BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP
ENGINEERING MANAGEMENT, NOIDA, SECTOR-142

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Title: 420 kV Circuit Breaker		Date	22.04.15	22.04.15	22.04.15
		Group	TBEM		

CUSTOMER: **TELANGANA STATE POWER GENERATION CORPORATION LTD.**

PROJECT: **1x800 MW KOTHAGUDEM TPS – 400 kV SWITCHYARD & 4x270 MW BHADRADRI TPS – 400 kV SWITCHYARD**

LOI NO: **CEE/111/KTPS-VII(1X800MW)/D.No. 150/14, Dated: 27/12/2014 & CEE/SE-IV/BHADRADRI TPS (4X270MW)/D.No.72/15, Dated:21/03/2015**

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SECTION – 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Circuit Breaker complete with accessories as listed under this specification.

This section covers the specific technical requirements of Circuit Breaker. This constitutes minimum technical parameters for the above item as specified by the customer (TSGENCO). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:

Section-1: Scope, Specific Technical Requirements and Quantities.
Section-2: Equipment Specification
Section-3: General Technical Requirements
Section-4: Guaranteed Technical Particulars

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer : Telangana State Power Generation Corp. Ltd.
Name of the project 1 : 400 kV Switchyard at Kothagudem TPS-VII
Name of the project 2 : 400 kV Switchyard at Bhadradri TPS

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

Technical parameters

Rated voltage kV (rms)	:	420
Nominal system voltage kV (rms)	:	400
Rated frequency (Hz)	:	50 Hz, +3% to -5%
No. of poles	:	3- Single Pole
Design ambient Temperature (deg. C)	:	50
Applicable Standard	:	IEC 62271-100, 60694, IS:12729

Class

i)	Mechanical Endurance Class	: M1
ii)	Electrical Endurance Class	: E1
iii)	Restrike Probability Class	: C1
iv)	Electromagnetic Compatibility (EMC)	: As per IS 12729 / IEC 60694 Normal Severity Class

1) Rated Lightning Impulse withstand voltage

- between phase to earth : ± 1425 kVp
- between phases to CB open : ± 1425 kVp
- across isolating distance (impulse on one terminal and other terminal earthed) : ± 1425 (+240)* kVp

* Figure given in bracket ( ) are the peak value of the power frequency to be applied to the opposite terminal (across isolating distance)

2) Rated Switching Impulse withstand voltage

- between phase to earth : ± 1050 kVp
- between phases : ± 1575 kVp
- across isolating distance : ± 900 (+345)* kVp

* Figure given in bracket ( ) are the peak value of the power frequency to be applied to the opposite terminal (across isolating distance)

3) One minute power frequency dry and wet withstand voltage

- across isolating distance : 610 kV (rms)
- to earth and between poles : 520 kV (rms)

Max. radio interference Voltage (microvolts) : Less than 1000
(Voltage at 1.1 Urated/sq.. rt. 3)

Corona extinction voltage (kVrms) : 320 (min)

Minimum creepage distance: : 10500 mm

System neutral earthing : Effectively Earthed

Seismic acceleration : ----------0.3g horizontal------

Rating of auxiliary contracts	: --------10 A at 220 V DC-------
Breaking capacity of auxiliary contacts	: 2 A DC with circuit time constant of not less than 20 ms
Phase to phase spacing (mm)	: 7000 mm
Rated continuous current at 50 °C Ambient temperature	: 3150A
Rated short circuit current breaking capacity at rated Voltage (Symmetrical)	: 50 kA with percentage of DC component as per IEC 62271-100 Corresponding to Minimum opening time under operating conditions specified
Rated peak withstand current (kAp)	: 125
Symmetrical interrupting capability (kA rms)	: 50
Short time current duration	: 3-second
Rated short time making current (kAp)	: 125
Short time current carrying capability for 3 second (kArms)	: 50
Out of phase breaking current capacity (kArms)	: 12.5
Rated line/cable charging Interrupting current at 90 deg. leading power factor angle (A.rms)	: ------as per IEC------

(The breaker shall be able to interrupt the rated line/cable charging current with the test voltage immediately before opening equal to the product of U/√3 and 1.4 as per IEC - 62271-100)

Maximum allowable switching over-voltage under any switching condition.	: ------as per IEC------
Total break time	: ------as per IEC------

Opening time (ms)		: not more than 40
Closing time (ms)	:	Not more than 100
Rated operating duty	:	O-0.3 sec.-CO-3 min-CO cycle
Auto re-closing	:	Single & three phase
Operating mechanism	:	Spring operated
Trip coil and closing coil voltage	:	220 volt DC with variation as specified
Auxiliary contacts		: a) besides requirement of this spec., the bidder shall wire up 14 NO + 14 NC contacts for exclusively use of purchaser. b) Local Position – 1NO c) Close Position – 1NO
SF6 Gas		: As per IEC60376 & 61634
Noise level at base and upto 50 m.(distance from base of breaker)	:	---------140 dB (max)----------
Anti-pumping	:	Required.
Rated terminal load	:	As per IEC 62271-100 or calculated value whichever is higher
Temperature rise over the design ambient temperature	:	-----As per IEC 62271-100-------
First pole to clear factor	:	----------1.3----------
Number of terminals in common control cabinet	:	all contracts and control circuits are to be wired out upto common control cabinet plus 24 terminals exclusively for purchaser's use
Rated small inductive current Switching capability with Over-voltage less than 2.3 p.u.(A)	:	----------0.5 to 10A----------

1.3 QUANTITIES

A) Main Item

Sl. No.	Description	Unit	Quantity	
			Kothagudem	**Bhadradri**
01.	420 kV, 3150 A, 50 kA (3sec.), 3-ph, SF6 Circuit Breaker without PIR and spring-spring operating mechanism including corona shielding, operating mechanism, Insulators, base frame, HV terminal Plates, control cabinet, support structure, fixing bolts, cable glands and other accessories, complete in all respects.	Nos.	03	18
02.	420 kV, 3150 A, 50 kA (3sec.), 3-ph, SF6 Circuit Breaker with PIR and spring-spring operating mechanism including corona shielding, operating mechanism, Insulators, base frame, HV terminal Plates, control cabinet, support structure, fixing bolts, cable glands and other accessories, complete in all respects.	Nos.	08	-
03.	Circuit Breaker Accessories			
i)	Portable type SF6 Gas filling and evacuating plant	Nos.	1	1
ii)	SF6 leakage detector	Nos.	2	1
iii)	Circuit Breaker Operational Analyzer	Nos.	1	-
iv)	SF6 Gas (20% of total quantity ie. quantity used for 11 nos. circuit breaker for **Kothagudem** & 18 nos. circuit breaker for **Bhadradri**)	Lot	1	1

Note: Test equipment under circuit breaker accessories (Main Item Sl. No.3) shall be of reputed make and subject to customer approval.

B) Mandatory Spare:

i) Kothagudem

Sl. No.	Description	Unit	Quantity
1	Complete pole with column and interrupter and operating mechanism but without support structure	Nos.	1
2	Rubber gaskets, 'O' rings and seals (Complete replacement for one breaker)	Sets	3
3	Trip coils with resistor	Nos.	3
4	Closing coils with resistor	Nos.	3
5	Set of fixed contact contacts, moving contacts and contacts for pre-insertion resistor.	Sets	3
6	Pre-insertion resistor.	Nos.	3

7	Molecular filter for SF6 Circuit for 1 pole	Sets	1
8	Gas density monitor	Nos.	2
9	Operating mechanism with motor	Nos.	2
10	Fixed, moving and arcing contacts of 1 pole	Set	1
11	Aux. Switch	Set	1
12	Air pressure switch	Nos.	1
13	SF6 gas pressure switch	Nos.	1
14	Air pressure gauge	Nos.	1
15	Contacts for circuit	Nos.	1
16	MCB/MCCB for DC Circuit	Nos.	1
17	MCB/MCCB for AC Circuit	Nos.	1
18	Spare fuses for each type and rating	Sets	2
19	Auxiliary relay	Sets	1
20	Complete set of gaskets	Sets	2
21	Set of seals	Sets	2
22	Isolation valves, control valves & safety valves for air or oil system	Sets	1

ii) Bhadradri

Sl. No.	Description	Unit	Quantity
1	Complete Pole of circuit breaker including grading capacitor, pole column, interrupter, with driving mechanism and Marshaling Box but without support structure for without PIR	Nos.	1
2	Grading Capacitor(if applicable)	Nos.	1
3	Rubber gaskets, 'O' rings and seals (Complete replacement for one breaker)	Sets	1
4	Trip coils with resistor	Nos.	2
5	Closing coils with resistor	Nos.	1
6	Terminal Pads	Nos.	2
7	Molecular filter	Nos.	2
8	Corona Rings	Nos.	1
9	Relays, Power contactors, switch fuse units, limit switches, push buttons, timers & MCB etc.	Sets	1
10	Pressure switches of each type	Sets	1
11	Auxiliary switch assembly	Sets	1

C) **Supervision of Erection, Commissioning & Site Testing:**

i) **Kothagudem**

Sl. no.	Description	Unit	Quantity
1.	Supervision of Erection ,Testing & Commissioning of all 420kV Breakers with special tools and test instruments* in Bidder scope (1 lot =11 CBs)	lot	1

ii) **Bhadradri**

Sl. no.	Description	Unit	Quantity
1.	Supervision of Erection ,Testing & Commissioning of all 420kV Breakers with special tools and test instruments* in Bidder scope (1 lot =18 CBs)	lot	1

Note:1 The Supervision of testing and commissioning shall be inclusive of the following:

i. Testing equipments required for testing.
ii. To and Fro fares from Bidder's headquarter to BHEL site.
iii. Accommodation and conveyance at site.
iv. Any other incidental charges.

No other charges shall be paid by BHEL.

Note: 2

1. '*' - The following instruments/kits shall be brought out at site by Bidder/supplier:
   (a) Time Interval meter (Timing kit)
   (b) Gas leak Detector

   The following instruments/kits shall be provided by BHEL at site:
   (a) Circuit Breaker Analyzer- (Make- SCOPE T&M HISAC 2406) - Adaptor/Transducer for above Analyzer suitable for your Breaker shall be in scope of bidder.
   (b) DCRM
   (c) Dew Point Meter
   (d) Megger
   (e) Multimeter

1.4 Pre-qualification Requirement

SF6 Circuit Breakers being offered should be from manufacturer who has manufactured and supplied minimum fifteen (15) nos. of SF6 Circuit Breakers of offered voltage class or higher, and which must have been in successful operation for a minimum period of two (2) years as on date of Techno-Commercial bid opening.

1.5 TYPE TESTS

Bidder shall submit valid type test reports (as per relevant IEC/IS standard) for the tests carried out within last five years from the date of LOA. The reports should have been conducted on identical or similar equipment/components to those offered. In case type test reports are more than 5 years old (from the date of LOA) or the reports of type tests are found to be technically unacceptable, the type test shall be conducted by the vendor without cost and delivery implication to BHEL.

In addition to type test report, test reports of following additional type tests shall be provided.

Sl No.	Additional type test On 420kV Circuit Breaker
1	Short line fault test
2	Out of phase making and breaking test as per IEC.
3	Rated line charging current breaking test. The breaker shall be able to interrupt the line charging current with a test voltage of 1.4 p.u. instead of 1.2 p.u. as per IEC.
4	Test to demonstrate ability to withstand 2.5 times the rated voltage across the open circuit breaker at & below lockout pressure.
5	Seismic withstand test in unpressurised condition.

1.6 INSPECTION & TESTING

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, provided by the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on each item in accordance with the applicable IEC/IS and the material shall be offered for final inspection by BHEL and TSGENCO in accordance with agreed quality plan with 3 weeks advance information. The charges for these shall be deemed to be included in the equipment price.

1.7 QUALITY PLAN

The contractor shall carry out contract works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval.

1.8 TITLE BLOCK

The drawings / documents submitted shall be project and product specific and shall incorporate following details:

A) Kothagudem TPS

a) Project Name : 400 kV Switchyard at Kothagudem TPS-VII

b) Customer Name : Telangana State Power Generation Corp. Ltd.
c) Consultant Name : DCPL
d) Contractor : BHEL
e) Customer LOA no.: CEE/111/KTPS-VII(1X800MW)/D.No. 150/14, Dated: 27/12/2014

B) Bhadradri TPS

a) Project Name : 400 kV Switchyard at Bhadradri TPS
b) Customer Name : Telangana State Power Generation Corp. Ltd.
c) Consultant Name : DESIN
d) Contractor : BHEL
e) Customer LOA no.: CEE/SE-IV/BHADRADRI TPS (4X270MW)/D.No.72/15, Dated: 21/03/2015

1.9 Drawings / Documents

In addition to no. of sets of documents to be submitted to customer (refer section 3), two sets of all documents submitted for approval / information and five sets of all approved documents shall be provided for BHEL use.

Soft copies in CD-R of documents shall comprise

i) Scanned images of all approved documents, including drawings.
ii) Editable versions (AUTO CAD 2000 or High) of all drawings viz. drawings, GTP, Manufacturing and field quality plan, type test reports, O & M instructions / manuals.
iii) Foundation bolt distances marked drawing of base plate of support structure shall be submitted for design of foundation.

SECTION - 2

EQUIPMENT SPECIFICATION

1.0 Circuit Breaker

Each circuit breaker shall be furnished complete with:

i) Fittings and accessories. (As per annexure B)
ii) Auxiliary equipment. (As per annexure B)
iii) First filling of SF6 gas plus 20% spare.

The equipment will be used in the switchyard having characteristics as listed in the section 1.

The equipment will be installed outdoor in a hot, humid and tropical atmosphere.

All equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.

1.1 Type and Duty

The circuit breaker shall be three single pole, sulphur hexafluoride (SF6) type, having internal isolation without any sequential interlock.

The circuit breaker shall be restrike free as per IEC under all duty conditions and shall be capable of performing their duties without opening resistors.

The duty of the circuit breaker shall involve satisfactory interruption of short circuit currents as listed in the annexure.

The breaker shall be suitable for operation even under condition of "phase opposition" arising out of faulty synchronisation.

The breaker shall be capable of clearing the "Kilometric" fault of same magnitude as rated short-circuit current.

The breaker shall be capable of interruption of low reactive currents (lagging/leading) without undue over voltage.

Breakers with multi-break interruptions shall be so designed that the voltage developed across a pole is uniformly distributed over the power breaks.

The circuit breaker shall be capable of :

i) Interrupting line/cable charging current as per IEC without any restrike and without use of opening resistors.

ii) Clearing short line fault (kilometer faults) with source impedance behind the bus equivalent to symmetrical fault current specified.

iii) Breaking 25% of the rated fault current at twice rated voltage under phase

opposition condition.

1.2 Constructional Feature

Each circuit-breaker shall comprise of three (3) identical poles complete with individual operating mechanism for specified duty. Three poles shall be linked together electrically for simultaneous closing.

The circuit-breaker shall be single pressure type. The design and construction shall be such that there is minimum possibility of gas leakage and ingress of moisture. Further, the arrangement shall be such that condensation of SF6 gas on the internal insulating surfaces of the circuit breaker must not occur under any condition.
Each pole shall form an enclosure filled with SF6 gas independent of two other poles. The SF6 gas density of each pole shall be monitored and regulated by individual temperature compensated gas density monitoring devices, which shall be mounted at a convenient and easily approachable location. The device shall have provision for low gas pressure alarm and breaker lockout arrangement. Also pressure gauge shall be mounted at a convenient height so that gas pressure can be visually observed.

The circuit-breaker shall have proper sealing so that leakage of gas outside is not more than 1% per annum under all conditions of operation. Further, it shall incorporate devices to absorb any moisture which may exist/be released within breaker poles after assembly, gas charging and during operation. The devices shall be so located as to permit easy removal/replacement.

The operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals. All gasketted surfaces shall be smooth, straight and reinforced, if necessary, to minimise distortion and make a tight seal.

The circuit-breaker units shall be complete with associated valves, piping, gauges, pressure switches, seals, lubricants and other accessories/materials to ensure proper assembly and functioning.

Suitable means shall be provided in the gas chamber of circuit breaker for pressure relief so as to avoid damages or distortion during occurrence of abnormal pressure increase or shock waves generated by internal electric fault arcs. The position of vents, diaphragms and pressure relief devices, if provided, shall be so arranged as to minimise danger to personnel in the event of gas or vapour escaping under pressure.

Breaker shall be furnished with first charge of SF6 gas plus additional 20% of total gas used which shall be supplied in non-returnable gas cylinders as spare for future use.

The SF6 gas shall be supplied in properly treated steel cylinder of adequate strength. Chemical analysis of gas supplied shall be furnished for Owner/Purchaser's reference.

The circuit breaker shall be provided with terminal pads of adequate size for connection to Rigid Aluminum tube by expansion type terminal connector. Adequate transversal and vertical force shall be considered for the terminals so as to support the interconnecting tubes spanning around 10 meters during short circuit and wind force.

1.3 Main Contacts and Arc Quenching Chamber

i) The main contacts shall have adequate area and contact pressure for carrying rated continuous and short time current without excessive heating liable to cause pitting and welding. Contacts shall be permanently under pressure of SF6 gas.

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

iii) The tips of the arcing and main contacts shall be heavily silver-plated.

iv) The contacts shall be adjustable to allow for wear, shall be easily replaceable and shall have minimum movable parts and adjustments.

v) Main contacts shall be first to open and last to close so that there will be little contact burning and wear.

vi) Arcing contacts shall be first to close and last to open and shall be easily accessible for inspection and replacement.

vii) The arc quenching device shall be of robust construction and shall not require any critical adjustment. The devices shall be easily accessible and removable for access to the breaker contacts.

1.4 Accessories and Attachments

i) Circuit breaker operation analyser shall be supplied to record contact travel, speed and for making measurement of operating timings, pre-insertion timing of closing resistors, synchronization of contacts in one pole or all poles

ii) The SF6 gas density monitor shall be dial type and properly temperature compensated. The sensing probe of SF6 gas leaked detector shall be able to reach all the points on the breaker where leakage is to be sensed. The accuracy of the equipment shall be at least 10 ppm. It shall be free from induced voltage effect.

The density monitor shall meet the following requirements:

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

b) It shall damp pressure pulsation while filling the gas in service so that flickering of the pressure switch contacts does not take place.

iii) A Portable SF6 gas filling and evacuating system shall be supplied with necessary gas valves, gas cylinders, safety devices, gas purity monitoring devices, regulators, vacuum pump, pressure gauges/switches, hose pipes etc.

1.5 Auxiliary Contacts

i) The auxiliary switches required for satisfactory operation of the circuit breaker including auto reclosing (Single shot, single and 3 phase) ON/OFF indicators

both in control room and switchyard, discrepancy switch in the mimic diagram in the control room and antipumping features shall be provided on each circuit breaker. In addition, each breaker shall be provided with six (6) normally open and six (6) normally closed electrically separate spare auxiliary contacts, in addition to those required for its own operation and indication.

ii) The auxiliary contacts shall be rated 10A at 240 V A.C. and 5A at 220 V D.C with circuit time constant of at least 20 millisecond.

1.6 Control & Interlock

i) All electrical and mechanical interlocks which are necessary for safe and satisfactory operation of the circuit breaker shall be furnished. Breaker operation shall be locked in case of low SF6 gas pressure at preset values. Alarms shall be provided for low gas pressure at values higher than lock-out pressure of SF6 gas. It is intended that before lock-out occurs, the breaker shall be in trip position.

ii) The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.

iii) The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. Provision shall be made for local electrical/local manual control. For this purpose, local/remote selector switch, close & trip control switch, auxiliary relays, indication lamps etc. shall be provided in the control cabinet for the breaker. In addition local manual emergency trip button shall be provided.

iv) Gas analyser contacts, pressure switch contacts, etc. shall be suitable for direct use as permissive in closing, tripping, annunciation and control circuits. DC supplies for all auxiliary circuits shall be monitored and provision shall be made for remote annunciations.

1.7 Insulators

i) Insulator shall be wet-process porcelain, brown glazed and free from all blemishes. Metal parts and hardware shall be hot-dip galvanised.

ii) Insulator shall have adequate mechanical strength and rigidity to withstand the duty involved.

iii) When operated at maximum system voltage, there shall be no electrical discharge. Shielding rings, if necessary, shall be provided.

iv) Insulation shall be coordinated with basic impulse level of the system. The creepage distance shall correspond to heavily polluted atmosphere.

v) All routine tests shall be conducted on insulators as per IEC233/ relevant IS in addition to the following tests :

a) Ultrasonic test.
b) Pressure test.

c) Bending load test in four directions at 50% specified bending load.

d) Bending load test in four directions at 100% specified bending load as acceptance test of lot.

e) Burst pressure test as a sample test.

vi) The insulator porcelain shall be in one integral place in green and fired stage. No jointed porcelain is acceptable.

1.8 Operating Mechanism

i) Operating mechanism shall be stored energy type, with motor operated spring – spring charged closing mechanism. Anti-pumping and trip free features complete with 2x100% shunt trip coils shall be provided. The mechanism of the breaker shall be such that the position of the breaker is maintained even after leakage of operating media and/or gas.

ii) The operating mechanism shall be suitable for high speed reclosing (single phase and three phase). It shall be anti-pumping and trip free (as per IEC definition) electrically and either mechanically or pneumatically under every method of closing (except during manual closing of a breaker for maintenance). A latch checking switch shall be provided on mechanically trip free mechanism to prevent reclosure before the breaker latches have reset.

iii) 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.

iv) The operating mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operation of the power operated closing devices.

v) Mechanical indicator shall be provided to show open and close positions of each pole of the circuit breaker. It shall be located in a position where it will be visible to a man standing on the ground. An operation counter at 1000-1300 mm level shall also be provided. The counter readings shall be visible from the ground even with the mechanism housing closed.

vi) Closing coil shall operate correctly at all values of voltage between 85% & 110% of the rated voltage. Similarly trip coil shall operate correctly at all values of voltage between 70% & 110% of the rated voltage. If additional elements are introduced in the trip coil circuit, their successful operation for similar applications on outdoor breakers shall be clearly brought out in the appropriate schedule.

vii) The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.

viii) Each breaker pole shall be provided with two (2) independent tripping circuits, valves, pressure switches and coils each connected to a different set of protective relays. The trip coils shall be suitable for trip circuit supervision during both open & close positions of the breaker
and the closing coil shall be suitable for pre-close supervision.

ix) The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

x) All three breaker poles shall operate simultaneously. Pole discrepancy feature shall be provided to trip the breaker out if all the poles do not close simultaneously within the stipulated time.

1.9 Spring operated mechanism

Spring operated mechanism shall be complete with motor, opening spring and closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.

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

After failure of power supply to the motor one close open operation shall be possible with the energy contained in the operating mechanism.

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. The motor rating shall be such that it requires not more than 30 seconds for full charging of the closing spring.

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

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

Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition. Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is already in the closed position.

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 the tripping energy is derived from the operating mechanism.

1.10 Sulphur Hexafluoride (SF6) Gas

i) The SF6 gas shall be new and comply with relevant IEC/IS and shall be suitable in all respects for use in the circuit breakers under the various operating conditions.

ii) SF6 gas shall be tested for quality, dew point, air, hydrolysable fluorides and water content as per IEC quoted above and test
certificates shall be furnished covering all tests for each lot of SF6 gas. Further site test for moisture and air content to be done prior to commissioning of the breaker. Variation of SF6 gas pressure with

temperature curves shall be furnished.

iii) The high-pressure cylinders in which SF6 gas is shipped and stored at site shall comply with requirements of the following standards and regulations : IS-4379, IS-7311

The cylinders shall also meet Indian Boiler Regulations.

1.11 Control Cubicle

1.12 A common control cubicle shall be furnished to house electrical, controls, monitoring devices and all other accessories except those, which must be located on individual poles.

1.13 The cubicle shall be IP-55, of gasketted weatherproof construction, fabricated from sheet steel minimum 2 mm thick.

1.14 The cubicle shall have front access door with lock & keys and removable gland plate at the bottom.

1.15 Thermostat controlled space heater, internal illumination lamp and 5-pin 5A socket with individual ON-OFF switches shall be provided in the cubicle.

1.16 For local operation, following shall be provided :

1.16.1 LOCAL/REMOTE selector switch.
1.16.2 TRIP/CLOSE push buttons.

1.17 All electrical, pneumatic connections between the control cubicle and individual poles shall be furnished.

1.12 Wiring

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

1.14 DC circuit for trip coil 1 & 2 shall be wired separately so as to connect with duplicate DC supply from two independent sources.

1.15 Wiring shall be done with flexible 1100V grade, fire resistant, PVC insulated, switchboard wires with 2.5 mm^2 stranded copper conductor. Wiring between individual poles and control cubicle shall be routed through rigid G.I. conduit or / and metallic flexible conduits.

1.16 Each wire shall be identified at both ends with permanent markers bearing wire numbers as per Contractor's wiring diagram. AC/DC wiring shall have separate colour-coding.

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

vi) All spare contacts of relays, push buttons, auxiliary switches etc. shall be wired up to terminal blocks in the control cubicle.

1.13 Terminal Blocks

i) 1100V grade, multi way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the wiring. Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm2 stranded copper conductor and provided with acrylic insulating cover.

ii) Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Separate terminal blocks shall be used for AC/ DC wiring termination.

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

iv) Terminal blocks used for interface with DCS via termination cabinet shall be suitably sized to facilitate proper termination of interconnecting cables.

1.14 Support Structures

The equipment shall be supplied with support structures, which are integral part of the breaker.

All support structure shall be hot dip galvanized with minimum 610 gram/sq.m of zinc after full chemical treatment as per relevant standard.

The height of the support structure shall be decided based on, whichever is higher, of the following:

a. The minimum vertical distance from the bottom of lowest porcelain part of the bushing shall be at least 2440 mm from top of the plinth level of the foundation.

b. The height of the lower terminal pad at the specified elevation above the plinth level.

The design of the structure shall be submitted for approval.

1.15 Name Plate

Each circuit breaker and its operating devices shall be provided with nameplate clearly marked the particulars in accordance with IEC.

The nameplate shall be provided in visible portion of normal service and installation.

1.16 Grounding

Each circuit breaker shall be provided with two ground pads for connection to station ground mat.

The ground pad shall comprise buffed metal surface with two holes, M10 G.I. bolts and spring washers to receive 75x12 mm G.I. flat.

1.17 TESTS

1.17.1 Routine Test

During manufacture and on completion, all equipment accessories shall be subjected to the Routine Tests as laid down in latest revision of IEC/IS.

In addition to above tests specified by IEC/IS, the following tests also have to be carried out for specific equipments:

i) The speed curves for EHV circuit breaker shall with the help of a suitable operation analyser to determine the breaker contact movement during opening, closing, auto-reclosing and trip-free operation under normal as well as limiting operating conditions (Control Voltage, pneumatic pressure etc.)

Type Test

Type tests on all equipment shall be carried out as stipulated in relevant IEC/Indian Standards. Test certificates for type tests, as stipulated in Indian Standards carried out on similar equipment clamps, connectors etc. shall be furnished.

Test certificates for following additional type tests shall also be furnished:

i) Short line fault test

ii) Out of phase making and breaking test as per IEC.

iii) Rated line charging current breaking test. The breaker shall be able to interrupt the line charging current with a test voltage of 1.4 p.u. instead of 1.2 p.u. as per IEC.

iv) Test to demonstrate ability to withstand 2.5 times the rated voltage across the open circuit breaker at & below lockout pressure.

v) Seismic withstand test in unpressurised condition.

1.18 APPLICABLE STANDARDS

The circuit breakers shall strictly conform to the following Indian and International standards as appropriate:

IEC 60056 (1987)	Specification for high voltage alternating-current circuit breaker.
IEC 376: 1971	Specification and acceptance of new sulphur hexaflouride.
IEC 376A: 1973	First supplement - Section 13 : Mineral oil contents
IEC 376B: 1974	Second supplement: Clause 26
IEC 62271-100	High voltage Switchgear and control gear, HV-AC Circuit Breaker

IS 13947 (Part 1):1993	Low voltage switchgear and control gear, General rules
IS 13947 (Part 2): 1993	Low voltage switchgear and control gear, Circuit Breakers.
IS 325: 1978	Three phase induction motors.
IS 2629: 1985	Recommended practices for hot dip galvanizing on iron and steel.
IEC 60 (Part 1) 1989	High voltage test techniques, General definition and test requirement.
IEC 60 (Part 3): 1976	Measuring devices
IEC 60 (Part 4):1977	Application guide for measuring devices
IEC 60694: 1980/ 1996	Common clauses for high voltage switchgear and controlgear standards
IEC 71 (Part 1): 1993	Insulation coordination, Definition Principle and rules
IEC 71 (Part 2): 1976	Insulation coordination, Application Guide
CIGRE WG Report No. 13-02-1973	Switching over-voltage in EHV and UHV systems with special reference to closing and re-closing transmission lines
IS 2633 : 1986	Method for Testing Uniformity of coating on zinc coated articles.
IS 2544 : 1973	Specification for Porcelain Post Insulators for systems with nominal voltages greater than 1000 volts.
IS 5561 : 1970	Electric Power Connectors.
IS 5621 : 1980	Hollow insulators for use in electrical equipments.
IEC 233 : 1974	Tests on hollow insulators for use in Electrical Equipment.
IS 4379 : 1981	Identification of contents & industrial gas cylinders.
IS 7285 : 1988	Seamless steel cylinders for permanent and high pressure liquifiable gases.
IEC 427(1989)	Synthetic testing of High Voltage alternating current Circuit Breaker

ANNEXURE-B

FITTINGS & ACCESSORIES

A. **Circuit Breaker**

A.I Each Circuit Breaker shall be furnished complete with fittings and accessories as listed below :

1. Operating mechanism complete with all accessories, fittings and double tripping coils and closing coil, pole discrepancy feature and low pressure blocking device etc. as required.
2. Complete SF6 gas system along with valves, pressure switches, pressure gauges, SF6 gas density monitor, etc.
3. Various attachments & accessories for gas filling.
4. Two ground pads per pole suitable for termination of 75 x 10 mm M.S. flats.
5. Base frame and anchor bolts and nuts.
6. Set of valves, pressure gauges and pressure switches as required.
7. Auxiliary contacts and relays.
8. LOCAL/REMOTE Selector switch, TRIP/CLOSE Push Buttons.
9. Manual tripping devices with protective flap.
10. Mechanical ON-OFF indicator.
11. Operation counters.
12. Weatherproof outdoor type control cubicle and pole boxes having IPW55 enclosure.
13. Set of switch fuse units/MCCB for A.C. and D.C. supply.
14. Space heater with thermostat and ON-OFF switch.
15. Cubicle illumination lamp with ON-OFF switch.
16. 3 Pin 5A Socket with ON-OFF Switch.
17. Terminal blocks and internal wiring - lot as required.
18. Set of pre-fabricated copper pipe with fittings, clamps, and hardware for connection between control cubicle and pole boxes as required.
19. Interconnecting wires, G.I. conduits and accessories for connection between control cubicle and pole boxes.
20. The gas filling and internal pressure monitoring devices per pole for SF6 breakers.
21. Other standard accessories which are not specifically mentioned but supplied with breakers of similar type and rating for efficient and trouble-free operation.
22. ~~First filling of SF6 gas along with 20 % additional for the complete lot in non returnable container.~~
23. Supporting galvanized steel structure.
24. Other standard accessories, which are not specifically mentioned but are usually provided with current transformers of such type and rating for efficient and trouble-free operation.

A.II Auxiliary Equipment Common for All Circuit Breakers

1. Portable SF6 gas evacuation and filing system with necessary gas valves, gas cylinders, safety devices, gas purity monitoring devices, regulators, vacuum pump, pressure gauges/switches, hose pipes etc. (One set)
2. Portable SF6 gas leaked detectors (2 sets)
3. Operational analyser to record contact travel, speed and for making measurement of operating timings, synchronisation of contacts in one pole or all poles. (One set)

SECTION - 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

GENERAL TECHNICAL REQUIREMENTS

1.0 PROJECT DETAILS

A) Kothagudem TPS

A)

Customer	:	M/s Telangana State Power Generation Corporation Ltd.
Project Title	:	1x800MW Kothagudem Thermal Power Station Stage VII, Unit 12
Project Location	:	Paloncha Village, Khammam District, Telangana
Nearest Railway station	:	Bhadrachalam Road railway station.
Nearest Road Head	:	Khammam 16 km approx., Nearest Highway NH221 (Vijaywada – Jagdalpur Highway).
Nearest Airport	:	Hyderabad (about 200 Km)
Postal Address	:	Chief Engineer (O&M), Kothagudem Thermal Power Station Stage VII, Unit – 12, TSGENCO, Village - Paloncha, Dist. – Khammam, Telangana -507115

B) Bhadradri TPS

Customer	:	M/s Telangana State Power Generation Corporation Ltd.
Project Title	:	4x270MW Bhadradri Thermal Power Station
Project Location	:	Ramanujavaram Village, Khammam District, Telangana
Nearest Railway station	:	Manuguru railway station.
Nearest Road Head	:	Khammam
Nearest Airport	:	Hyderabad (about 345 Km)
Postal Address	:	Chief Engineer (O&M), Bhadradri Thermal Power Station Stage TSGENCO, Village - Ramanujavaram, Dist. – Khammam, Telangana

1.1 SITE CONDITIONS (FOR DESIGN PURPOSES)

1.1.1 SITE CONDITIONS

a). Average rainfall per year : 1124 mm

b). Maximum hourly rainfall intensity : 102 mm

c). Altitude : 1000 m

1.1.2 DESIGN AMBIENT

a). Minimum Temperature : 13.5°C

b). Maximum Temperature : 45°C

c). Design Ambient Temperature : 50 °C

1.1.3 RELATIVE HUMIDITY

a). Maximum :: 85%

1.1.4 WIND PRESSURE (AS PER IS:875-1987)

a). Design wind speed : 44 m/sec.

1.1.5 SEISMIC FACTORS

a). Horizontal Seismic Coefficient : As per latest IS : 1893

b). Vertical Seismic Coefficient : As per latest IS : 1893

} *Zone – III*

1.1.6 ELECTRICAL DATA

		400 kV System	415V AC System	240V AC System	220 V DC System	48 V DC System
I.	Nominal Voltage	400 kV	415 V	240 V	220 V	48 V
2.	Highest System Voltage	420 kV	457 V	264 V	242 V	55 V
3.	No. of phases	3	3	1	NA	NA
4.	Frequency	50 Hz	50 Hz	50 Hz	NA	NA
5.	Voltage variation	± 5%	±10 %	±10 %	+10 % to -15%	±10 %

6.	Neutral Earthing	Effectively Earthed	Solidly Earthed	Solidly Earthed	-	-
7.	Fault Level	50 kA for 1 sec.	50 kA for 1 sec.	50 kA for 1 sec.	15 kA for 1 sec.	-

1.1.7 SYSTEM PARAMETERS

Dry and wet one minute power frequency withstand voltage	630 kVrms
Dry impulse withstand voltage positive and negative	1425 kVpeak
Minimum Total Creepage	25 mm/kV

1.1.8 MINIMUM CLEARENCE (AS PER IS: 10118)

Phase to phase (PP)	4200 mm
Phase to earth (PE)	3500 mm
Section clearance	6500 mm
Minimum ground clearance from plinth level (Plinth level : 300 mm)	8000 mm
Vertical ground clearance to nearest part not at earth potential of an insulator supporting live conductor/ equipment	2440 mm

1.2 INSTRUCTION TO BIDDERS

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification. It is recognised that the Manufacturer may have standardised on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously.

1.3 STANDARDS

The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

The equipment to be furnished under this specification shall conform to latest issue (with all amendments) of specified standards.

In addition to meeting the specific requirement called for in Sections 1 and 2 of the Technical Specification, the equipment shall also conform to the general requirement of the applicable standards, which shall form an integral part of the specification. The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other. When the specific requirements stipulated in the specifications exceed or differ from those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards, which ensure equivalent or better performance than that specified in the standards referred, shall also be accepted. The bidder shall submit copies of such standards.

In case governing standard for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in the offer along with English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's / owner's approval. The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

1.4 TYPE TESTING/INSPECTION/TESTING & INSPECTION CERTIFICATE

All equipment being supplied shall conform to type tests and shall be subject to routine and acceptance tests in accordance with requirements stipulated under respective sections. Purchaser reserves the right to witness any or all the tests. The Manufacturer shall intimate the Purchaser the detailed programme about the tests at least three (3) weeks in advance in
case of domestic supplies & six (6) weeks in advance in case of foreign supplies. Purchaser reserves the option for getting any or all the type tests repeated on the equipment. The Manufacturer shall also submit type test procedure for approval of the Purchaser.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the technical specification or any/all additional type tests not carried out without any additional cost implication to the Purchaser.

The price of conducting all tests and additional type tests is deemed to be included in Bid price. In case any bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.

The purchaser intends to repeat the type tests and additional type tests on cables for which test charges shall be payable as per provision of contract.

The Purchaser, his duly authorised representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractors premises or Works and shall have the power, at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if pert of the Works is being manufactured or assembled at other premises or works, the Manufacturer shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Manufacturer's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

The Manufacturer shall give the Purchaser/inspector thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Manufacturer's account except for the expenses of the inspector. Unless witnessing of the tests is virtually waived, the Purchaser/ inspector will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, failing which the Manufacturer may proceed with the test which shall be deemed to have been made in the Inspector's presence and the Manufacturer shall forthwith forward duly certified copies of test reports in triplicate to the Inspector.

The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein, give notice in writing to the Manufacturer, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Manufacturer shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser/ inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

When the factory tests have been completed at the Manufacturer's works, the Purchaser/ inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser/inspector, the certificate shall be issued within fifteen (15) days of receipt of the Manufacturer's Test certificate by the Engineer/ Inspector. Failure of the Purchaser/inspector to issue such a certificate shall not prevent the Manufacturer from proceeding with the Works. The completion of this test or the issue of the certificate shall not bind the Purchaser to accept the equipment should it, on further tests/ after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of MICC by the Purchaser.

In all cases where the Contract provides for tests whether at the premises or at the works of the Manufacturer or of any Sub-Contractor, the Manufacturer except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser Inspector or to his authorised representative to accomplish testing.

The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Manufacturer in respect of the agreed quality assurance programme forming a part of the Contract.

The Purchaser will have the right of having at his own expenses any other test(s) of reasonable nature carded out at Manufacturer's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Purchaser.

1.5 MATERIAL/WORKMANSHIP

1.5.1 GENERAL REQUIREMENT

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purposes for which they are intended.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfil their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be construed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting,

levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances /instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits. Suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case, he shall declare in the proposal where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

1.5.2 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

1.6 COLOUR SCHEME AND COLOUR CODING

The contractor shall propose a colour scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade 631 of IS-5. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

1.7 PAINTING

a) All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with IS: 6005 "Code of practice for Phosphating Iron and Steel".

b) Oil, grease, dirt and swerve shall be thoroughly removed from emulsion by cleaning.

c) Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

d) After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute bichromate solution and over drying.

e) The phosphate coating shall be sealed by the application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "Flash dried" while the second coat shall be stoved.

f) After application of the primer, two coats of finishing epoxy paint shall be applied, each coat followed by stoving. The panel shall have colour conforming to shade 631 of IS-5 for outside and inside of the panel with black colour for base frame.

g) Each coat of primer and finishing paint shall be of a slightly different shade to enable inspection of the painting.

h) Finished painted appearance of panel shall present an asthetically pleasing appearance free from dents and uneven surface.

i) A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panels.

1.8 PROTECTION

a) All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

b) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.

c) The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

d) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

1.9 FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

1.10 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be throughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for paintaing shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

1.11 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvasized. Minimum weight of zinc coating shall be 610 gm/sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

1.12 AUXILIARY POWER SUPPLY

1.12.1 A.C power supply for auxiliaries will be available at 240 V, 50 C/s 1-phase, 2 wire and 415V, 50 C/s, 3-phase, 4 wire, neutral solidly earthed with variation in frequency of +/-5% and variation in voltage +/-10%

1.12.2 D.C. power supply at 220 V, 2-wire ungrounded will be available 187 V to 242 V.

1.13 INSPECTION AND TESTING

All tests and inspection of the equipment specified shall be performed to the extent and in the manner as stipulated in the relevant standards and in this specification. All type tests/routine tests/acceptance tests as specified shall be conducted in the presence of purchaser. Wherever equipment similar to the one being offered has already been type tested within 5 years from the date

of opening the bid. Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off. Otherwise the subcontractor will have to carry out the type tests without any extra cost and without any delivery implications.

1.14 PACKAGING

Aluminium Tube shall be partially packed with Hessians cloths. Similar items shall be grouped and tied with steel wires/strip for convenient handling during transits.

MARKINGS

The following details are to be clearly indicated in the material forwarding documents:

a) Name and address of the consignee.

b) Purchase order number.

c) Name of supplier/s.

d) Description of equipment / material.
e) Tare weight.

f) Gross weight.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises, while packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage wagons and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Purchaser takes no responsibility of the availability of the wagons.

1.15 HANDLING, STORAGE AND INSTALLATION

In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and

oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser.

Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the contractor at his own expenses.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the purchaser every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the Contractor' account.

The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning. Contractor shall be responsible for the maintenance to the equipment/material while in storage as well as after erection until taken over by Purchaser, as well as protection of the same against theft, element of such nature, corrosion, damages etc.

The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipments which require indoor storage.

The words erection and installation used in the specification are synonymous. Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

1.13 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

1.14 EQUIPMENT BASES

A cast iron or welded steel base-plate shall be provided for all rotating equipment, which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base-plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units shall have a raised lip all around, and shall have threaded drain connections.

1.15 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

1.16 DOCUMENTATION

1.16.1 DRAWINGS

All drawings shall be prepared in AutoCAD and ultimate documentation would include drawings/documents on CDs. All dimensions and data shall be in SI metric units.

All items of the equipment should be clearly identified by proper part nos. in the contract drawings. Such parts, which are to be dispatched to site from works in dispatchable units and are reassembled at site, should be marked by proper identification marks at works and indicated in the drawings and quantified. The shipping list should be sent along with the general arrangement drawings for engineer's approval. All the items of the shipping list should be identified in the drawing.

The drawing submitted by the supplier shall be reviewed by the purchaser as far as practicable within two weeks of receipt of drawings and shall be modified by the sub-contractor if any modifications and/or corrections are required by the purchaser. The sub-contractor shall incorporate such modifications and / or corrections and submit the final drawings for approval. Any delay arising out of failure of the subcontractor to rectify the drawings shall not alter the contract completion date.

Further work by the subcontractor shall be in strict accordance with these drawings and no deviation shall be allowed without the written approval of the purchaser.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at supplier's risk.

Approval of drawing or work by the purchaser/consultant shall not relieve the subcontractor of any of his responsibilities and liabilities under the contract.

In case of any modifications that may be necessary during erection or commissioning of the equipment, the subcontractor shall carry out modifications in the original drawing & submit 'As Built drawings' and required no. of prints thereof.

1.16.2 INSTRUCTION MANUALS

The supplier shall submit to the purchaser, draft instruction manuals for approval within 30 days of placement of order. The final instruction manuals complete in all respects shall be submitted 60 days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment furnished, the erection procedures, testing, operation & maintenance procedures of the equipment.

If after the commissioning and initial operation of the plant, the instruction manuals require any modification/ addition / changes, the same shall be incorporated and the up- dated final instruction manuals shall be submitted as required.

1.16.3 TITLE BLOCK & DRAWING/ DOCUMENT NUMBERING SCHEME

Title block for drawing / document should be followed as per ANNEXURE-3

1.16.4 DOCUMENTATION SCHEDULE AT CONTRACT STAGE

A.	For approval	No of Copies
	Copies of all drawings with project details, dimension, shipping weights, No. of cases & dimensions, fixing details, tolerance etc.	10
	Copies of type test reports.	5
	Copies of works quality plan & field quality plan.	5

Copies of installation, operation & maintenance manual.	5
Copies of drawings on floppies/CDs	1 set

B. <u>After approval and for information / distribution</u>

Copies of all drawings	15
Copies of installation, operation & maintenance manual including Routine test reports	15
Sets of RTF of drawings	2
CDs of Drgs.	3

C. <u>As Built Drawings</u>

Hard copies of Drawings	15
CDs	3

NOTE:

1. Any revision of drawings / documents shall be submitted in the same no. of copies submitted first time for approval
2. Final drawings / documents shall be submitted in bound volume with customer and project details etc. written on the top.

SECTION – 4
GUARANTEED TECHNICAL PARTICULARS

1	General	
	Rated Voltage	
	a) Name of the Manufacturer	
	b) Country of Manufacture	
	c) Type of Circuit Breaker	
	d) Manufacturer's type designation	
	e) Standard Applicable	
	f) Rated Voltage (kV rms)	
	g) Rated Current	
	i) Under normal condition (A)	
	ii) Under site condition (A)	
	h) Rated frequency (Hz)	
	i) Number of poles	
	j) Whether 3 pole or single pole unit	
	k) Whether All The 3 poles ganged	
	electrically or mechanically	
	l) Whether dead tank or live tank	
	design	
	m) Type of installation	
	n) No. of break per pole	
	o) Latching Current	
2.	Guaranteed Ratings	
	Rated Voltage	
	a) Rated short circuit breaking	
	current	
	i. Symmetrical component at	
	at highest system voltage (kA)	
	ii. DC Component (%)	

	iii. Asymmetrical breaking current	
	at highest system voltage (kA)	
	b) Rated Making Capacity	
	i. At higher rated voltage (kAp)	
	ii. At lower rated voltage (kAp)	
	c) i. Maximum Total break time	
	under any duty condition for any	
	current upto rated breaking	
	current with limiting conditions	
	of voltage and pressure (ms)	
	ii. Rated break time	
	d) Closing time (ms)	
	e) Minimum opening time under	
	any condition with limiting	
	voltage and pressure (ms)	
	f) Maximum opening time under any	
	condition with limiting voltage	
	and pressure (ms)	
	g) Maximum close open time under	
	any condition with limiting	
	voltages and pressures (ms)	
	h) First pole to clear factor	
	I) Short time current rating (kA) for 1s/3s	
	j) Rated operating duty	
	k) Maximum braking capacity under	
	kilometric faults and rated TRV	
	characteristic (kAp)	
	l) Maximum breaking capacity under	
	phase opposition (kAp)	
	m) Maximum line charging breaking	
	current with temporary over	
	voltage upto 1.4 p.u. (A)	
	n) Maximum over voltage (p.u.) on	
	switching transformer on no load	
	and corresponding charging current	
	o) Maximum period between closing of	
	first contact & last contact in a pole	

	(ms)	
	p) Maximum pole discrepancy (ms)	
	q) Maximum arc duration and	
	corresponding current under lockout	
	pressure	
	r) Pre-insertion resistor	
	i. Value/ pole(ohms)/ with tolerance	
	ii. Minimum and maximum duration	
	of insertion per pole (ms)	
	iii. Thermal rating for the C-1m-O-CO-	
	2m-C-1m-O-CO for terminal fault	
	considering maximum resistance and	
	iv. Thermal rating for the same duty as	
	(iii) above for reclosing against	
	trapped charges	
	s) Small fault current breaking	
	capacity (kAp)	
	t) Maximum temperature rise for main	
	contacts over design ambient	
	temperature of 50oC	
	u) Rated voltage & pick up range for	
	trip coil (V)	
	v) Rated voltage & pick up range for	
	closing coil (V)	
	Rated pressure and limits of	
	pressure of operating	
	mechanism	
	x) Rated pressure and limits of	
	pressure of extinguishing medium	
	y) Minimum dead time for	
	i) Three phase reclosing (ms)	
	ii) Single phase reclosing (ms)	
3.	Dielectric withstand of complete Breaker	
	Rated Voltage	
	a) One minute dry & wet power	
	frequency withstand voltage	
	i. Between live terminal and	
	ground (kV rms)	

	ii. Between terminals with breaker	
	contacts open (kV rms)	
	b) 1.2/50- micro second impulse	
	withstand test voltage	
	i. Between live terminals and	
	ground (kVp)	
	ii. Between terminals with breaker	
	contacts open (kVp)	
	c) 250/2500 micro second switching	
	surge withstand test voltage	
	i. Between live terminals and	
	ground (kVp)	
	ii. Between terminals with breaker	
	contacts open (kVp)	
	d) Corona extinction voltage (kV rms)	
	e) Maximum radio interference	
	voltage (micro V) at 1.1 Ur/ /3	
	f) Total creepage distance	
	i) To ground (mm)	
	ii) Between terminals (mm)	
4.	Operating Mechanism	
	Rated Voltage	
	a) Type of operating mechanism for	
	i. Closing	
	ii. Opening	
	b) Manufacturer's type designation	
	c) Normal power consumption (W)	
	at rated voltage of	
	i) Trip coil	
	ii. Closing coil	
	Spring charged mechanism	
	Rated Voltage	
	a) Number of close open operations	
	possible after failure of AC	
	supply to motor	
	b) Time required for motor to	
	charge the closing spring (min)	
	c) Whether indication of spring	

	charged condition provided in central control cabinet	
5.	Type of Breakers	
	Rated Voltage	
5.1	SF6 Circuit Breakers	
	a) Quantity of SF6 per pole (m3) at rated pressure	
	b) Guaranteed maximum leakage rate per year	
	c) Rated pressure of SF6 in operating chamber	
	d) Limit of pressure at which breaker operates correctly (kg/ cm2)	
	e) Standard to which SF6 gas complies	
	f) Whether 20% spare SF6 gas stores in unused gas cylinder, included in proposal	
	g) Compacity & filling ration of containers in which SF6 gas would be shipped (m3)	
	h) Whether breakers are dispatched filled with SF6 or required to be filled at site	
	i) Type and make of SF6 pipe coupling used	
	j) Type and make of mandatory maintenance equipment	
	i. SF6 gas filling and evacuation trolley (portable)	
	ii. SF6 gas drying, filling, evacuating equipment and its capacity	
	iii. Operating analyzer type and make	
	iv. SF6 gas leak detector	
	k) Parameters of SF6 gas for initial filling & satisfactory operation	

	i. Density	
	ii. Dielectric strength/ kVmm	
	iii. Acidity (ppm)	
	iv. Water content (ppm)	
	v. Oil content (ppm)	
	vi. Condensation temperature °C)	
	vii. Resistivity (Ohm-cm)	
	l) Whether details of SF6 gas viz test	
	methods, handling etc. enclosed	
	m) Type and material of gasket used	
	to ensure gas tight joints for	
	i. Metal to metal joints	
	ii. Metal to porcelain joints	
	n) Method of housing SF6 gas	
	compressors and equipment	
	i. At circuit breaker	
	ii. In control cubicle	
	o) Type and make of	
	i. Densimeter	
	ii. Pressure gauge	
	p) Densimeter Settings	
	i. Lockout	
	ii. Alarm	
	q) Minimum time interval between	
	each make/ break operation (ms)	
5.2	General	
	Rated Voltage	
	a) Whether OGA drawing enclosed	
	b) Weight of complete 3 phase	
	breaker for foundation design (kg)	
	c) Weight of heaviest part of breaker (kg)	
	d) Impact loading for foundation design	
	e) Seismic level for which breaker is	
	designed	

	f) Minimum safety clearance from earthed objects	
	g) Noise level in (dB) at base of the breaker	
	h) Minimum clearance in air	
	i. Between live parts (mm)	
	ii. Live parts to earth (mm)	
	iii. Live parts to ground level (mm)	
6.	Constructional Details	
	Rated Voltage	
	a) Whether arcing contacts provided	
	b) Type and material of main contacts and arcing contacts	
	c) Contact pressure on main contacts (kg/ cm2)	
	d) Contact separation in arcing position (mm)	
	e) Contact separation in open position (mm)	
	i. Main contacts	
	ii. PIR contacts	
	f) Whether pressure relief device for each of the gas chamber of SF6 CB provided	
	g) Rate of contact travel	
	i. Opening (m/sec)	
	ii. Closing (m/sec)	
	h) Whether the making & breaking contacts are hermetically sealed	
	I) Type and capacity of device used to obtain uniform voltage distribution between breaks	
	j) Overvoltage withstand capability of grading components (kV/mms)	
	i) Continuous	
	ii. 10 minutes	

	iii. 1 minute	
	iv. 5 seconds	
	k) Number of auxiliary contacts per pole provided for Owner's use	
	l) Rated voltage of auxiliary contacts (V)	
	m) Current rating of auxiliary contacts	
	i. Continuous (A)	
	ii. DC breaking with 20 ms time constant (A)	
	n) Whether auxiliary contacts silver plated	
	o) Whether support structure included in supply	
	p) Height of support structure	
	q) Material of support structure	
	r) Standard to which the design of support structure conforms	
	s) Whether foundation bolts for breakers and cabinets included in scope of supply	
7.	Detailed Literature	
	Rated Voltage	
	a) i. Type test reports as per IEC-62271-100	
	ii. Factory test report & /or filed test report in case of reactor switching duty	
	iii. Details of operating mechanism	
	iv. Drawing of breaker of support structure	
	v. Calculations for compressed	
	vi. Details of SF6 gas filling	
	vii. Details of SF6 gas leak detector	
	viii. Procaution in use of SF6 gas	
	ix. Leaflets & literature bringing out salient features of equipment offered	
	x) Schematic diagrams of switching mechanism for closing resistor showing the duration of insertion	

	alongwith calculation for thermal rating of closing resistors	
	xi. Whether drawings/data data furnished as per cl.12 of chapter switchgear (CB)	
	xii. Method of checking of voltage distribution devices at site enclosed	
	xiii. Details alongwith a complete catalogue of operation analyzer enclosed	
	xiv Data on capabilities of circuit breaker in terms of time and number of operations at duties ranging from 100% fault currents to load currents of the lowest possible value without requiring any maintenance or checks	
	xv) Effect of non simultaneity between contact within a pole or between poles and also show how it is covered in the guaranteed rated break time.	
	xvi) Details and type of filters used in interrupter assembly and also the operating experience with such filters	
	xvi) Curves supported by test data indicating the opening time under close open operation with combined variation of trip coil voltage & pneumatic/ hydraulic pressure	
	xvii) All duty requirements specified along with adequate test reports	
	CONTROL CABINETS	
	Rated Voltage	
1.	Manufacturer's Name	
2.	Indoor/ Outdoor application	
3.	Design ambient air temperature (deg. C)	
4.	Standards applicable	
5.	Thickness of sheet steel (mm) and whether cold rolled or hot rolled	

6.	Degree of protection provided	
7.	Bill of material for all the	
	equipment mounted on control	
	cabinet giving the following	
	details	
	a) Make and type	
	b) Applicable Standard	
	c) Voltage rating	
	d) Current rating	
	e) Duty class, if applicable	
	f) Manufacturers catalogue No.	
	g) Total heat load of cabinet	
	(for purpose of ventilation requirement)	
8.	Colour of finish paint IS:5	
	a) Outside	
	b) Inside	
9.	Control Wiring	
	(a) Size of conductor	
	i. For CT circuits	
	ii. For other circuits	
	b) Conductor Solid/ Standard	
	c) Number of Strands/ conductor	
10.	Terminal Blocks	
	(a) Make & type	
	b) Current rating	
	i) Power terminals (A)	
	ii) Other terminals (A)	
11.	Space Heater Rating at 240 V AC	
12.	Control cabinet drawing showing	
	the following	
	a) Outline dimensions, floor	
	openings, floor/ wall/ pedestal	
	fixing arrangements, weights etc.	
	b) Front view, inside view showing	
	the mounting arrangement of	
	various equipment	
13	Schematic/ Wiring diagram of	
	control cabinet enclosed	
14	Interconnection drawing showing	
	cable, connections to the control	

	cabinet enclosed	
15	Type test report to verify design	
	of protection enclosed	
16	Details of terminal rows:	
	i) Whether arranged	
	vertical or horizontal	
	ii) Clearance from adjacent components	
	iii) Distance between rows	
	iv) Whether transparent protection cover	
	provided	
	BUSHING/SUPPORT INSULATOR	
	Rated Voltage	
1.	Manufacturer's Name	
2.	Type	
3.	Applicable Standards	
4.	i) Height	
	ii. Diameter (Top)	
	iii. Diameter (Bottom)	
5.	Total Creepage distance (mm)	
6.	Rated voltage (kV)	
7.	Power frequency withstand voltage for	
	1 Min. (kV rms) dry and wet	
8.	1.2/50 micro sec. Impulse	
	withstand voltage (kVp)	
9.	250/2500 micro sec. Switching	
	impulse withstand voltage	
	(kVp) dry and wet	
10.	Corona Extinction voltage (kV)	
11.	Weight (kg)	
12.	Max. Allowable span (mm)	
13.	Cantilever Strength (kg)	
14	OGA drawing enclosed	

ANNEXURE – A

NO DEVIATION CERTIFICATE

It is confirmed that there is no deviation and the offer is in full compliance with the specification. It is also confirmed that there are no deviations in any other form such as comments, variations and or exceptions. Further it is confirmed that at all drawings/ data sheets/ QP/ type tests reports shall be submitted to BHEL for organizing approval of ultimate customer. Also, furnishing of all relevant information/ repetition of type tests (if required for meeting the specification requirement) shall be carried out by us at no extra cost to BHEL and without affecting delivery requirements.

Signature of the authorized representative of Bidder

Name _____

Designation _____

Place _____

Date _____

Company Seal

SECTION - 6

CHECK LIST FOR 420 KV CIRCUIT BREAKERS

Put a tick mark (√) on 'YES' if the specified requirement is met, or put a tick mark on 'NO', if the specified requirement is not met and give comments in the "Remarks" column.

Sl. No.	Parameters	420 kV	YES/NO	Remarks
1	Type/class of Circuit Breaker	SF6 / C1M1	YES/NO	
2	Manufacturer's type designation			
3	Standard Applicable	IEC 62271 - 100	YES/NO	
4	Rated Voltage (kV rms)	420	YES/NO	
5	Rated Current	3150 A	YES/NO	
6	Max fault level (3 s)	50 kA	YES/NO	
7	Phase to phase spacing	7000 mm		
8	Rated frequency (Hz)	50	YES/NO	
9	Number of poles	3	YES/NO	
10	Whether All The 3 poles ganged electrically or mechanically	Electrically	YES/NO	
11	Whether dead tank or live tank design	Live	YES/NO	
12	No. of break per pole		YES/NO	
13	Rated short circuit breaking current			
	i. Symmetrical component at highest system voltage (kA)	50	YES/NO	
	ii. DC Component (%)	As per IEC	YES/NO	
14	Rated short circuit Making Current (kAp)	125	YES/NO	
15	Closing time (ms)	100	YES/NO	
16	First pole to clear factor	1.3	YES/NO	
17	Short time current rating (kA) for 3s	50 kA	YES/NO	
18	Rated operating duty	O-0.3 Sec –CO -3 min – CO	YES/NO	
19	Out of phase breaking current	12.5 kA	YES/NO	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
20	Small fault current breaking capacity (kAp)	As per IEC	YES/NO	
21	Maximum temperature rise for main contacts over design ambient temperature of 50°C	As per IEC	YES/NO	
22	Rated voltage & pick up range for trip coil (V)	220 V DC, Range – 70 % to 120 %	YES/NO	
23	Rated voltage & pick up range for closing coil (V)	220 V DC, Range 85 % to 120 %	YES/NO	
24	Reclosing	Single and three phase high speed auto reclosing	YES/NO	
25	Rated terminal load	As per IEC.	YES/NO	
26	**Dielectric withstand of complete Breaker**			
a)	One minute dry & wet power frequency withstand voltage			
	i. Between live terminal and ground (kV rms)	520	YES/NO	
	ii. Between terminals with breaker contacts open (kV rms)	610	YES/NO	
b)	1.2/50- micro second impulse withstand test voltage			
	i. Between live terminals and ground (kVp)	±1425	YES/NO	
	ii. Between terminals with breaker contacts open (kVp)	1) ±1425(+240)	YES/NO	
c)	250/2500 micro second switching surge withstand test voltage			
	i. Between live terminals and ground (kVp)	±1050	YES/NO	
	ii. Between terminals with breaker contacts open (kVp)	1) 900(+350)	YES/NO	
d)	Corona extinction voltage (kV rms)	320	YES/NO	
e)	Maximum radio interference voltage for Frequency between 0.5 MHz and 2 MHz	1000 (max) at voltage 266 kV rms.	YES/NO	
f)	Total creepage distance			
	i) To ground (mm)	1) 10500 for 420 kV	YES/NO	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
	ii) Between terminals (mm)	1)10500 mm for 420 kV	YES/NO	
27	**Pre-insertion resistor requirement**			
	Rating (ohms)			
	Minimum pre-insertion time (ms)			
	opening of PIR contacts			
28	**Operating Mechanism**			
	a) Type of operating mechanism for			
	i. Closing	Spring	YES/NO	
	ii. Opening	Spring	YES/NO	
29	**General**			
a)	Whether OGA drawing enclosed		YES/NO	
b)	Filled in GTP furnished		YES/NO	
d)	Interpole cabling included in Scope alongwith required Glands, Lugs etc. (FRLS)		YES	
e)	All Type Test Reports & additional tests as per IEC 62271 – 100, not older than 5 years are available with bidder		YES	
f)	Bidder's unconditional acceptance of "Undertaking on Type Test Reports" – enclosed.		YES	
g)	**Whether GI support structure included in Supply**		YES	
h)	**Whether foundation bolts for breakers and cabinets included in scope of supply**		YES	
i)	Whether documentation schedule as per attached enclosure agreed by bidder.		YES	
j)	No. of Aux. contacts per pole for purchaser's usage Contact for local position Contact for remate position	14 NO + 14 NC 1 NO 1 NO	YES	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
k)	Min clearance in Air (mm) as per section-3			
	(i) Between Live Parts		YES/NO	
	(ii) Live Part to Earth		YES/NO	
	(iii) Live Part to ground with Support Structure / Stool		YES/NO	
l)	Control Cabinet –			
	Degree of Protection	IP 55 (Min.)	YES/NO	
	Type Tested for IP 55 within last **5** years		YES/NO	
n)	**Mandatory spares included in scope of supply as per section 1**		YES/NO	
o)	**Circuit Breaker accessories included in scope of supply as per section 1**		YES/NO	
p)	**Supervision of Erection, testing and commissioning included in scope**		YES/NO	