CHAPTER 22: TECHNICAL SPECIFICATION FOR 132KV, 66kV & 33KV CIRCUIT BREAKER (AIS)

SCOPE

The intention of this Section of the Specification is to cover design, manufacture, testing at manufacturer's works and of 132kV, 66kV and 33 KV Circuit Breakers with all fittings and accessories including mounting structures as specified hereunder.

GENERAL REQUIREMENTS

The circuit breaker shall be of three phase unit (gang operated) (or) three identical single-phaseunits (as said in data sheet), outdoor, SF6 gas filled single pressure puffer type(132kV and 66kV)and VCB for 33kV. The operating mechanism shall be electrically and mechanically trip/free with anti-pumping facility suitable for remote electrical closing, tripping as well as local Operation facility as specified. The CBs are meant for installation with Transformers & Lines and capacitor banks as applicable.

The circuit breaker shall be capable of 3-ph auto-reclosing.

The circuit breaker shall be so designed to withstand the effects of temperature, wind load, short circuit, seismic conditions and other adverse conditions.

The circuit breaker shall be capable of switching transformer magnetizing currents and shall be restrike - free.

All similar parts, particularly removable ones, shall be interchangeable with one another.

All cable ferrules, lugs, tags, etc. required for cabling from equipment control cabinet/operating mechanism to the central control cabinet of the breaker shall be supplied loose as per approved schematics.

The SF6 breaker shall be designed to ensure that condensation of moisture is controlled by proper selection of organic insulating materials having low moisture absorbing characteristics

The support structure of circuit breaker shall be hot dip galvanised. Sufficient galvanising thickness shall be achieved with 900 gm/m² (130 micron). All other parts shall be painted as per painting specification enclosed separately.

All mechanical parts and linkages shall be robust in construction and maintenance free over at least 10,000 switching operations except for lubrication of pins/articulated joints at 5000 operations and electrical E2 performance.

OPERATING MECHANISM

A power spring operated mechanism for closing and tripping shall be provided in the breaker control cabinet. This device shall be so interlocked that while it is under maintenance, the breaker cannot be operated from remote. A slow acting, manually operated device shall be provided for inspection and maintenance purposes.

Circuit breaker operating mechanism shall be capable of storing energy for at least two complete closing and tripping operations.

Each mechanism shall have an operation counter.

The operating mechanism shall be trip-free and mounted and enclosed in a weather- proof, vermin-proof, sheet steel cabinet conforming to IP: 55 degree of protection. Sheet steel thickness shall be as specified in data sheet. The cabinet shall also house relays, control and auxiliary equipment of each breaker and provision for terminating all control, alarm and auxiliary circuits. It shall be provided with hinged doors with provision for locking and removable gland plates to be drilled at site. Inspection window shall be provided for observation of the instruments without opening the cabinet. It shall be mounted so as to provide convenient access from ground level. Two trip coils shall be provided.

The cabinet shall be fitted with a thermostatically controlled anti-condensation heater, a 15A, 1 phase, 5 pin socket outlets with switch and a cubicle illuminating lamp suitable for operation on 240 V AC 50Hz supply.

Circuit breakers shall feature high repeatability of absolute closing time over a wide range of parameters (ambient temperature, pneumatic pressure, control voltages, etc).

Main poles shall operate simultaneously. There shall be no objectionable rebound and the mechanism shall not require any critical adjustment. It shall be strong, rigid, positive and fast in operation.

Pole discrepancy shall be provided which shall detect pole position discrepancy.

The design of the circuit breaker shall be such that contacts will not close automatically upon loss of gas/ air pressure.

Closing release shall be capable of operating within the range of the rated voltage as specified in the data sheet. Shunt trip shall operate satisfactorily under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker within the range of the rated voltages specified in the Data sheet.

Working parts of the mechanism shall be of corrosion resisting material. Bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker.

All controls, gauges, relays, valves, hard drawn copper piping and all other accessories as necessary shall be provided including the following:

Low pressure alarm and lock out relay with adjustable pressure setting suitable for operation on DC system

A no-volt relay for remote indication of power failure for compressor motor/ Spring Charge motor.

As long as power is available to the motor, continuous sequence of closing and opening operations shall be possible.

After failure of power supply to the motor, at least two close-open operation of the circuit breaker shall be possible from stored energy.

Spring charging motor shall be standard single phase universal motor suitable for 220 volts supply for Rangia GIS and 110volts for Nalbari GSS.

Motor rating shall be such that it requires only about 30 seconds for full charging of the closing spring.

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

During closing, springs are discharged and after closing of breaker, springs shall automatically be charged for the next operation. Facility for manual charging of closing springs shall be provided. Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is already in the closed position.

OPERATING MECHANISM CONTROL

The breaker shall normally be operated by remote electrical control. However, provision shall be made for local electrical control. For this purpose, a local/remote selector switch, close and trip control switch/push button shall be provided in the breaker central control cabinet.

Two electrically independent trip circuit including two trip coils per breaker shall be operated from two separate DC sources. First trip coil shall be utilized for tripping the breaker on main protection fault detection. Whereas second trip coil shall be used to trip the breaker when first trip coil fails to trip the breaker and backup protection comes into operation and shall also be used to trip the breaker on command.

The trip coils shal be suitable for trip circuit supervision during both open and close position of the breaker. Necessary terminals shall be provided in the central control cabinet of the circuit breaker by the supplier.

The auxiliary switch with 12NO+12NC contacts of the breaker shall be positively driven by the breaker operating rod.

A conveniently located manual tripping lever or button shall also be provided for local tripping of the breaker and simultaneously opening the reclosing circuit. A local manual closing device which can be easily operated by one man standing on the ground shall also be provided for maintenance purpose. Direction of motion of handle shall be clearly marked.

When the spring get fully charged either through motor or hand cranking, the spring charging motor and the hand cranking suitable mechanical and electrical indication shall be provided for same. On restoration of electrical supply the mechanical handle shall be automatically disengaged.

SF6 GAS SYSTEM

SF6 gas shall serve as an arc-quenching medium during opening/closing operation and as an insulating medium between open contacts of the circuit breaker.

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

All gasketed surfaces shall be smooth, straight and reinforced, if necessary, to minimise distortion and to make a tight seal, the operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals. The SF6 gas leakage should not exceed 1% per year

In the interrupter assembly there shall be an absorbing product box to minimise the effect of SF6 decomposition products and moisture. The material used in the construction of the circuit breakers shall be such as fully compatible with SF6 gas decomposition products.

Each pole shall form an enclosure filled with SF6 gas independent of two other poles (145 and 66 kV CBs) and the SF6 density of each pole shall be monitored.

The dial type SF6 density monitor shall be adequately temperature compensated to model the pressure changes due to variations in ambient temperature within the body of circuit breaker as a whole. The density monitor shall have graduated scale and shall meet the following requirements:

It shall be possible to dismantle the density monitor for checking/replacement without draining the SF6 gas by providing suitable interlocked non return valve coupling.

22.5.7: SF6 gas shall be as per IEC 60376

VACUUM INTERRUPTER ASSEMBLY

22.6.1. Each pole of the circuit breaker shall be provided with vacuum interrupter, one for each phase, hermetically sealed for life and encapsulated by ceramic insulators. The interrupter shall be provided with steel chromium arc chamber to prevent vaporized contact material being deposited on the insulating body. A further shield giving protection to the metal bellows shall also follow the travel of the moving contacts to seal the interrupter against the surroundings atmosphere.

22.6.2. It shall have high and consistent dielectric strength of vacuum unaffected by environment and switching operations. Bronzed joints should ensure retention of vacuum for life time. It shall have low and stable contact resistance due to absence of oxidation effects and shall ensure low power loss. The arcing voltage shall be low and minimum contact erosion

BUSHINGS AND INSULATORS

Bushings and Insulators shall be of Porcelain, Solid core type. Porcelain used for the manufacture of bushings and insulators shall be homogeneous, free from defects, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

Glazing of the porcelain shall be of uniform brown colour, free from blisters, burns and other similar defects. Bushings shall be designed to have sufficient mechanical strength and rigidity for the conditions under which they will be used. All bushings of identical ratings shall be interchangeable.

Puncture strength of bushings shall be greater than the dry flashover value. When operating at normal voltage, there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the bushings when operating at the normal rated voltage.

Bushings shall satisfactorily withstand the insulation level specified in data sheet.

FIXED AND MOVING CONTACTS

Main contacts shall have ample area and contact pressure for carrying the rated current and the short time rated current of the breaker without excessive temperature rise which may cause pitting or welding. Contacts shall be adjustable to allow for wear, easily replaceable and shall have minimum moving parts and adjustments to accomplish these results. Main contacts shall be the first to open and the last to close so that there will be little contact burning and wear out.

Arcing contacts, if provided, shall be the first to close and the last to open and shall be easily accessible for inspection and replacement. Tips of arcing and main contacts shall be silver faced.

If multi-break interrupters are used, they shall be so designed and augmented that a fairly uniform voltage distribution is developed across them.

INTERLOCKS

Key release mechanical interlocks shall be incorporated in the operating mechanism for interlocking with the associated isolators, so that operation of the circuit breaker is dependent on a "key-trapped" situation. In addition, electrical interlocks with associated isolators shall be provided.

ADDITIONAL DUTY REQUIREMENTS

Circuit breakers shall be capable of clearing short line faults with the same impedance behind the bus corresponding to the rated fault current.

Circuit breakers shall be capable of breaking 25% of rated fault current at twice rated voltage under out of phase conditions.

The Bid shall highlight the design features provided to effectively deal with:

a) Breaking of inductive currents and capacitive currents.

b) Charging of long lines and cables.

c) Clearing developing faults within the full rating of the breaker.

d) Opening on phase opposition.

ACCESSORIES

Gas Pressure Detector

The circuit breaker shall be provided with gas pressure monitor with temperature compensation for initiating alarm and locking the operating mechanism in the event of abnormality. Gas pressure monitor shall be combined for all three phases for (145kV and 66kV) Circuit Breakers. Each phase of Circuit Breaker shall be provided with pressure gauge with Red and Green zone and pressure level marked on the dial.

Position Indicator

Each pole of the circuit breaker shall be provided with a position indicator.

Terminals

Each circuit breaker shall be provided with suitable terminal pads of high conductivity aluminium alloy for connecting to the line.

Auxiliary Switches

Each circuit breaker shall be equipped with auxiliary switches with sufficient number of contacts for control, indication and interlocking purposes. Twelve normally open and twelve normally closed contacts shall be provided as spares. All contacts shall be rated for the DC voltage specified in data sheet.

Terminal Blocks

All accessories, spare contacts of contactors and control devices shall be completely wired up to terminal block. All wirings which are connected to external circuit shall be terminated on terminal blocks installed in the control cabinet. The terminal blocks provided shall have twenty (20) percent spares. Each terminal block shall be suitable to receive two conductors of minimum 2.5sqmm copper.

Operating mechanism housing shall be supplied with all required accessories including the following:

a) Padlocks and duplicate keys.

b) Space heaters equipped with automatic thermostatic control.

c) Local/remote changeover switch.

d) Manually operated tripping push button/lever (mechanical) conveniently located to trip all three phases simultaneously.

e) Control switches to cut off control power supplies.

f) Fuses as required.

g) Two earthing terminals.

h) Auxiliary relays required for satisfactory operation.

i) Motor contactor with thermal release

j) Provision for mechanical interlock with isolator.

k) Indication Lamps for On/OFF operation

22.11.06:

SUPPORT STRUCTURES

The Circuit Breakers shall be suitable for mounting on steel structures.

The support structure shall be of steel hot dip galvanised type. The height of support structure shall be designed to keep the bottom most live part and bottom of insulators of circuit breakers at minimum clearance from the plinth as specified in data sheet.

All necessary galvanised bolts, nuts and washers to complete the erection shall be furnished including the embedded anchor bolts for securing the supporting structure to the concrete foundations.

The support structures shall be capable to withstand the minimum seismic acceleration of 0.36 g in horizontal direction and 0.6g in vertical direction.

NAME PLATES

All equipment shall have non-corrosive name plates fix at a suitable position indelibly mark with full particular there on in accordance with the standard adapted.

EARTHING

Two earthing pads shall be provided on each supporting structure. Each operating mechanism control cabinet or terminal box mounted on the supporting structure shall also be connected to an earthing pad. Separately mounted control cabinets shall be provided with two earthing pads adjacent to the base of the cabinet. The earthing connection shall be bolted type and suitable for receiving 75mm x 12mm GS strip.

TERMINAL CONNECTORS

The equipment shall be supplied with required number of terminal connectors of approved type suitable for ACSR conductors. The type of terminal connector, size of connector, material, and type of installation shall be approved by the Employer, as per installation requirement while approving the equipment drawings.

TESTS

All routine tests shall be carried out in accordance with relevant IS. All routine/acceptance tests shall be witnessed by the AEGCLs authorised representative. The tests shall include the following:

a) Routine/Acceptance Tests (all units) i)Mechanical Operation tests

ii)Power frequency voltage withstand test (dry) iii)Tests on auxiliary & control circuits

iv) Measurement of resistance of the main circuit.

v) Insulation Resistance Test

b)Type Tests:

The bidder shall furnish type test certificates and results for the following tests along with the bid for breaker of identical design.

i) Breaking(terminal fault, L90,etc) and making capacity test

ii) Short-time current withstand test

iii) Temperature rise tests

iv) Lightning Impulse voltage test

v) Operating Duty test

vi) Pole Discrepancy test

vii) Power Frequency withstand test

viii) IP degree of protection of operating mechanism enclosure

ix) RIV/PD test

x) Contact Resistance of CB

xi) IR value test for operating mechanism circuits

xii) Creepage distance test

c) Test Certificates

Copies of routine/acceptance test certificates shall be produced with the endorsement of the inspecting authority to the Employer before effecting despatch. The test report shall contain the following information.

i) Complete identification data, including serial No. of the breaker.

ii) Method of application, where applied, duration and interpretation of results in each test.

PRE-COMMISSIONING TESTS

Contractor shall carry out following tests as pre-commissioning tests. Contractor shall also perform any additional test based on specialties of the items as per approved document of the equipment AEGCL without any extra cost to the AEGCL. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to AEGCL for approval.

(a) Insulation resistance of each pole.

(b) Check adjustments, if any suggested by manufacturer.

(c) Breaker closing and opening time.

(d) Slow and Power closing operation and opening.

(e) Trip free and anti-pumping operation.

(f) Minimum pick-up voltage of coils.

(g) Contact resistance measurement.

(h) Functional checking of control circuits interlocks, tripping through protective relays and auto reclose operation.

(i) Insulation resistance of control circuits, motor etc.

(j) Resistance of closing and tripping coils.

(k) SF6 gas leakage check.

(l) Dew Point Measurement

(m) Verification of pressure switches and gas density monitor.

(n) Checking of mechanical 'CLOSE' interlock, wherever applicable.

(o) Testing of grading capacitor.

(p) Resistance measurement of main circuit.

(q) Checking of operating mechanisms

(r) Check for annunciations in control room.

(s) Sniffer test of VCB

SPECIAL TOOLS AND TACKLES

The Bidder shall furnish a list of any special tools and tackles required for maintenance and operation purposes with recommended quantities for each substation.

TECHNICAL DATA SHEET FOR CIRCUIT BREAKER

Sl.		Particulars	Unit	Data for	Data for 66kV CB	Data for		
No.				132kV CB		33 kV CB		
I		II	III	IV	V	VI		
		Type		SF6	SF6	VCB		
		No of poles		3	3	3		
				(3 Phase Ganged Unit)	(3 Phase Ganged Unit)	(3 Phase Ganged Unit)		
		Service		Outdoor	Outdoor	Outdoor		
		Rated System Voltage	kV	132	66	33		
		Highest System Voltage	kV	145	72.5	36		
		System earthing		Solidly earthed system	Solidly earthed system	Solidly earthed system		
		Rated Voltage of Breaker	kV	145	72.5	36		
		Rated Continuous Current	Amps	3150	2000	2500/2000/1600/1250		
		Rated Frequency	Hz	50	50	50		
		Rated Short Circuit breaking current (I) - 3secs - symmetrical	kA RMS	40	31.5	31.5		
		Rated Short Circuit making current	kA PEAK	2.5*I	2.5*I	2.5*I		
		Duty cycle		0-0.3 Sec - CO -3 Min -CO	0-0.3 Sec - CO -3 Min -CO	0-0.3 Sec - CO -3 Min -CO		

Sl.		Particulars	Unit	Data for	Data for 66kV CB	Data for		
		First pole to clear factor		1.3	1.3	1.3		
		Operating time						
		i) Opening Time	ms	Not exceeding	Not exceeding 50ms	Not exceeding		
						50 ms		50 ms
		ii) Closing Time	ms	Not exceeding	Not exceeding	Not exceeding		
		D		100 ms	100 ms	100 ms		
		Insulation level						
		i) One minute Power Frequency withstand Voltage (Dry)	kV RMS	275	140	75		
		ii) Full Wave Impulse withstand Voltage (1.2/50 µsec)	kV Peak	650	325	170		
		Minimum clearance between phases	mm	1300	630	320		
		Minimum clearance between phase to earth	mm	1300	630	320		
		Minimum Ground clearance (from bottom most live part to plinth level)	mm	4600	3700	3700		
		Minimum clearance from bottom of support insulator to plinth level	mm	2500	2500	2500		
		i) Minimum Creepage Distance (Total)	mm	4495	2247.5	1116		
		ii) Minimum Creepage Distance (Protected)	mm	2250		460		
		Operating mechanism			Spring Charged			
		a) Type		Spring Charged		Spring Charged		
		b) Rated 3 Phase, 50Hz Voltage for Drive Motor	V	220AC	220AC	220AC		
		c) Rated voltage of Shunt trip coil & operating range	V. DC	220 or110[50% - 110%]	220 or110[50% - 110%]	220 or 110 [50% - 110%]		
		d) Rated voltage of Closing coil & operating range	V. DC	220 or 132 [80% - 110%]	220 or 132 [80% - 110%]	220 or 132 [80% - 110%]		
		e) No. of trip coils	No	2 per CB	2 per CB	2 per CB		
		f) No. of closing coils	No	1 per CB	1 per CB	1 per CB		

Sl.		Particulars	Unit	Data for	Data for 66kV CB	Data for		
		g) No of spare auxiliary contacts & contact rating	Nos AMPS	12 N/O+12 N/C (per CB) 10 A at 240V AC & 4A at 220V/ 110V DC	12 N/O+12 N/C (per CB) 10 A at 240V AC & 4A at 220V/ 110V DC	12 N/O+12 N/C (per CB) 10 A at 240V AC & 2A at 220V/ 110V DC		
		h) Minimum thickness of steel sheet for control cabinet	mm	3	3	3		
		i) Enclosure Protection		IP55	IP55	IP55		
		Reclosing		Three Phase	Three Phase auto reclosing	Three Phase		
				auto reclosing		auto reclosing		
		Support structure		Galvanised	Galvanised	Galvanised		
		(Painted / Galvanised)						
		All other parts (Painted / Galvanised)		Synthetic enamel shade 631 of IS5 (125 microns)	Synthetic enamel shade 631 of IS5 (125 microns)	Synthetic enamel shade 631 of IS5 (125 microns)		
		Minimum size of control wiring (Copper)	Sq. mm	2.5	2.5	2.5		
		ITRV and TRV of CB interrupter		IEC	IEC	IEC		