CIRCUIT BREAKER

June 2025

Engineering Department

WEST BENGAL STATE ELECTRICITY TRANSMISSION COMPANY LIMITED
পশ্চিমবঙ্গ রাজ্য বিদ্যুৎ সংবহন কোম্পানি লিমিটেড
(পশ্চিমবঙ্গ সরকারের একটি উদ্যোগ)
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Updates for WBSETCL / TECH SPEC / Rev.-3.1

1. The clause 12.01 - This point is added in the clause, CB design life should be "Minimum" 100 nos. operation at rated short circuit level.
2. "Silver coating may not be required for the tips of the main contacts of VI. " – This point is added as clause no 12.01. vii.
3. As clause no 12.01.viii, this point is added "The LIFE CURVE (the curve showing number of operations against current level being interrupted during the life span of the VI) of vacuum interrupter must be provided with each VCB"
4. A clause 12.05 added – "Terminal connectors shall be provided for VCBs if it is specified in the BOQ. "
5. The phrase added to 12.01.vi - (consider three VIs per CB)
6. The creepage distance has been changed to 31 mm/kV from 25 mm/kV in Special Technical Parameters.
7. In Special Technical Parameters column 15 "Rated small inductive making/breaking current within permissible switching over voltage" transformer ratings changed.
8. This point added in Operating Mechanism details and Clause 12.01(vi) "OCO operation (if CB is in closed condition) or one CO operation (if CB is in open condition)
9. Data of 66 KV "Phase to phase clearance of pipe bus" and "Minimum clearance of live parts in air and ground" is added.
10. Reactor rating in clause 5.17 is increased from 80 to 125 MVAR.

TECHNICAL SPECIFICATION FOR CIRCUIT BREAKERS

1. SCOPE

This specification covers design, manufacture, assembly, testing at manufacturer's works of SF6 Circuit Breaker of 420KV, 245 KV, 145KV, 72.5KV & Vacuum Circuit Breaker of 36 KV class (Outdoor) as detailed in the enclosed schedule, complete with accessories required for efficient and trouble free operations.

The circuit breakers offered shall be as per specific technical parameters and suitable for outdoor installation.

The circuit breakers are required complete with structures, operating mechanism, all associated accessories and auxiliaries.

2. STANDARDS

The equipment to be furnished under this specification, shall unless and otherwise stated, be designed constructed and tested in accordance with the latest revisions of Indian Standards as follows :

IS-13118	-	General requirements for circuit breakers for voltages above 1000 V
IS-9135	-	Guide for testing of Circuit Breaker
IS-2099	-	Bushings
IEC	-	376, 376A, 376B - SF6 Gas
IEC	-	62271-100
IEC	-	60694
IEC	-	56

3. I) DEVIATION

Normally the offer should be as per Technical Specification without any deviation.

II) MODIFICATION:

If any modification felt necessary to improve performance, efficiency and utility of equipment, the same must be mentioned in the 'Modification Schedule' with reasons duly supported by documentary evidences and advantages. Such modifications suggested may or may not be accepted, but the same must be submitted along with Pre-Bid Queries. The modifications not mentioned in the schedule will not be considered.

4. GENERAL INFORMATION

The circuit breakers of 72.5KV to 420KV class shall be of outdoor type SF6 CB and 36KV class shall be of outdoor type Vacuum CB.

The equipment covered by this specification shall be complete in all respects. Any material or accessory which may not have been specifically mentioned but which is usual or necessary for satisfactory and trouble-free operation shall be within the scope of supply without any extra charge to the WBSETCL.

Schematic diagram of the circuit breaker shall be same as per our standard drawings which will be furnished to the successful bidder for all voltage class from 36KV to 420KV.

The support structure of the circuit breaker shall be hot dip galvanized. All other parts including control cabinet shall be painted as per specification.

5. DESIGN CRITERIA

5.1. The circuit breakers shall be used in effectively earthed (neutral solidly ground system) with symmetrical fault level of minimum 50KA for 1 second for 400KV systems, 40KA for 3 seconds for 220KV systems, 31.5 KA for 3 seconds for 132KV, 66KV and 33KV respectively. 33KV systems for 132/33KV transformer are non-effectively earthed through earthing transformer.

5.2. All controls shall be suitable for 85% to 110% for closing and 70% to 110% for tripping of 220V(±10%) D.C supply voltage for 33 KV & above. The A.C. supply shall be available at 400V(±10%), 50 Hz, 3 phase 4 wire system or 230V(±10%), 50 Hz, 1 phase 2 wire system.

5.3. Radio Interference Voltage shall not exceed 1000 micro volt when the equipment will be operated at maximum service voltage for circuit breakers rated 132KV and above.

5.4. The maximum temperature attained by any part of the equipment at specified rating should not exceed the permissible limits as stipulated in relevant standards. Equipment shall be designed for taking 50ºC as maximum ambient temperature. The current carrying contact must be designed to withstand 125ºC (50ºC Ambient + 75ºC)

5.5. Minimum clearance between phases (As per IS : 3072 – 1975)

1. For 36KV – 400mm
2. For 72.5KV – 750mm
3. For 145KV – 1600mm
4. For 245KV – 2700mm
5. For 420KV – 3200mm

5.6. Minimum clearance between phase and earth (As per IS : 3072 – 1975)

1. For 36KV – 320mm
2. For 72.5KV – 630mm
3. For 145KV – 1380mm
4. For 245KV – 2300mm
5. For 420KV – 3070mm

5.7. Provision of electrical interlocks for safe and satisfactory operation of the breaker shall be furnished. The interlocking device shall be of proven quality.

5.8. The breaker shall be able to function even under conditions of phase opposition that may arise due to faulty synchronization or otherwise as per relevant IS standard or IEC Standard.

5.9. 420KV, 245KV breaker shall be suitable to make & break magnetizing current of 315MVA, 400/220/33KV, 160MVA, 220/132/33KV transformers respectively without exceeding the peak value as indicated in the following Table I. 145KV breaker shall be suitable to make and break magnetizing current of 160MVA, 220/132/33KV transformer without exceeding the peak value of permissible switching over-voltages as indicated in the following Table I.

Table I

Suggested values of maximum permissible switching over-voltages when Interrupting line-charging, Cable charging and single capacitor bank breaking current

Rated Voltage (RMS Value)	Rated Lightning Impulse Voltage (Peak Value)	Maximum Permissible Switching Over Voltage to Earth			
		A		**B**	
(KV)	(KV)	Peak Value (KV)	Col (3) Col (1) sqrt (2/3) (PU)	Peak value (KV)	Col (5) Col (1) sqrt (2/3) (PU)
1	**2**	**3**	**4**	**5**	**6**
36	170	112	3.8	73	2.5
145	650	415	3.5	297	2.5
245	1050	600	3	400	2
400	1425	895	2.6	688	2

5.10 Breaker shall be capable of interrupting line/cable charging current as per IEC without any restriking and without use of opening resistors.

5.11 The breaker shall be capable of interrupting rated breaking current with recovery voltage equal to maximum line service voltage and at all indicative power factor of the circuit equal to or exceeding 0.15.

5.12 Breaker shall be capable of clearing short line fault without excessive rise of restriking voltage.

5.13 The breaker shall be suitable for interrupting low inductive currents (0.5A to 10A) as well as capacitance, without undue over voltage.

5.14. The Bidder may indicate in his offer the methods adopted for limiting over voltages.

5.15. The circuit breaker of 420KV, 245 KV, 145KV, 72.5KV & 36KV rating shall be capable to withstand power frequency over voltage as per value specified in IEC 62271-100 or relevant IS.

5.16. Operating duty of all circuit breakers from voltage range 36 KV to 420KV shall be as follows : **O-0.3 sec-CO-3.0 min-CO**

5.17. The breaker shall be re-strike free and possible fitted with switching resistor for 420KV voltage class to limit the switching surge voltage equal to or less than 2.3 P.U. 420KV

breaker shall be suitable for making and breaking magnetizing current of 315MVA, 400/220/33KV transformer and shunt reactor of capacity of 80MVAR not exceeding 2.3 P.U. of normal phase voltage to ground. 420KV breaker shall withstand the switching in and out of 400KV Shunt Reactor for any value from 50MVAR to 125MVAR[R3.2] without giving rise to over voltage more than 2.3 P.U.

5.18. The Circuit Breaker shall be re-strike free as per IEC under all duty conditions and shall be capable of performing their duties without opening resistors.

5.19. The Circuit Breaker shall meet the duty requirement of any type of fault or fault location also for switching when used on 420/245/145 /72.5 KV effectively grounded system and 33KV ungrounded system for 33KV tertiary as well as non-effectively grounded but with Earthing transformer for 220/132/33KV & 132/33KV substation and perform make and break operation as per duty cycles specified in above clause.

5.20. **PRE INSERTION RESISTOR**

420KV Circuit Breaker whenever specified shall be provided with single step pre- insertion closing resistors to limit switching surge to a value less than 2.3 P.U. The value of pre-insertion resistor and the duration of pre-insertion time shall be as given in STP. The resistor shall have thermal rating for the following duties :

i) Terminal fault :
Close …..1 Min …… Open …… Close open 2 Min …… Close …..1 Min ……Open Close Open.

ii) Reclosing Against Trapped Charges
Duty same as (i) above. The first, third and fourth closing are to be on de-energized line while second closing to be made with lines against trapped charge of 1.2 P.U. of opposite polarity.

iii) Out of Phase Closing
One closing operation under phase opposition that is with twice the voltage across the terminals.

iv) No allowance shall be made for heat dissipation of resistor during time interval between successive closing operations. The resistors and resistor supports shall perform all these duties without deterioration. Calculations and test reports of resistors proving thermal rating for duties as specified above shall be furnished along with the bid. The calculation shall take care of adverse tolerance on resistors values and time settings.

v) If specifically mentioned in BOQ, Circuit breaker shall be provided with **Pre Insertion Resistor (PIR)** as per relevant standard.

5.21. The breaker shall be capable of interrupting steady state and transient magnetizing current corresponding of power transformers.

5.22. If specifically mentioned in BOQ, Circuit breaker shall be provided with **Control Switching device** as per relevant standard.

6. CONSTRUCTIONS

Each 145KV and 72.5 KV SF6 circuit breaker & 36KV VCB shall comprise of three identical poles linked together electro-mechanically for simultaneous operation of pole units. The circuit breaker for rating 245 KV & 420KV shall be suitable for single phase auto reclosing as well as three phase reclosing type. The Circuit Breaker for rating 145KV shall be suitable for gang operated three phase auto reclosing.

For Circuit Breaker with SF6 gas, a temperature compensated gas density monitor with gas pressure gauge and pressure switch shall be provided at a convenient place to indicate SF6 gas density and gas pressure. The circuit breaker with spring charged mechanism shall be provided with indication for **spring charged condition**.

Operation counter should be provided to monitor the no. of operations.

MAIN CONTACTS AND ARC QUENCHING CHAMBER:

The tips of the main contacts shall be of suitable design and adequately silver plated to withstand arcing.

Complete details of main contacts and arc quenching device with sectional drawings shall be furnished.

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

If multi break interrupters are used, these shall be so designed that a uniform voltage distribution is developed across them. The thermal and voltage withstand of the grounding elements shall be adequate for the service condition and duty specified.

OPERATING MECHANISM:

The operating mechanism shall be electrically controlled spring /spring operated for 420KV, 245KV, 145 KV, 72.5KV class and 36 KV class breakers.

The mechanism shall have anti-pumping and trip free circuitry. The anti-pumping arrangement shall be initiated through Normally open (NO) type auxiliary contact of circuit breaker and shall be of 'self-hold' type. Type of such mechanism shall be mentioned. Local arrangement for operating the breakers both electrically and mechanically shall be provided in addition to remote electrical operation.

The breaker with SF6 shall have gas density monitoring devices. The device shall be provided to:

a) Initiate an alarm on breaker-control panel for pressure below the normal operating range.
b) Operate lockout device of breaker in case the pressure is below the permissible value.

There shall be mechanical ON/OFF indicator and number of operation counter for each pole of breaker in case of single pole operation and one mechanical ON/OFF indicator and provision for operation counter for 3 pole gang operated breaker.

All three poles of circuit breaker shall operate simultaneously. Pole discrepancy feature shall be provided to trip the breaker if all the poles do not close/open simultaneously in case of single pole operation. For mechanically gang operated breaker pole discrepancy feature need not be provided.

The operating mechanism box shall be fixed at a suitable man working height from ground level. View glass shall be provided on hinged door at the front. Hinged door shall be properly earthed with main body through copper flexible braided conductor. In case operating mechanism box shall not be placed at a suitable man working height, platform is to be arranged /supplied for each such breaker by the contractor. Suitable arrangement at site has to be made near each breaker to climb on the platform and work comfortably.

Suitable arrangement shall have to be made for easy accessibility to the operating mechanism box. All necessary arrangements are within the scope of bidder.

Indication for spring charged condition shall be provided for breaker with spring charging mechanism. The spring charging mechanism shall be motor operated. After failure of power supply to the motor, one OCO operation (if CB is in closed condition) or one CO operation (if CB is in open condition) [R3.2] shall be possible with the energy stored in the operating mechanism.

SPRING OPERATED MECHANISM:

i) The circuit breaker shall be single pressure type. The design and construction of the C.B. shall be such that there is a minimum possibility of gas leakage and entry of moisture. There should not be any condensation of SF6 gas on the internal insulating surfaces of the circuit breaker.

ii) In the interrupter assembly there shall be an absorbing product box to minimize effect of SF6 decomposed products and moisture.

iii) Spring operating mechanism shall be complete with motor. Opening spring and closing springs with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also to be provided.

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

v) Breaker operation shall be independent of the motor, which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided.

vi) Closing action of circuit breaker shall compress the opening spring ready for tripping.

vii) When closing springs are discharged after closing a breaker, closing spring, shall be automatically charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.

viii) Provisions shall be kept to prevent a closing operation of the breaker when spring is in partially charged condition. Mechanical interlocks shall be provided in the operating

mechanism to prevent discharging of closing springs when the breaker is already in closed position.

ix) The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case of tripping energy is derived from the operating mechanism.

COMMON CONTROL CUBICLE / MARSHALLING BOX:

A free standing outdoor type weather proof common marshalling box/cubicle shall be provided to house different accessories except those which must be located in the pole unit operating box. Rubberized gaskets of durable quality shall be provided to make it water proof, dust and vermin proof. Degree of protection shall be IP-55 as per IS:13947

This outdoor cubicle shall be of 3.00 mm thick steel sheet and shall have hinged doors at front and rear for access to the mechanism. Doors should be of proper design & adequate MS sheet thickness and providing adequate stiffener, for smooth opening and closing. There shall be arrangement for padlocking, individual door panel should be connected with the main panel body by flexible braided copper conductor for earthing purpose at two points.

A removable gland-plate, 3.00 mm thick shall be provided at the bottom of the cubicle for cable entry. Gland sizes shall be suitable for entry of adequate number of multicore cables separately for AC & DC as per approved scheme.

Terminal blocks for AC & DC shall be kept isolated. Terminals shall be suitable for at least three nos. 2.5 mm sq. copper leads. All control wiring shall be of 1100 Volt grade 2.5 mm sq. copper PVC insulated cables.

Thermostat controlled heaters shall be provided to prevent condensation within the cubicle /switchgear. Cubicle illumination lamps with switch shall be provided.

A 230 Volt combined 5A/15A three pin socket with neutral earthing and a control switch shall be provided inside the box.

Suitable arrangement i.e. platform shall be provided with support structure for easy access to the operating mechanism box for personnel of average height. View glass shall be provided on hinged door for reading pressure gauge, ON-OFF indication mounted inside the cubicle.

For 72.5KV and 145 KV one number and for 420KV & 220KV, 3 nos. SF6 gas density monitor with pressure gauge shall be provided on this operating mechanism box / marshalling box where applicable. Density monitor contacts and pressure switch contacts of SF6 gas shall have alarm and lock out contacts. These contacts shall be suitable for direct use as permissible in closing and tripping circuit. Separate contacts have to be used for each of tripping and closing circuits. Spring charged mechanism shall be placed within the operating mechanism box / marshalling box and contacts shall be provided for spring charged indication.

All controls, alarms, indications and interlocking devices furnished with breaker shall be wired up to the terminal block in common operating box / marshalling box. Not more than two wires shall be connected to one terminal. All spare contacts available in the pressure switches etc shall be wired upto terminal block.

All wires shall be identified at both ends with ferrule marking in accordance with approved wiring diagram.

The terminal blocks shall be of 1100 V grade "Elmex" / "Connectwell"make and have continuous rating to carry the maximum expected currents on the terminals. Insulating barriers shall be provided between the terminals. The terminal block shall have locking arrangement to prevent its escape from the rails. The terminal blocks to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring. At least 20% spare terminals shall be provided.

Power and control cables between individual pole operating box for 245 KV and 420KV breakers shall be in the scope of supply.

INSULATORS :

The porcelain to be used in bushing shall be homogeneous, free from laminations, cavities and other flaws which may impair its mechanical and/or dielectric strength and shall be glossy, tough and impervious to moisture.

The bushings shall have adequate mechanical strength and rigidity for conditions under which they will be used.

Bushing insulation shall be coordinated with that of Circuit Breaker. The puncture strength of the bushings shall be greater than the dry flashover value.

When operating at rated voltage and under operation in heavily polluted area, there shall not be any electrical discharge between bushing terminal and earth. No radio disturbance shall be caused by the bushings when operating up to the maximum system voltage. It shall also be free from corona.

All iron parts shall be hot dip galvanised.

All bushings of identical rating shall be interchangeable. Each bushing shall be provided with proper termination pad.

AUXILIARY CONTACTS :

The breaker shall be provided with 9 NO + 9 NC for 420KV, 245KV, 145KV, 72.5KV and 6 NO + 6 NC for 36KV CBs as spare auxiliary / multiplied contacts in addition to the auxiliary contacts required for breaker's own operational requirements. In case of 245KV and 420KV CBs requirement of spare auxiliary contact shall be per pole basis.

The auxiliary / multiplied contacts shall have continuous current rating of at least 10 A. The breaking capacity shall be adequate for the circuits controlled, and at least 2 A at 220 V DC for inductive circuit with time constant of minimum 20 ms.

All auxiliary / multiplied contacts shall be wired up to terminal block in the control cubicle.

Auxiliary/multiplied contacts shall be suitably protected against arcing. Insulating materials of the base of the contacts shall be molded plastic or other non-breaking, non-inflammable insulating material.

7. GROUNDING

Circuit Breaker shall be provided with two grounding terminals suitable for connecting G.S. Flat of 50×10mm (min) for all voltage classes per pole each with tapped holes. Necessary stainless steel bolts and washers, spring washers are to be supplied for connection to grounding strip, size of which shall be as per requirement.

8. PAINTING

Painting should be suitable to withstand hot and humid tropical weather. All steel surfaces shall be cleaned with sand blasting shall be given a coat of high quality red oxide or other suitable primer and shall be finished with two coats of synthetic enamel paints of shade 631 of IS – 5.

9. EQUIPMENT FOUNDATION AND SUPPORT STRUCTURE

All equipment shall be furnished complete with hot dip galvanized steel support structure, anchor / foundation bolts and hardware.

Suitable holes with bolts and washers and spring washers shall be provided on structure for connection to grounding strip. Foundation design and details of calculations for Dynamic Stability of the Support Structure shall have to be submitted for approval. Confirmation towards Dynamic Stability is to be made. Detail structure drawing incorporating dimensions of all components, Bill of Materials etc. shall have to be furnished for approval.

10. SF6 CIRCUIT BREAKER

10.1. The circuit breakers of 72.5KV to 245 KV voltage class shall be of single pressure throughout the interrupting chamber. The breakers for 400KV system may be multi break type with grading capacitor for keeping the interrupting voltage distribution across each breaker same.

10.2. Design and construction of the breaker shall be such that there is minimum possibility of gas leakage and no ingress of moisture.

10.3. Interrupter assembly shall be provided with absorbing elements for absorption of SF6 decomposed products and moisture in operation.

10.4. For 245KV Class and 420KV Class each pole shall from an enclosure filled with SF6 gas independent of the other two poles. Density of each pole shall be monitored by providing density monitor with gas pressure gauge for each individual pole at a position suitable for measuring SF6 gas density and gas pressure of all the poles.

For 72.5 and 145KV a common gas density monitor with common gas pressure gauge shall be provided for monitoring gas density and gas pressure of all the three poles.

10.5. The pressure release device, if necessary, shall be so arranged to minimise danger to the operator in the event of gas or vapour escaping under pressure.

10.6. Sufficient SF6 gas shall be provided to fill all the poles of each circuit breaker.

10.7. Density monitor shall be temperature compensated and it shall meet the following requirements:

i) It shall be possible to remove the density monitor for checking/replacement without draining the SF6 gas by using suitable valve. ii) It shall damp the pressure pulsation while filling gas in service so that pressure switch does not operate on such pulsation.

10.8. All piping for SF6 gas with associated valves, fittings, clamps and hardwares shall be furnished to make the system complete in all respects. Pipe bend shall be of cold bending. Pipe joints shall be totally leak proof.

11. SULPHUR HEXAFLUORIDE (SF6) GAS

11.1. SF6 gas shall comply with IEC-376, 376A and 376B and shall be suitable in all respect for use in the breaker under operating condition.

11.2. The high pressure cylinders in which SF6 gas will be shipped and stored at site shall comply with requirements of the IS-4379 or equivalent. IEC regarding identification of the contents of Industrial gas cylinder and IS-7311 or equivalent IEC regarding seamless high carbon steel cylinder for permanent and high pressure liquefiable gases.

11.3. For green field substation one no. of Portable kit for filling & evacuation of SF6 gas comprising of vacuum pump, adopter and other accessories in one housing etc complete to be supplied. For each existing substation you will have to supply one no. gas filling arrangement comprising of hose pipe and adapter fitting for breaker & SF6 gas cylinder side.

12. 36 KV VACUUM CIRCUIT BREAKER :

Each vacuum Circuit breaker shall comprise of three identical poles linked together electrically and mechanically for synchronous operation.

12.01 VACUUM INTERRUPTER AND CONSTRUCTIONAL FEATURE

The vacuum interrupter, consisting of fixed contact and moving contact, shall be interchangeable among the same type interrupter. Short circuit capacity of vacuum bottle should be 31.5 KA and **design life should be "Minimum" 100 nos. operation at rated short circuit level.**

i) Constructional features of the vacuum chamber along with its functional arrangements are to be shown in a drawing submitted along with tender documents.

ii) The gap between contacts of the Circuit Breaker inside interrupter should be capable of withstanding 1.5 time voltage to neutral at one atmospheric pressure at normal ambient condition within Breaker in the event of vacuum pressure drop due to leakage.

iii) The circuit breakers and their components shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current of the system without any damage or deterioration of material.

iv) The circuit breakers shall have motor wound spring charged trip free mechanism with anti pumping feature, and shunt trip. In addition, facility for manual charging of spring, shall be provided.

v) Each breaker shall be provided with manual close & open facility, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator.

vi) For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One OCO operation (if CB is in closed condition) or one CO operation (if CB is in open condition) [R3.2] of the circuit breaker shall be possible after failure of power supply to the motor. A visual mechanical indicating device will also be provided to show the position of the spring.

vii) Silver coating may not be required for the tips of the main contacts of VI.

viii) The LIFE CURVE (the curve showing number of operations against current level being interrupted during the life span of the VI) of vacuum interrupter must be provided with each VCB

12.02 36KV VCB, with duty cycle O- .3sec CO-3min CO, Class- C2-M2 as per relevant IEC, 1600A, 31.5KA for 3 sec, 70kvrms/170kvp, 3-Phase, Outdoor VCB with 2TC & 1CC, 220V DC.

12.03 The offered VCB shall be well proven in WBSEDCL/WBSETCL & other Power utility. Offered bottle shall be identical with Type tested one. Brochures/leaflet on technical data sheet for vacuum bottle shall also to be submitted.

12.04 The VCB shall be complete with structure, operating mechanism in a common Control cubicle with degree of protection IP-55, situated at accessible man height, along with all associated accessories and auxiliaries and ~~terminal connector~~ as per specification and approved drawing during detailed engineering. The supply shall include 5% of total offered Vacuum Interrupter bottles (consider three VIs per CB) as spares subject to minimum of 1 number.

12.05 Terminal connectors shall be if it is specified in the BOQ.

12.06 The bidder shall submit detailed as well as complete Type test reports as stipulated in relevant IS and IEC with complete identification, date and serial no. of circuit breakers of identical design with identical bottle from CPRI, NABL accredited/a Government recognized test house or laboratory during detailed engineering.

12.07 Make & Type of VCB & Vacuum Interrupter with detailed literature shall be furnished along with bid.

12. **GUARANTEE :**

Electrical characteristics shall be guaranteed by the bidder. In case of failure of materials to meet the guarantee, WBSETCL shall have right to reject the material. Guaranteed Technical Particulars are to be submitted by successful bidder during detailed engineering along with submitted drawings/documents. However format for submission of GTP shall be handed over to intending bidders at the time of sale of tender documents.

14. CONTRACT DRAWING AND CATALOGIE

After placement of L.O.A. six (6) copies of various drawings, data and write up as listed below shall be submitted for approval as well as for reference as applicable. In all drawings, manuals etc. reference no. of L.O.A. shall be indicated.

14.1. Dimensional General Arrangement drawing showing all dimensions and disposition of fittings and space requirement and mounting/fixing arrangements.

14.2. Sectional views of contact assembly, operating mechanism and arc extinguishing chamber.

14.3. Transport/shipping dimensions with weights.

14.4. Foundation and anchor details including dead-load and impact load with direction and also point of application.

14.5. Assembly drawing for erection at site with part numbers and schedule of materials.

14.6. Electrical schematic and wiring diagram with explanatory notes, if any.

14.7. Schematic flow diagram and layout drawing of SF6 filling device. Also drawing of spring charged operating mechanism schematic layout drawings, as applicable.

14.8. Structural Drawing incorporating all dimensions of each component, BOM, etc

14.9. Name plate drawing and any other relevant drawings and data necessary for erection, operation and maintenance.

14.10. Outline drawings of bushings, terminals and terminal connectors.

14.11. The contractor shall submit four (4) sets of approved drawings both in hard and soft copy for each type of circuit breaker per sub-station for distribution purpose. Six copies of instruction manuals in binding form for each type of CB per substation and data sheets for each rating of equipment shall be submitted. The manuals shall clearly indicate the installation methods, checkups and tests to be carried out for testing the equipment and maintenance procedure.

15. TEST AT FACTORY AND TEST CERTIFICATES

All Acceptance tests shall be carried out at manufacturer's works in presence of the WBSETCL as per relevant IS & IEC. In addition to above, all routine tests are also to be carried out on the breakers as per relevant IS & IEC. The entire cost of acceptance and routine tests that are to be carried out as per relevant IS shall be treated as included in the quoted price of breakers. The contractor shall give at least 15 (fifteen) days advance notice intimating the actual date of inspection and details of all tests that are to be carried out from the date when the tests will be carried out. Selection of samples for Acceptance Test as well as rejection and retesting shall be guided by relevant IS & IEC.

Routine tests report of each breaker are to be submitted along with inspection offer. Acceptance test report shall be furnished in Three (3) copies along with soft copy to the Chief Engineer, Engg. Deptt.

16. TEST REPORTS AND TYPE TESTS

Only type tested Circuit Breaker from the maker's list of WBSETCL are to be offered conforming to our technical specification, and relevant IS and IEC. Circuit Breaker offered should be similar with ones on which type testing has been carried out as per relevant IS and IEC. Three sets of complete type test reports carried out in Govt. recognized Test House or Laboratory /NABL accredited laboratory shall have to be submitted by successful bidder positively along with submission of drawings during detailed Engineering if asked. Successful bidder may require producing original copies of type test reports at the time of detail Engineering if asked by WBSETCL.

Each type test report shall comply the following information with test result

i) Validity of type test will be guided by current revision of CEA guide line.
ii) Complete identification, date and serial no.
iii) Relevant drawings as documented with test report.
iv) Method of application, Where applied, duration and interpretation of each test.
v) Bidder shall quote price for carrying out type tests if mentioned in the schedule for type test charges on 400KV Circuit Breaker so that the same can be carried out as per option of WBSETCL. The price shall be considered for the purpose of evaluation of bids.

17. SPECIFIED LIMIT OF AUXILIARY SUPPLY VOLTAGE

i) The auxiliary supply voltage for 36 KV to 420KV class breakers shall be 85% to 110% of the rated 220 V DC supply for closing coil and the same shall be 70% to 110% for tripping coil. ii) The operating voltage for motor operated spring charged mechanism shall be 400 V AC, 3phase, 50 Hz or 230 V, 1-phase, 50 Hz. The motor shall operate at a voltage variation of 85% to 110% of the supply voltage.

18. NAME PLATE

i) Rated voltage/Maximum voltage
ii) Rated insulation level
iii) Model No./Sl. No./Year of manufacture
iv) Rated current
v) Rated frequency
vi) Rated short circuit breaking current
vii) Class of breaker(36KV) M2-C2
viii) Rated transient recovery voltage for terminal fault
ix) Rated short circuit making current
x) Rated operating sequence
xi) Rated short time current
xii) Rated line charging/breaking current
xiii) Rated cable charging current
xiv) Rated single capacitor bank charging/breaking current
xv) Rated small inductive breaking current

xvi) Rated supply voltage of auxiliary circuits
xvii) Rated Supply Frequency of auxiliary circuits
xviii) Applicable standard
Any other information as per requirement of WBSETCL to be indicated during approval of drawing shall have to be included in the nameplate.

19. AVAILABILITY OF SPARE and MANDATORY SPARES

i) The successful bidder shall submit manufacturer's undertaking during submission of drawings of Circuit Breaker that the spares for the supplied breaker(for all voltage classes and all makers) shall be available for at least ten years from the date of placement of LOA. All the participating bidders shall have to confirm in writing through Cover-II submission that the above mentioned undertaking from the manufacturer shall be submitted in case they receive order.

ii) At least 15% spare quantity of SF6 Gas and Portable kit for filling and evacuating SF6 gas with all accessories are to be supplied with the each lot of CBs.

20. ACCESSORIES

Each breaker shall be furnished complete with fittings and accessories as listed below (The list is illustrative & not exhaustive) :
i) Base frame and foundation/anchor bolts.
ii) Operating mechanism, trip and close coils, pole discrepancy feature and low pressure blocking device, auto reclosing device wherever required.
iii) Set of valves, gas pressure gauges and pressure switches. Temperature compensated gas density monitor.
iv) Auxiliary contacts and relays/contacts.
v)Local/Remote selector switch and Close/Trip Control Switch.
vi)Manual close and trip devices.
vii)Mechanical ON/OFF indicators.
viii)Operation counter.
xi) Weatherproof Control cubicle and operating mechanism boxes, with locking arrangement.
xii) Set of Switch-fuse/MCB/MCCB units for A.C. & D.C. supply
xiii) Pipings of SF6 system
xiv) Space heaters with thermostat and switch
xv) Cubicle illumination lamp with switch
xvi) Terminal blocks and internal wiring
xvii) G.I. Conduits and accessories for connection between Central Control
xviii)Cubicle and operating mechanism boxes where applicable
xix)SF6 gas filling/Monitoring device
xx)Breaker absorbent in sufficient quantity
xxi)Sufficient spare quantity of SF6 Gas filled Cylinders
xxii)Portable kit for filling and evacuating SF6 gas with all accessories as per Cl. no. 11.3 of this technical specification if applicable
xxiii)Other standard accessories which are not specified but are necessary for efficient and trouble free operation shall be within the scope of supply

SPECIFIC TECHNICAL PARAMETERS

Sl.no	Description	400KV	220KV	132 KV	66KV	33 KV
01	Service	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
02	Type	SF6	SF6	SF6	SF6	Vacuum
03	Auto Reclosing	1 Ph./3 Ph.	1 Ph./3Ph.	3ph	3PH	3 ph
04	Rated frequency (Hz)	50	50	50	50	50
05	i) Nominal system voltage (KV)	400	220	132	66	33
	ii) Rated voltage (KV)	420	245	145	72.5	36
06	System neutral Earthing	Effectively Earthed	Effectively Earthed	Effectively Earthed	Effectively Earthed	NEE through Earthing Transformer
07	1.2/50 ıg level impuls KVp) micro-volt. ɜec e a) vithstand b) between line terminals and ground (KVP) between terminals with circuit breaker open	±1425 ±1425 impulse on one terminal and 240KVp Power frequency voltage of opposite polarity on other terminal	±1050 -	±650 -	±325	±170 -

08	i) 1 min power frequency withstand voltage (KV rms)(dry & wet) a) between line terminals and ground b) between terminals with Circuit breaker open ii) 250/2500 switching impulse withstand voltage (dry & wet) a) between. line terminal and ground (KVP) b) between terminal with circuit breaker open	520 610 ±1050 900KVp impulse on one terminal and 345KVp PF voltage of opposite polarity on other terminal	460 - 	275 - 	140 	70 -
08	Rated current (Amps.) (i) Continuous	2000	2000/1600	2000/1600	2000/1600	2000/1600
	ii) Short time rating(KA)	50 for 1 sec.	40 for 3 seconds	31.5 for 3 seconds	31.5 for 3 seconds	31.5 for 3 seconds
09	Min. Creepage distance (mm) bet. ph. to ground and bet. CB terminals (Very Heavily polluted atmosphere).[R3.2]	13020 in each case	7595	4495	2248	1116
10	Rated Breaking time (m.sec.)	40 m. sec.		Not exceeding 60 millisec		
11	Total Closing time (m.sec.)		Not exceeding 120 millisec			
12	Rated line charging breaking current (Amps)	400	125	50	10	-
13	Rated cable charging breaking current (Amps)	400	250	160	125	50

14	Rated single capacitive making /breaking current (Amps) Within permissible switching over voltage (As per Table I)	-	250	160	125	50

15	Rated small inductive making/breaking current within permissible switching over voltage (As per Table I)	Eqvt. To magn. current of 500 MVA,400/220/33 KV Tr. and 80MVAR Shunt Reactor[R3.2]	Eqvt. To magn. current of 200 MVA, 220/132/33 KV Trf. [R3.2]	Eqvt. To magn.current of 200 MVA, 220/132/33 KV Trf. IV side [R3.2]		-
16	Rated operating sequence (O – Operating, C – closing)		O-0.3 sec- CO – 3.0 min-CO			
17	Operating mechanism	Spring/Spring	Spring/Spring	Spring/Spring	Spring/Spring	Spring/Spring
18	Mode of operation	Individual Pole Operated	Individual Pole Operated	Gang Operated	Gang Operated	Gang Operated
19	No. of trip coils	2 per pole	2 per pole	2 common for 3 pole	2 common for 3 pole	2 common for 3 pole
20	Trip coil and closing coil voltage (DC volt)	220	220	220	220	220
21	Phase to phase clearance of pipe bus(mm)	7000	4500	2700	2100[R3.2]	1500
22	Minimum clearance of live parts in air and ground (mm)	8000	5500	4600	4000[R3.2]	3700
23	First pole to clear factor	1.3	1.3	1.3	1.5	1.5
24	Altitude above mean sea level (meter)		Not exceeding 1000			
25	Supply voltage for operating device		400 V, 3-Phase, 50 Hz or 230 V, 1-Phase, 50 Hz			
26	Corona extinction voltage (KVrms) (Min.)	320				

27	Max. radio interference voltage (micro volts) between 0.5 MHZ and 2 MHZ in all position of equipment	1000 (at 266 KVrms)	1000 (at 156 KVrms)	500 (at 92KVrms)		
28	Thermal rating of auxiliary contacts.		10 A at 220V DC			
29	Breaking capacity of auxiliary contacts.		2A DC with circuit time not less than 20 ms.			
30	Seismic acceleration		0.3g horizontal			
31	Rated transient recovery voltage (TRV) (TRV peak valve-KV)	624	364	215	83	62
32	Rated transient recovery voltage for out of phase breaking (KV) in earthed neutral system	857	500	296	185 (other than earthed neutral system)	92 (other than earthed neutral system)
33	Rating of Preinsertion resistor (Ohm)	400	NA	NA	NA	NA
34	Minimum Preinsertion time (ms)	8	NA	NA	NA	NA

GUARANTEED TECHNICAL PARTICULARS OF CIRCUIT BREAKERS

(To be filled in and signed by the Bidder)

SL	DESCRIPTION	400 KV	220 KV	132 KV	66KV	33 KV	Remarks
1	GENERAL						
1.01	Name of the Manufacturer						
1.02	Date of Last Type Test						
1.03	Type & Model of the Manufacturer						
1.04	Total Height of the Breaker from Plinth level after complete Erection						
1.05	Total weight of the Breaker after complete Erection						
1.06	Number of Interrupting per pole						
1.07	Rated Operating Voltage (KV)						
1.08	Design Voltage (KV)						
1.09	Maximum Voltage (KV)						
2	CB Insulation Level : 1.2/50 micro-sec. L.I. withstand voltage						
2.01	Between line terminals and ground parts (KVp)						
2.02	Between terminals with breaker contacts open						
2.03	250/2500 micro-Sec switching Impulse withstand voltage for 400KV only (KVP)						
2.04	One minute Power frequency withstand Voltage (KVrms)						

2.04.1	Between line terminals and ground parts (KVp)						
2.04.2	Between terminals with breaker contacts open (KVp)						
2.05	Rated TRV for terminal fault (KVp)						

2.06	Restriking Voltage for 100% / 60% and 10% rated capacity						
2.07	RRRV (Volts/micro sec)						
2.08	Max. Radio Interference Voltage in micro-volt at $1.1Ur/\sqrt{3}$ between 0.5 MHz to 2 MHz .						
3	CIRCUIT BREAKER CURRENT						
3.01	Rated normal current Amps (rms)						
3.02	Short time current rating (KA) (1 Sec. for 400KV & 3 Sec. for 220KV & below)						
3.03	Short circuit Breaking Current						
3.04	Asymmetrical Breaking current (including % DC component) -KA (rms)						
3.05	Rated making capacity (KA peak)						
3.06	Breaking capacity under phase opposition condition in KA and the recovery voltage over poles in KV						
3.07	Line-charging current (A)						

3.08	Maxm.cable charging current breaking capacity in Amps and corresponding over voltage in KV as observed in Tests						
3.09	Temperature rise above ambient, due to rated current in main contacts (o C)						
4	CIRCUIT BREAKER TIME						
4.01	Rated operating duty cycle						
4.02	Total break-time in milli seconds measured from the instant of trip-circuit energisation						
4.03	Arcing time (ms)						
4.04	Reclosing time (ms)						
4.05	Dead time for 1 phase & 3 phase (ms)						
5	CIRCUIT BREAKER ACCESSORIES						
5.01	Value of Parallel Capacitor (pF)						
5.02	Value of Pre-Insertion Resistor						
6	CIRCUIT BREAKER DRIVES						
6.01	Number of Trip coils						
6.02	Operating Voltage of Trip & Close Coil						
6.03	Number of Auxiliary Contacts						
7	CIRCUIT BREAKER SF6 GAS (if applicable)						
7.01	Total Quantity of Gas in KG per pole						
7.02	Loss of SF6 Gas per year						

7.03	Normal Operating Pressure of SF6 Gas (bar)						
7.04	Low Gas Pressure set at (bar)						
7.05	Trip Lockout set at (bar)						
8	CIRCUIT BREAKER SPARES						
8.01	The CB spares will be available for total service life. (Yes/ No)						
8.02	If offered designed CB are out of mnufacturing, the manufacturer will arrange spares for total service life (Yes/ No)						

FOR 36 KV VACUUM CIRCUIT BREAKERS (in addition to above)

Sl. No.	Description		Particulars
1.	Conforming Standard	:	
2.	Service (Outdoor/Indoor)	:	
3.	Frequency	:	
4	Rated operating duty	:	
5	Rated (TRV) for terminal fault	:	
6	Short time Fault breaking capacity MVA	:	
7	Line charging current breaking capacity	:	
	a) line charging current AMP	:	
	b) Corresponding Over voltage (KV)	:	
	c) Whether Switching Resistor is provided	:	
	i) Value of Resistor	:	
	ii) Time of insertion	:	
	iii) Thermal Rating of Resistor	:	

8	Maximum shunt capacitor bank switching/breaking capacity in MVA and the over voltage factor.	:	
9	Maximum over voltage in Kilovolts on switching OFF Transformer on low load.	:	
	i) Breaks per pole (No)	:	
	ii) Length of each break per pole (mm)	:	
	iii) Length of moving contact travel mm	:	
	iv) Rate of contact travel (m/sec)	:	
10	Make time (milisecs.)	:	
11	Minimum reclosing time at rated interruptingCapacity from the instant of the trip coil energisation (milisecs.)	:	
12	Minimum dead time for 1 phase & 3 phase reclosing With corresponding limits of adjustment of dead time, If any.	:	
13	Maximum radio interference voltage between 0.5 MHz to 2 MHz with Voltage of 110% of rated rms voltage between phase & ground (Micro- Volt)	:	
Sl. No.	Description		Particulars
30.	Details of manually/motor operated spring charging mechanism.	:	
31.	i)Voltage and Power requirement for a) closing coil b) Tripping coil ii) No of Tripping Coil	:	
32	Vacuum Bottle		
32 a)	Make, Country, Type & Designation of Vacuum Bottle used in VCB.	:	
32 b)	Number of operation at full short ckt level,		
32 c)	no. of operation at rated current and other details		

32 d)	Whether Literature & Catalogue of offered Vacuum Bottle containing the specific particulars enclosed?		
33.	Weight of Vacuum Circuit Breaker	:	
34.	No. of auxiliary contacts (Spring Charging LS) number of NO and NC shall be mentioned. No. of auxiliary spare contacts	:	
35.	Power frequency withstand capability of breaker in open condition at :	:	
	i) Atmospheric Pressure of Air/Zero Vacuum Pressure	:	
36.	Actual opening time (from Trip Coil energisation to contact separation) (ms)	:	
37.	Allowable time limit between breaker per pole (for multibreak type) and between poles (ms)	:	
38.	Actual closing time (from Closing Coil energisation to contact touching (ms)	:	
39.	Whether type tests report submitted in line with specification for similar breaker with offered vacuum Interrupter?	:	
40.	Whether a) Dimensional GA Drawing Cross Sectional b)Drawing of interrupting Chamber and c)scheme diagram are furnished.	:	a) b) c)
41.	Whether brochure/ leaflet on Technical data for Vacuum bottle enclosed?		