

Technical Specifications for 33 kV Vacuum Circuit Breakers

1. 33 kV Vacuum Circuit Breakers

1) SCOPE

This specification covers design, manufacturing, testing at manufactures works, supply of 33 KV Vacuum Circuit Breakers complete with all accessories required for their satisfactory operation for the sub-transmission system. The Breakers shall be used for Transformer protection or Feeder Control, in the system.

2) TYPE AND RATING

The circuit breakers shall be suitable for outdoor operation under the climatic conditions, as specified in Tender specification, without any protection from sun and rain.

The circuit breakers shall have the following rating:-

S.No.	PARTICULARS	33 KV
i)	Number of Poles	3 Nos.
ii)	Frequency	50 Cycles
iii)	Nominal System Voltage	33 KV
iv)	Highest System Voltage	36 KV
v)	Interrupting Capacity at nominal system voltage	1500 MVA
vi)	Rated Continuous Current	1250 Amps
vii)	Short-time Current Rating for 3 Secs.	25 KA
viii)	Basic Insulation Level	170 KV
ix)	Power Frequency Withstand Voltage for one Minute	70 KV
x)	Total Break-time for any Current up to the rated breaking current	5 cycles (max.)
xi)	Control Circuit Voltage	24 Volt D.C.
xii)	Operating duty for gang operation	O – 0.3 Sec – CO – 3 Min – CO
xiii)	The VCBs shall be suitable for one reclosing followed by one delayed reclosing and lock out	
Minimum clearances		
a)	Between Phases	430 mm
b)	Between Live Parts & Ground	3700 mm
c)	Creepage Distance	900 mm

The above are our minimum requirements. The *manufacturers* may offer their standard design, keeping in view our minimum requirements.

3) STANDARDS

The circuit breakers shall comply with the requirements of IEC 56 or IS 13118 (1991) with latest amendment thereof, except wherein specified otherwise. Equipment, meeting any other authoritative standard, which ensures equal or better quality than the standard mentioned above, would also be acceptable. The bidders shall clearly indicate the applicable standards to which their equipments complies-with. A copy of such standard may also be enclosed.

4) GENERAL

The circuit breaker shall be of porcelain clad vacuum type. The breaker, complete in all respect, shall be supplied with all accessories in-place and all internal wiring installed and terminated in the mechanism housing and the equipment shall be complete in all respects.

The circuit breakers shall provide rapid and smooth interruption of current under all conditions, completely suppressing all undesirable phenomena, even under the most severe and persistent short-circuit conditions or when interrupting small currents or leading/ lagging reactive currents. The details of any device incorporated to limit or control the rate of rise of Restriking voltage across the circuit breaker contacts shall be stated. The over voltage caused by the circuit breaker switching on inductive or capacitive load shall not exceed 3.2 times the normal phase to neutral voltage. The total break-time for the circuit breaker, throughout the range of breaker operating duty, shall be stated in the tender and shall be guaranteed. The breaker shall be fit for capacitor switching for 5 MVar Bank.

The breakers shall be provided with trip free mechanism.

The circuit breakers shall be suitable for mounting on steel structures. The cost of necessary frames for mounting the circuit breakers shall be included in the offered prices. Strongly supported bracket or frame, for mounting associated 3 nos. 33 KV CTs, shall also be provided. All the structures shall be hot dip galvanized with

3 dips. Please note that cantilever type supports for mechanism box are not acceptable. The mechanism box shall have firm supports from bottom. This is necessary to minimize vibration of mechanism box, which in turn may disturb various settings. The agency shall indicate clearly the vibration level of the breaker during fault / normal ON OFF operations in all three directions.

The owner intends to operate 33 KV feeders with automatic reclosing scheme, the arrangement envisaged is as under:-

On the occurrence of a fault the concerned protective relay will open the circuit breaker as per its own characteristic. Thereafter, the breakers shall re-close but after pre-set time delay, which shall be adjustable (say range 4 – 10 sec. or near about). There shall be no further automatic reclosing. A simple type of reclosing relay (reputed make) for this purpose shall be provided under this kind of operation. It is also necessary that the breaker shall be suitable for this reclosing duty. The auto-recloser relay is to be installed in respective indoor control panels.

5) SPECIFICATION FOR CIRCUIT BREAKERS

The circuit breakers shall consist of three identical phase units with a common operating mechanism. While offering the circuit breaker, the following details should be confirmed and furnished with the tender:-

- i) Complete construction details of the equipment offered. It should be noted that the breakers should be suitable for out-door duty. Indoor breakers accommodated in out-door kiosks are not acceptable.
- ii) Type, make & source of vacuum bottles with relevant details shall be indicated in the offer, clearly.
- iii) The capacity of breaker to interrupt inductive and capacitive currents shall be indicated in the offer (rating of capacitor bank should be stated and type test report shall be furnished).
- iv) Spare availability of vacuum interrupter should be confirmed by the bidder for the designed expected life of the breakers being offered.

6) VACUUM INTERRUPTER

The design of the vacuum interrupter shall be such that it gives trouble free operation under normal load and fault conditions throughout the life of the equipment. As the efficiency of the breaker depends on the degree of vacuum inside the interrupter, manufacturer shall ensure that the same is maintained consistently during service. To know the residual life of vacuum interrupter, an indicator to indicate the status of contact erosion shall be provided.

The insulating ceramic body of the interrupter should have high mechanical strength and it should be capable of withstanding high temperature without any significant deterioration in its mechanical and electrical properties

The metal/ alloy used for the fixed and moving contacts shall have very low resistivity and low gas content. They should be resistant to arc erosion and the contact should have no tendency to get cold-welded under the high vacuum in the interrupter.

The interrupter design should ensure rapid de-ionization of the gap so that normal electrical strength of the gap is restored instantaneously.

The metallic bellow or any other similar vacuum sealing arrangement should be provided at the moving contact and should have a long fatigue life.

Manufacturer's catalogue on vacuum bottle, indicating all the details shall essentially be submitted with the tender.

7) MOUNTING OF 33 KV CTs

The offered steel structures for breakers to be supplied by the bidders should have provision and adequate strength to accommodate 3 nos. 33 KV CTs on it after provision of suitable supports from ground.

8) TEMPERATURE RISE

The maximum temperature attained by any part of the equipment, when in service at site, under continuous full load conditions, exposed to the direct rays of the sun, shall not exceed 45° Centigrade, above ambient temperature. The limits of temperature rise shall be as per relevant standards. The corrections proposed shall be stated in the tender and shall be subject to approval of the owner.

9) INSULATION OF THE CIRCUIT BREAKER

The insulation to ground, the insulation between open contacts and the insulation between phases of the completely assembled circuit breaker shall be capable of withstanding satisfactorily di-electric test voltage corresponding to specified basic insulation level in the standard.

10) INSULATORS

The basic insulation level of the Insulator and insulating porcelains shall be as specified and porcelain shall be homogenous and free from cavities and other flaws. They shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation under conditions specified above. All insulators of identical ratings shall be inter-changeable. The puncture strength of the insulators shall be greater than the flash over value. The insulators shall be type tested from independent Govt. Laboratory as per relevant standards or at any recognized and reputed international laboratory or testing institutions.

11) OPERATING MECHANISM

The circuit breakers shall be designed for remote control from the control room and in addition there shall be provision for manual operation of circuit breakers during maintenance and for local tripping and closing by the normal means.

The circuit breakers shall have operation control and mechanical "open" "close" indicator, in addition to facilities for remote electrical indication.

The operating mechanism shall be of the spring charging type, by electric control under normal operation. The mechanism shall be trip free electrically and mechanically. The mechanism shall be capable of performing satisfactorily, the reclosing duty cycles indicated above, within the time specified. All working parts in the mechanism shall be of corrosion resistant material and all bearings, which require greasing, shall be equipped with pressured grease fittings. The mechanism shall be strong positive quick in action and shall be removable without disturbing the other parts of the circuit breaker. The mechanism and breaker shall be such that the failure of any spring will not prevent tripping and at the same time will not cause any false tripping or closing. The operating Mechanism should be motor operated spring charged type preferably without chain drive. The motor for spring charging shall be suitable to perform satisfactorily for input supply voltage of 230 Volt A.C. 50 Hz with a variation of plus 10 and minus 20 percent. The A.C. Motor should have overload protection. Provision should also be made for mounting of mechanism box at an adequate height and gear ratios shall be so chosen that one man should be able to charge the spring, without any additional efforts.

12) CONTROL CUBICLE

A common control cubicle shall be provided to house electrical, controls, monitoring devices and all other accessories, except those which must be located on individual poles. The cubicle shall be gasketed and shall have weather-proof construction, fabricated from sheet steel of minimum 2.5 mm thickness. The type test report on degree of protection test (IP-55) shall also be furnished.

The cubicle shall have front access door with lock and keys, space heater, internal illumination lamp, 3 pins 5 Amp socket with individual ON-OFF switches shall be provided in the cubicle.

For local operation following shall be provided:-

- a) LOCAL / REMOTE selector switch
- b) TRIP / NORMAL / CLOSE control switches with pistol grip handle

The control circuits shall be designed to operate on 24 Volt DC, as indicated in the schedule and it shall be possible to adopt to work on other voltages by simply changing the operating coils. The shunt tripping coils shall be designed to operate satisfactorily within 110% and 70% of the rated DC supply voltage and the shunt closing coils should operate up to 85% of the rated DC voltage. These checks shall be repeated during pre-commissioning checks at site before putting the breakers in service.

AC Power supply for auxiliaries will be available at 230 Volt (+/- 10% variation) single phases 50 C/s at substation. The agency shall be required to extend this supply, using proper protection, to desired location through cable.

Necessary double compression type cable glands for the cables of the operating mechanism shall be provided. The cables used for operation are all un-armoured 2.5 sq. mm copper control cables of 1100 V grade. The cable glands shall be suitable for 1 no. 8 core and 2 nos. 4 core cables and cables as per site requirements. The gland plate should be made of non-magnetic materials and suitably drilled at site to suit the cable entry.

The Circuit breaker shall be provided with trip free Mechanism so that tripping instructions could over-ride the closing instructions. An additional tripping coil shall also be provided in the trip circuit. The second coil shall have separate tripping lever arrangements in the mechanism, so as to avail full advantage of second trip coil. Also the two trip coils shall have separate fuses in the DC circuit, so that in the event of any short circuit/damage in any one of the trip coils, the supply is available to the other one.

The circuit diagram of Control circuit of VCB along with operating instructions (DOS/ DON'T) shall be embossed on metallic plate duly laminated and the same shall be fixed on the rear door of the control cubicle from inside.

13) WIRING

Wiring shall be completed in all respects to ensure proper functioning of the control, protection, monitoring and interlocking schemes.

All the wiring shall be carried out with 1100 V grade, PVC insulated stranded copper conductor of 2.5 sq. mm as per IS: 1554.

Each wire shall be identified at both ends with permanent markers bearing wire numbers as per wiring diagram.

Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

All spare contacts of auxiliary switches etc. shall be wired up to terminal blocks in the control cubicle.

14) TERMINAL BLOCKS

Terminal blocks shall be of 1100 V grade, box clamp type ELMEX 10 sq. mm or approved equivalent. Not more than two wires shall be connected to any terminal. Spare terminals, equal in number to 20% of active terminals, shall be provided.

Terminal block shall be such located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

15) TERMINAL CONNECTORS

6 Nos. Terminal bi-metallic connector suitable for Dog conductors shall be supplied with each breaker. For ensuring quality and uniformity, the owner may decide to specify the design of terminal connector, the material of terminal connector and thickness of clamps. Further compliance of which will have to be done by the agency without any extra cost. Suitable earth connector for earthing connections shall also be supplied. The connector drawing shall be got approved from the owner.

16) AUXILIARY CONTACTS

Eight numbers each of auxiliary contacts both of the normally open and normally closed types shall be provided in each circuit breaker for use in the remote indication and control scheme of the circuit breaker and for providing safety interlocking. Special contacts for use with trip coils, which permit for relative adjustment with respect to the travel of the circuit breaker contact, shall also be provided, wherever required. There shall be provision to add more auxiliary contacts at a later date, if required.

17) ACCESSORIES

The vacuum circuit breaker shall be supplied as a complete unit with internal wiring installed and terminated in mechanism box and equipped with the following accessories:

1	Motor operated spring charged mechanism (Motor voltage – 230 V AC)	1 No.
2	Trip coil suitable for 24 V DC	2 Nos.
3	Closing Coil suitable for 24 V DC	1 No.
4	Pistol grip C.B. Control switch having Trip/ Normal/ Close position	1 No.
5	Local/ Remote selector switch	1 No.
6	Spring Charged indicator	1 No.
7	Manual operating handle for maintenance	1 No.
8	Facility for manual charging of spring	1 No.
9	Operation counter	1 No.
10	Auxiliary contacts (8 NO-8 NC)	1 Set
11	Anti-pumping device suitable for 24 V DC	1 No.
12	Terminal connectors suitable for connecting Dog Conductor	6 Nos.
13	Cubicle illuminating lamp with cage and switch	1 No.
14	Spare terminals connectors	20% of Total Terminals
15	Mechanical ON/OFF Indicator	1 No.
16	MCB for both AC and DC supply	1 No. each
17	Space heater and ON-OFF switch in the mechanism box	1 No.
18	Power Type 3 Pin Socket with ON-OFF switch	1 Set
19	Earthing Terminals	2 Nos.
20	LED indicating lamps	Complete set

Indicating Bulbs: The indicating lamps should be supplied with Low Voltage protection Circuit (LVGP) and surge suppressor circuit having LED indication. Lamp assembly should be of fire – retardant glass epoxy PCB, industrial heat resistant, fire resistant, non- Hygroscopic DMC material , chrome – plated corrosion resistant solid brass bezel , polycarbonate lens in desired colour shades of Red , Green, Amber, Yellow etc. the intensity of light should be minimum 100 mcd at 20 mA . Indication lamp should be suitable to operate on 24 V Direct Current supply source.

18) TYPE TESTS

Type test certificates on VCB for the following tests, strictly as per IS 13118, with latest amendment thereof, from any of the independent Govt. Laboratory, or at any recognized and reputed international laboratory or testing institution, shall invariably furnished :-

- Short Circuit Duty Tests
- Short Time Current Rating Tests
- Mechanical Endurance Test
- Temperature Rise Test
- Lightning Impulse Voltage withstand Test
- Capacitor Switching Duty Test for Single Bank of 5 MVAR capacity
- Power Frequency withstand Voltage Test dry & wet
- Degree of protection IP-55 for control cubicle
- The offered equipment/Material must have been fully type tested from **CPRI/ERDA/NTH/NSIC only.**

The above type test certificates must accompany drawing of type tested equipment, duly signed by type testing authority.

The above tests must not have been conducted on the equipment earlier than 5 years from the date of opening of bids.

In case of any change in design/type of Breaker already type tested and the one offered against this specification, the owner reserves the right to demand repetition of type tests, without any extra cost.

19) ACCEPTANCE AND ROUTINE TESTS

All acceptance and routine tests, as stipulated in relevant standards, shall be carried out by the manufacturer, in presence of owner's representative

Immediately after finalization of the programme of type testing, the manufacturers shall give, fifteen days advance intimation to the owner, to enable him depute his representative for witnessing the tests.

20) RATING PLATES

The detailed rating plate shall be as per IS and in addition, shall indicate serial number of the equipment, manufacturer's name, our order number and date.

21) EXPERIENCE

Minimum 3 years' experience in the field of design and manufacture of the equipment offered is essential for the bidder. Details in this regards shall be clearly stipulated in the offer.

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 33 KV VACUUM
CIRCUIT BREAKER (VCB)**

S. No.	Particulars	Unit	Offered by tenderer
1.	Name of manufacturer		
2.	Manufacturer's type designation		
3.	Rated voltage	KV	
4.	Maximum (continuous) rated service voltage	KV	
5.	Nominal current rating		
	a. Under normal conditions	Amps	
	b. Under site conditions specified	Amps	
6.	Short time current rating 3 seconds (r.m.s.)	KA	
7.	Maximum temperature rise over ambient	⁰ c	
8.	Breaking capacity		
a.	Symmetrical	KA	
b.	Symmetrical at rated service voltage	KA	
9.	Making capacity	Peak KA	
10.	Total break time		
a.	At 10% rated interrupting capacity	ms.	
b.	At rated interrupting capacity	ms.	
11.	Arcing time	ms.	
12.	Make time	ms.	
13.	Minimum reclosing time at full rated interruption from the instant of trip coil energisation	ms.	
14.	Minimum dead time for 3 phase reclosing	ms.	
15.	Rate of restriking voltage		
a.	Amplitude factor		
b.	Phase factor		
c.	Natural frequency		
d.	R.R.R.V./micro second		

16.	Dry-1 minute power frequency withstand test voltage		
a.	Between line terminal and grounded objects	KV r.m.s.	
b.	Between terminals with breaker contacts open	KV r.m.s.	
17.	1.2/50 micro second full wave impulse withstand test voltage for the two cases above.		
a.	Between line terminal and grounded objects	KV (peak)	
b.	Between terminals with breaker contacts open	KV (peak)	
18.	Bushing or insulator		
a.	Type of bushing		
b.	Dry-1 minute power frequency withstand voltage	KV (rms)	
c.	Dry flashover value	KV (rms)	
d.	Wet flashover value	KV (rms)	
e.	1.2/50 micro second impulse withstand value		
f.	Creepage distance		
	i) Total creepage distance	mm	
	ii) Protected creepage distance	mm	
g.	Puncture value of bushing	KV	
h.	Weight of bushing	Kg.	
19.	Minimum clearance in air		
a.	Between phases	mm	
b.	Live parts to earth	mm	
c.	Live parts to ground level	mm	
20.	Number of poles of circuit breaker		
21.	Number of breaks per phase.		
22.	Total length of break per phase	mm	
23.	Material of main contacts		

24.	Type of auxiliary contacts		
25.	Material of auxiliary contacts		
26.	Contacts silver plated or not		
27.	Thickness of silver plating	Micron	
28.	Main contact resistance (milivolt drop & across each contact)	Micro ohms	
29.	Contact pressure		
30.	Voltage distribution between breaks	%	
31.	Type of device if any, used to limit the rate of rise of restriking voltage		
32.	Voltage grading device if any used		
33.	Number of spare auxiliary contacts provided		
a.	Those closed when breaker is closed		
b.	Those open when breaker is closed		
c.	Those adjustable with respect to the position of contacts		
34.	Type of operating mechanism		
a.	Opening		
b.	Closing		
35.	Control circuit voltage		
36 a.	Power required for trip coil at 24 VDC	Watts	
b.	Minimum operating voltage required to trip C.B.	Volts	
37 a.	Power required for close coil at 24 VDC	Watts	
b.	Minimum operating voltage required to close the breaker.	Volts	
38.	Rating and speed of spring charging motor		
a.	Class of insulation		
b.	Time required for motor to charge the spring fully	Sec.	
c.	Temperature rise	°C	

39.	Number of tanks per phase/per breaker		
40.	Tank dimension		
41.	Total weight of one complete breaker	Kg.	
42.	Over all dimension	mm	
43.	Details of mounting		
44.	Number of breaks at rated capacity after which circuit breaker required :- Inspection of contacts		
45.	The rating of the circuit breaker for capacitor switching	MVA	
46.	Derating factor for installation at following altitudes		
a.	Upto 2000 metres		
b.	Upto 2500 metres		
47.	Maximum capacitor switching capacity	MVAR	
48.	Maximum nominal current capacity (continuous)	AMP	
49.	Maximum symmetrical breaking capacity		
50.	Maximum making capacity		
51.	Maximum short time current for 1 sec.		
52.	Is the offered design of circuit breaker fully type tested as per IEC-6 or its latest version. If 'Yes' whether a zerox copy of the full type test report of the breaker enclosed with the tender.		

GUARANTEED TECHNICAL PARTICULARS OF VACUUM INTERRUPTOR BOTTLE

S. No.	Particulars	Offered by tenderer
1.	Name of tenderer	
2.	Make	
3.	Manufacturer type and designation.	
4.	Size	
5.	Insulation	
6.	Degree of vacuum inside the bottle.	
7.	Gap between the contacts in vacuum.	
8.	Area of contacts.	
9.	Interrupter weight.	
10.	Electrical ratings of vacuum bottle.	
11.	Rated short circuit current.	
12.	Rated short circuit making current.	
13.	Rated short time withstands current.	
14.	Duration of short time current.	
15.	Maximum contact resistance at minimum closing force	
16.	Capacitor switching capacity	
17.	Contact stroke (in mm)	
18.	Opening speed	
19.	Maximum over travel during opening	
20.	Closing speed	
21.	Electrical life at rated normal current.	
22.	Electrical life at rated short circuit current.	
23.	Mechanical life.	
24.	Contact erosion limit	
25.	Shelf life	

NOTE: - All details and dimensional drawing should be enclosed with Tender Bid Part-I.