipment:
 - (i) Typical general layout diagram complete with dimensions, including air clearances, with front, back and side view diagrams.
 - (ii) Layout diagram for operating mechanism and local control panel, including colour picture of the mechanism;
 - (iii) Electrical schematic drawings of the 33 kV VCB, including typical application drawings; all the auxiliary & control circuits and indication drawings shall be clearly labelled, e.g., closing circuit, opening circuit, motor charging circuit, etc.;

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- (iv) Support steel structure mounting details;
- (v) Foundation plan and details;
- (vi) Details of top and bottom terminal pads;
- (vii) Electrical circuit diagram of the circuit breaker mechanism;
- (viii) Technical data and ratings;
- (ix) Name Plate details.
- (x) Product catalogue
- (xi) Operation and maintenance manual
- (xii) Guaranteed technical particulars (GTP)

- 8.2. The successful bidder shall, within four weeks of placement of order, submit five (5) sets of final versions of all the above said drawings for KPLC's approval. KPLC shall communicate the comments/approval on drawings to the supplier within a period of four (4) weeks.
- 8.3. The supplier shall, if necessary, modify the drawings and re-submit five (5) copies of the modified drawings for KPLC's approval, within one (1) week from the date of purchaser's comments.
- 8.4. After receipt of KPLC's approval the supplier shall, within two (2) weeks submit five (5) prints along with reproducible of the approved drawings and descriptive literatures on 33 kV VCBs and all allied equipment covered by the specification for KPLC's use.
- 8.5. The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without written approval of KPLC.
- 8.6. Approval of drawings by KPLC shall not relieve the supplier of any of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirement of the latest version of applicable standard of engineering, design and workmanship and latest revision of relevant standards at the time of supply. KPLC shall have the power to reject any work or material which in her judgment is not in accordance there-with.

9. WARRANTY AND TRAINING**9.1. Training**

- 9.1.1. Training to five (5) persons of KPLC on construction, installation, commissioning and Operation & Maintenance shall be imparted by bidder free of charge. Duration of the complete training shall be seven (7) working days, covering the minimum below specified curriculum. Any other specific area may be brought to notice. These shall include;
- a) Construction of 33kV VCB
 - b) Operating mechanism of 33kV VCB

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- c) Maintenance of 33kV VCB
- d) Overhaul of 33kV VCB(Interrupting chamber)
- e) Overhaul of 33kV VCB(Operating Unit)
- f) Operation of 33kV VCB with SCADA
- g) Construction and Maintenance of Local control panel
- h) Erection of 33kV VCB at site.
- i) Installation & Testing of 33kV VCB at site
- j) Type tests of 33kV VCB
- k) Routine tests of 33kV VCB
- l) Faults simulation of 33kV VCB
- m) Localization of 33kV VCB fault.

9.1.2. Bidder shall at his cost arrange for the above training facilities and in addition shall bear all living expenses plus inland travel expenses of all the trainees. The Purchaser shall only pay to and fro passage of the trainees.

9.2. Warranty and guarantee

9.2.1. The bidder shall guarantee for the equipment/workmanship for a minimum period of sixty (60) months from the date of commissioning or sixty six (66) months from the date of last receipt goods at stores, whichever is earlier. The manufacturer shall guarantee to replace or repair to the satisfaction of the purchaser the defective parts at site free of cost within the above period. Should however, the manufacturer fails to do so within a reasonable time, KPLC reserves the right to effect repair or replacement and recover such charges for repair or replacement from the bidder. The bidder shall submit a performance Guarantee of 10% of the order value valid for a period of 90 days beyond the expiry of the warranty period.

9.2.2. If during the defect liability period any services performed is found to be defective, these shall be promptly rectified by the supplier on its own cost (including the cost of dismantling and reinstallation) on the instruction of KPLC.

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ANNEX A: Guaranteed Technical Particulars (to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records, four customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation, all in English Language)

Particulars		To be Filled by BIDDER	
Bidders Name and Address			
Manufacturer and Country of Manufacture			
Type & Designation			
Type tested at	Name of laboratory		
	Address of laboratory		
1.0	SCOPE		
	Covers design, Manufacture, assembly, testing, supply, delivery	Specify	
	Ratings of the Vacuum circuit breaker offered	Specify	
	List all components and accessories of the VCB	Specify	
2.0	List standards of manufacture	Specify	
3.0	Terms and definitions	State if applicable	
4.0	Requirements		
4.1.1	Service conditions	Provide	
	Ambient Air Temperature, °C	Specify	
	Max Temperature, °C	Specify	
	Min Temperature, °C	Specify	
	Daily Average Temperature, °C	Specify	
	Solar Radiation, W/m ²	Specify	
	Altitude above MSL, m	Specify	
	Relative humidity	Specify	
	Condensation	Specify	
	Vibration level	Specify	
	Noise level	Specify	
	Induced Electromagnetic Disturbance, kV	Specify	
	Seismic conditions	Specify	
	Vertical, g	Specify	
	Horizontal, g	Specify	
4.1.2	System requirements		
	List the appropriate physical conditions	Specify	
Existing system conditions	Frequency, Hz	Specify	
	Nominal System voltages, kV	Specify	
	Maximum System voltages, kV	Specify	
	Design system insulation levels	Power frequency withstand, kVrms	Specify
		Lightning impulse withstand, kVpeak	
	Power frequency one minute withstand (wet and dry)	Specify	

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		voltage	
		Site pollution severity (SPS)	Specify
		Specific creepage distance	Specify
4.1	DESIGN AND CONSTRUCTION		
4.11	General		
4.1.1.2	Construction shall include the following	Fixed contact	Y/N
		Movable contact	Y/N
		Arc shield mounted inside vacuum chamber	Y/N
		Stainless steel bellows	Y/N
		Stored energy operating mechanism	Y/N
		Electrical controls	Y/N
		Interlock devices	Y/N
		Disconnect devices	Y/N
		operator housing	Y/N
	Permanent sealing of the vacuum chamber	Y/N	
4.1.1.3	Vacuum vessel made of Glass vessel or ceramic vessel		Y/N
	Metallic vapours do not stick on inner surface of outer insulating cover		Y/N
4.1.1.4	33kV VCB is structure mounted		Y/N
	Open type		Y/N
	Vacuum Interrupting media		Y/N
	Interrupters rating		Y/N
	Common drive mechanism		Y/N
	Have local control and remote control provision		Y/N
4.1.1.5	Fitted with spring mechanism		Y/N
	Performs all test duties		Y/N
	Interrupts out-of-phase current		Y/N
	Produces very low over voltage		Y/N
4.1.1.6	Terminal pads of aluminium alloy with smooth finishing		Y/N
	Inspection and maintenance of carried out easily and quickly		Y/N
	Contact gaps adjustable		Y/N
4.1.1.8	Suitable for	Inter-tripping for simultaneous tripping of other CBs	Y/N
		Auto-reclose	Y/N
4.1.1.9	Manufacturers years of experience in similar 33kV CBs		Specify
	Years of operation of offered VCBs		Provide proof
4.1.2	Porcelain Insulator		Specify
4.1.2.1	Material of manufacture	Type designation	Specify
		Grade	
4.1.2.2	Creepage distance		Specify
	Flashover distance		Specify
4.1.2.4	Internal surfaces of hollow insulators glazed		Specify
	Porcelain properties	Higher strength	Specify
		Homogeneity	Specify
		Uniform glaze	Specify
		High quality finish	Specify

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		Withstand maximum expected static and dynamic loads	Specify
4.1.3	Vacuum Interrupter Unit		Provide
4.1.3.1	Degree of vacuum of the vacuum envelope		Specify
	Offers mechanical support and electrical insulation		Specify
	Made of alumina or glass ceramic		Specify
4.1.3.2	Material of manufacture of end cups or plates and center shell		Specify
4.1.3.3	Material of manufacture of stationary and movable rods		Specify
4.1.3.4	Material of manufacture of the metal vapour condensing shields		Specify
4.1.3.5	Design of flexible metallic bellows allows for motion to be transferred into the interrupter without loss of vacuum		Specify
	Material of manufacture		Specify
4.1.3.6	Electrical contacts	Material of manufacture	Specify
		Peak current range	Specify
		Weld breaking force range	Specify
	Characteristics	Good electrical conductivity	Specify
		Good anti-welding properties	Specify
		Must not chop the current at high values	Specify
	Welded or silver-alloy brazed		Specify
Pressure of interrupter		Specify	
4.1.4	Auxiliary contacts		Provide
	No of auxiliary contacts and their states		Specify
	DC voltage and current rating provided and marked on CBs		Specify
	Timing of make or break operation of auxiliary in relation to main contacts closing or opening operation		Specify
4.1.5	Indication		Provide
	Made of non-corroding material		Specify
	Visible from operating side of breaker without opening door		Specify
	The word 'OFF' in white and on green background marked clearly		Specify
	The word 'ON' in white and on red background marked clearly		Specify
	Drive positive in both directions		Specify
	Local and remote electrical indication available		Specify
	Spring charging indication provided		Specify
	Mechanical counters on each 33kV VCB mechanism		Specify
4.1.6	Operation and controls		Provide
	Has local electrical and mechanical operation		Specify
	Has shunt trip coil		Specify
	Local/remote switch	Stay put type	Specify
		Local selector inhibits 33kV VCB operation from remote source	Specify
	ON/NEUTRAL/OFF control switch or ON and OFF push buttons		Specify
	If push buttons	Momentary contact type	Specify
		With rear terminal connections	Specify
		GREEN close push button	Specify
		RED open push button	Specify

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Table 2	Mechanical emergency trip device	Suitable for manual operation in event of failure of electrical supplies	Specify	
		Accessible without opening any access door	Specify	
		Distinctly labeled	Specify	
		Can be operated manually in absence of auxiliary power and electrical operation	Specify	
		Shall not close if trip coil is energized	Specify	
		Reclosing from a sustained close signal	Specify	
		Can perform 10000 operating cycles at no load	Specify	
		Technical requirements	Provide	
		Service type	Specify	
		Number of poles	Specify	
		Nominal system voltage, kV	Specify	
		Highest system voltage, kV	Specify	
		Rated normal current at 50°C	For bus-bar of CB, A	Specify
			For interrupter, A	Specify
			For outgoing feeders/transformer, A	Specify
			Rated short circuit breaking current (rms), kA	Specify
			Rated short circuit making current (peak), kA	Specify
			Rated short time current withstand capability for 1 sec, kA	Specify
			Opening time, s	Specify
			Closing time, s	Specify
	Rated insulation level	One minute power frequency withstand voltage to earth (wet and dry) rms	Common value, kVrms	Specify
			Across isolating distance, kVrms	Specify
		Impulse withstand voltage to earth with 1.2/50 sec, wave of +ve and -ve polarity (peak)	Common value, kVpeak	Specify
			Across isolating distance, kVpeak	Specify
	First pole to clear factor	Terminal fault	Specify	
		Out-of-phase	Specify	
		Rated operating sequence (for auto reclosing)	Specify	
		Maximum break time, s	Specify	
		Rated out of phase breaking current, A	Specify	
		Maximum pole scatter	Specify	
	Class of 33KV VCB as per IEC 62271:200	Electrical endurance	Specify	
		Mechanical endurance	Specify	
		Restrike performance	Specify	
		Maximum contact resistance	Specify	
		Rated auxiliary supply for spring charge motor, lamp & heater circuit	Specify	
	Auxiliary contacts as per IEC 60694 table 16	Class	Specify	
		Rated supply voltage for trip/close coil	Specify	
		Rated continuous current, A	Specify	
		Rated short-time withstand current, kA	Specify	

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	Breaking capacity, kA	Specify
	Minimum creepage distance, mm	Specify
	Minimum protected creepage distance, mm	Specify
	Other Related Circuit Breaker Parameters	Provide
A	Specific design parameters	Provide
	Rated Short Circuit breaking current - single phase test	Specify
	Rated Line charging breaking current	Specify
	Rated Cable charging breaking current	Specify
	Capacitor bank switching capability	Specify
	BC1	Specify
	BC2	Specify
	Inductive current	Specify
	Reactive current	Specify
	Out of phase making & breaking current	Specify
	Rated short line fault current	Specify
	TRV characteristic	Specify
	First Pole to Clear factor	Specify
	Nos. of interrupters per phase	Specify
	Type of arc control device provided if any	Specify
	Type of arcing contacts	Specify
	Material of main contact	Specify
	Material of Arcing contacts	Specify
	Filter material	Specify
	Timings of operations	Specify
	Opening at nominal control voltage	Specify
	Opening at minimum control voltage	Specify
B	Closing time at nominal control voltage	
	Maximum pole discrepancy time	Specify
	Tripping	Specify
	Closing	Specify
	Rated operating duty cycle	Specify
	Tripping Coils	Specify
	- No of coils	Specify
	- Rated Voltage	Specify
	- Rated Current	Specify
	- Rated Watts	Specify
	- Resistance	Specify
	Closing Coil	Specify
	- Rated Voltage	Specify
	- Rated Current	Specify
	- Rated Watts	Specify
	- Resistance	Specify
	Spring Charging Motor	Specify
	- Rated Voltage	Specify
	- Rated Current	Specify
	- Rated Watts	Specify
	Spring charging time at rated Aux supply	Specify
	Spring charging time at min Aux supply	Specify

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	Maintenance required after nos. of operation at	No load	Specify
		Rated current	Specify
		25% of rated SC current	Specify
		50% rated SC current	Specify
		Rated SC current	Specify
	Provision of Manual trip		Specify
	Electrical interlocking		Specify
	Padlocking		Specify
	Type of Operation counter provided		Specify
4.2	OPERATING MECHANISM		Provide
4.2.1	Shall be motor wound spring charged		Specify
	Electrically and mechanically trip free		Specify
	Has anti-pumping device		Specify
	Shall be corrosion resistant		Specify
	Shall be self-lubricating		Specify
	Has wearing resistant bearings		Specify
	Fully closes the 33kV VCB		Specify
	Sustains 33kV VCB in closed position against forces of the rated making current		Specify
	Shall fully open the 33kV VCB without undue contact bounce at a speed commensurate to achieve rated breaking capacity		Specify
	Can be locked in either open or closed position		Specify
	Capable of fully closing and opening after the auto reclose time interval specified in this specification as 0.3 seconds		Specify
4.2.2	Spring mechanism		Provide
	Operated with spring charging motor		Specify
	Opening and closing springs with limit switches and all accessories necessary for automatic charging		Specify
	Explain how recharging of operating springs in normal condition works		Specify
	Shall be possible to hand charge the operating spring with the 33kV VCB in either open or closed position conveniently from ground level		Specify
	Closure while a spring charging operation is in progress shall be prevented		Specify
	Release of the springs shall not be possible until they are fully charged		Specify
	Mechanical device indicates	"SPRING CHARGED" when closing spring is fully charged and operation is permissible	Specify
		"SPRING FREE" when closing spring is not fully charged and the operation is not possible	Specify
	Provision shall be made for remote electrical indication of "Spring charged" and "Spring free" conditions		Specify
	Failure of any auxiliary spring	shall not cause tripping or closing of the CB	Specify
		Shall not prevent tripping against trip command	Specify
	Closing of the 33kV VCB shall charge the opening spring ready for tripping		Specify
	From the closing position with the spring charged, one open-close-open operation shall be possible without recharging the spring		Specify

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4.2.3	Spring charging Motor		Provide
	Shall be single phase 230 volt A.C motor		Specify
	Motor rating		Specify
	Motor rating 10 % above continuous motor rating		Specify
	Remains within its rated capacity at all operating points arising in service		Specify
4.3	AUXILIARY POWER SUPPLY		Provide
	DC and/or AC power supply for spring charging motor		Specify
	DC supply voltage for auxiliary circuits		Specify
	Operation of the power supplies		Specify
	AC supply	Voltage from 115% to 85% of normal voltage	Specify
	Frequency	From 105 % to 95% of normal frequency	Specify
	Combined voltage	From 115% to 85% of normal frequency variation	Specify
	DC supply	Voltage from 120% to 70% of normal voltage	Specify
4.4	INTERLOCKS		Provide
	Type of interlocks		Specify
	Operation		Specify
	Safety features of interlocks		Specify
4.5	TERMINAL CONNECTOR		Provide
	State type of connector		Specify
	Size of connector		Specify
	Material of manufacture of connector		Specify
4.6	INSULATION AND CLEARANCE		Provide
	Minimum clearance in open air	Between phase to earth	Specify
		Between poles	Specify
		Ground clearance for live parts	Specify
4.7	EARTHING		Provide
	Scope of earthing		Specify
	Diameter of the clamping screw or bolt		Specify
	Connection point marked with "Protective Earth" symbol		Specify
	Parts of metallic enclosures considered as an earthing conductor		Specify
	All metal not live shall be connected to duplicate earthing system		Specify
	Earthing terminals made of suitable electroplated brass		Specify
	Earthing terminal provided on each CB		Specify
	Suitable identification mark adjacent to the earthing terminals		Specify
	Earth continuity conductors	Scope	Specify
		Cross-section area in mm ²	Specify
	Size of the earth continuity conductor	Size in mm ²	Specify
		Potential rise in volts	Specify
Temperature rise		Specify	
Type of joints		Specify	
Jointing surfaces perfectly flat		Specify	
4.8	PERFORMANCE REQUIREMENTS		Provide

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4.8.1	Opening and closing times at	120% of rated voltage	Specify
		100% of rated voltage	Specify
		70% of rated voltage	Specify
	Minimum make break time at rated voltage, s		Specify
	Total break time , s		Specify
4.8.2	Maximum Temperature of any part under continuous load and exposed to direct sunlight		Specify
	Temperature correction		Specify
4.9	ACCESSORIES FOR THE CIRCUIT BREAKER		Provide
	Manual springs charging handle/tool provided		Specify
	Support steel structure provided		Specify
	Mounting bolts and washers provided		Specify
	Any other necessary accessory provided		Specify
4.10	Quality Management System		State
	Quality Assurance Plan		State
	Copy of ISO 9001:2008 Certificate		Provide
	Manufacturer's experience		Provide
	Manufacturing capacity (units per month)		Provide
	List of previous customers		Provide
	Customer reference letters		Provide
5.1	Test standards and responsibility of carrying out tests		Provide
5.2	Design & construction validated by Type Tests and applicable Tests		Provide
5.3	Copies of Type Test reports submitted with tender		Provide
5.4	Acceptance tests to be witnessed by KPLC at factory before shipment		Provide
5.5	Test reports to be submitted by supplier to KPLC for approval before shipment		Provide
5.6	Replacement of any rejected equipment or component		Provide
6.1	Marking		Provide
6.2	Packing		Provide
7.0	Mandatory Spare Parts for 33kV VCB		Provide
	Complete pole assembly of the 33kV VCB(4)		Specify
	Vacuum interrupter bottle (for vacuum type only) (4)		Specify
	Tripping coils (6)		Specify
	Closing coils (6)		Specify
	Insulated drive rod (6)		Specify
	Spring charging motor (4)		Specify
	Set of spring charging limit switches (4)		Specify
	Set of gaskets complete for one 33kV VCB(4)		Specify
	Upper Housing assembly (4)		Specify
	Lower Housing assembly (4)		Specify
Other spares		List them	
8.0	Documentation	Documents submitted with tender	Provide/Specify
		Documents to be submitted by supplier to KPLC for approval before manufacture	Provide/Specify
9.0	Warranty and	Warranty statement	Attach

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	Training	Training curriculum	List
10.0	Statement of compliance to specification (Indicate deviations if any & supporting documents)		Provide

.....
Manufacturer's Name, Signature, Stamp and Date

NOTE:

1. The schedule in **Annex A** does not in any way substitute the detailed information required elsewhere in the specification but **MUST** be filled fully with values related to the 33kV VCB on offer. Proof of evidence based on the **BROCHURES, CATALOGUES** and **TEST REPORTS** from a third party ISO/IEC 17025 accredited laboratory **MUST** be clearly demonstrated by the bidders manufacturer.
2. Bidders who shall have **NOT COMPLIED** with this requirement above in bullet (1) will automatically be disqualified from Technical Evaluation process.

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ANNEX B: List of critical components of the 33kV VCB, place & country of manufacture and test reports from ISO/IEC Accredited Laboratory for the individual components

Sr. No.	Component part	Manufacturer, contact address and mobile number and country of manufacture	Laboratory of test – ISO/IEC Accreditation number	Method of test/Test standard
1	Interrupter Assembly	Fixed contact		
		Movable contact		
		Arc shield mounted inside vacuum chamber		
		Stainless steel bellows		
		A glass vessel or ceramic vessel (vacuum bottles)		
2	Complete pole assembly			
3	Tripping coils			
4	Closing coils			
5	Insulated drive rod			
6	Spring charging motor			
7	Spring charging limit switches			
8	Gaskets			
9	Permanent sealing of the vacuum chamber			
10	Porcelain insulator			
11	Motors			
12	Electrical controls			
13	Interlock devices			
14	Disconnect devices			
15	Operator housing			
16	Others not specified on this table			

Note: The successful bidder shall within 30 days of placement of order submit the above information regarding list of materials as well as bought out accessories; the names of sub-suppliers selected from those furnished along with the offer. Proof or purchase will ultimately be required.

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