



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

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Type of Document TECHNICAL SPECIFICATION		Sign				
Title 420 kV Circuit Breaker		Date				
		Group	TBEM			
CUSTOMER:		TELANGANA STATE POWER GENERATION CORPORATION LTD.				
PROJECT:		5x800 MW YADADRI TPS – 400 kV SWITCHYARD				
LOI NO: 17/10/2017		ED/TPC/SE-III/YADADRI TPS(5X800MW)/D.No. 102/17, Dated:				
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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 comprises of following sections:

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

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 : 400 kV Switchyard at 5X800MW Yadadri 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 : M2
- ii) Electrical Endurance Class : E1
- iii) Restrike Probability Class : C2
- 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 : $\pm 1425 (+240)^*$ kVp
(impulse on one terminal and other terminal earthed)

* 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 : $\pm 900 (+345)^*$ 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)
(Voltage at 1.1 U_{rated}/sq. rt. 3) : Less than 1000

Corona extinction voltage (kVrms) : 320 (min)

Minimum creepage distance: : 10500 mm

System neutral earthing : Effectively Earthed

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

Rating of auxiliary contacts	: -----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)	: 63 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)	: 157.5
Symmetrical interrupting capability (kA rms)	: 63
Short time current duration	: 3-second
Rated short time making current (kAp)	: 157.5
Short time current carrying capability for 3 second (kArms)	: 157.5
Out of phase breaking current capacity (kArms)	: 15.75
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 $U/\sqrt{3}$ 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 150
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 10 NO + 10 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 contacts 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 BILL OF QUANTITIES (BOQ)

Sl. No	Description	Unit	Quantity
1.	420 kV, 3150 A, 63 kA (3sec.), 3-ph, SF6 Circuit Breaker without PIR with grading capacitor (if applicable) 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 excluding foundation bolts	Nos.	33
2.	Foundation bolts for circuit breaker, platform and ladder (1 lot comprises of foundation bolts for 1 no. circuit breaker, platform and ladder)	Lots	33
3.	Circuit Breaker Accessories		
i)	Portable type SF6 Gas filling and evacuating plant (Min. 300L capacity) (Dilo make only) (Shall be supplied with necessary gas valves, gas cylinders, safety devices, gas purity monitoring devices, regulator, vacuum pump, pressure gauges/switches, hose pipes etc.)	Set	1
ii)	Portable SF6 vacuum pump with pressure gauge/ switches & hose pipes (Dilo 3-001-04-R002/R022 or better)	Set	1
iii)	SF6 leakage detector	Nos.	4
iv)	Circuit Breaker Operational Analyzer with DCRM as per specification (Hisac Ultima)	Nos.	1
v)	Basic timer kit with print facility (Scope Scot MXP+ or better)	Nos.	1
vi)	CRM Meter (100A) (Scope CRM 100C or better)	Nos.	1
vii)	SF6 Gas (20% of total quantity ie. quantity used for 33 nos. circuit breaker)	Lot	1
4	Controlled Switching Device (CSD) for above 400kV CB'S along with all accessories (except special cables) complete in all respects for Generator Transformer (GT) and Bus Reactor	Nos.	9
5	Controlled Switching Device (CSD) for above 400kV CB'S along with all accessories (except special cables) complete in all respects (CSD shall be suitable for dual operation (i.e. suitable for GT & ST/ FGD-ST switching) otherwise bidder may provide two nos. of CSD against price of 1 no. CSD)	Nos.	5
6	Special cables for CSD	m	5000
7	<u>Mandatory spares:</u> Complete pole with column and interrupter and grading capacitor (if applicable) and operating mechanism but without support structure	Nos.	3
8	<u>Mandatory spares:</u> Rubber gaskets, 'O' rings and seals (1 set comprise of complete replacement for one breaker)	Sets	6
9	<u>Mandatory spares:</u> Trip coils with resistor	Nos.	6
10	<u>Mandatory spares:</u> Closing coils with resistor	Nos.	6
11	<u>Mandatory spares:</u> Set of fixed contacts, moving contacts as below (1 set comprise of following) (Shall be suitable for complete replacement of 1 pole) a) Stationary contact – 2nos. b) Stationary arc contact- 2 nos. c) Moving contact- 2 nos.	Sets	14

	d) Moving arc contact- 2 nos. e) Puffer cylinder- 2 nos.		
12	<u>Mandatory spares:</u> Molecular filter for SF6 Circuit for 1 pole	Sets	2
13	<u>Mandatory spares:</u> Gas density monitor	Nos.	6
14	<u>Mandatory spares:</u> Operating mechanism with motor	Nos.	4
15	<u>Mandatory spares:</u> Aux. Switch (1 set shall be suitable for one complete pole)	Set	2
16	<u>Mandatory spares:</u> Air pressure switch If air pressure switch is not applicable as per manufacturer design, the following should be supplied. (1 no. comprise of following:) Relays, contactors, timers of each type & rating	Nos.	2
17	<u>Mandatory spares:</u> SF6 gas pressure switch If SF6 gas pressure switch is not applicable as per manufacturer design, gas density monitor shall be supplied against this item.	Nos.	2
18	<u>Mandatory spares:</u> Air pressure gauge If air pressure gauge is not applicable as per manufacturer design, the following should be supplied. (1 no. comprise of following:) a) Corona ring- 1 no. b) Terminal pad- 1 no.	Nos.	2
19	<u>Mandatory spares:</u> Contacts for circuit (shall be each type & rating) or Contactors of each type & rating	Nos.	2
20	<u>Mandatory spares:</u> MCB/MCCB for DC Circuit (shall be each type & rating)	Nos.	2
21	<u>Mandatory spares:</u> MCB/MCCB for AC Circuit (shall be each type & rating)	Nos.	2
22	<u>Mandatory spares:</u> Spare fuses for each type and rating If Spare fuses are not applicable as per manufacturer design, MCB of each type & rating shall be supplied against this item.	Sets	4
23	<u>Mandatory spares:</u> Auxiliary relay (for 1 pole) (shall be each type & rating) If Auxiliary relay is not applicable as per manufacturer design, Auxiliary Contactors shall be supplied against this item.	Sets	2
24	<u>Mandatory spares:</u> Complete set of gaskets (shall be suitable for complete replacement of one circuit breaker set)	Sets	4
25	<u>Mandatory spares:</u> Set of seals (shall be suitable for complete replacement of one circuit breaker pole)	Sets	4
26	<u>Mandatory spares:</u> Isolation valves, control valves & safety valves for air or oil system (for 1 pole) If Isolation valves, control valves & safety valves for air or oil system is not applicable as per manufacturer design, the following shall be supplied: 1 set comprising of a) Push button- 1no. b) Spring charging motor-1 no.	Sets	4
27	Supervision of Erection, Testing & Commissioning of supplied 420kV, 3 Phase Circuit Breakers at site	Mandays	99
28	Supervision of Erection, Testing & Commissioning of supplied CSDs	Mandays	28

	at site (including interface with CB)		
29	To & Fro charges applicable for supervision of Erection, Testing & Commissioning of supplied Circuit Breakers & CSDs at site	Nos. of visit	10

Note:

- 1) Total qty. of BOQ may vary -10% to +10%.
- 2) All wiring necessary for interface of circuit breakers with CSD is deemed to be included in the scope.
- 3) Supply of terminal connectors for circuit breakers is in BHEL scope.
- 4) a. For items at sl. no. 27 & 28 of BOQ, nos. of mandays consumed in the Supervision of Erection, testing and commissioning of Circuit Breakers and CSDs shall be duly certified by BHEL site incharge.
- b. The scope of Supervision of Erection, testing and commissioning of Circuit Breakers shall be duly inclusive of the following:
 - i. Testing equipments required for testing.
 - ii. Accommodation and conveyance at site.
 - iii. Any other incidental charges.

Visit charges (To & Fro charges) shall not be covered in supervision of ETC item and are covered separately under Sl. No. 29 of BOQ.

- c. The following instruments/kits shall be brought out at site by Bidder and shall be taken back after successful completion of testing and commissioning.
 - (a) Time Interval meter (Timing kit)
 - (b) SF6 gas leakage Detector
 - (c) SF6 gas filling adopter
 - (d) Transducer for operational analyzer (if required)

The following instruments/kits shall be made available by BHEL to testing engineer:

- (a) DCRM (operational analyzer kit)
- (b) 1 & 5kV insulation tester
- (c) Single phase variac
- (d) Dew Point Meter
- (e) Capacitance and Tan Delta Kit
- (f) Contact resistance measurement kit
- (g) Multimeter

Any other instrument(s), if required for testing/commissioning of circuit breaker shall be arranged by circuit breaker supplier without any price implication to BHEL.

- 5) Items at Sl. No. 29 of BOQ shall include To & Fro fares from bidder's headquarter to BHEL site. No other charges shall be paid by BHEL.

1.4 TYPE TESTS

Bidder shall submit valid type test and additional type tests reports (as per relevant IEC/IS standard) for the tests carried out after 17.10.2012. The tests should have been conducted on identical or similar equipment/components to those offered. In case type test reports are earlier than 17.10.2012 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	a) Two (2) times rated phase to ground voltage at lockout pressure for 15 minutes b) Rated phase to ground voltage test at zero-gauge pressure for 8 hours.
5	Seismic withstand test in unpressurised condition.

1.5 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.

1.6 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.

1.7 SPECIAL TOOLS AND TACKLES

Bidder shall supply all special tools & tackle (other than maintenance tools/spares mentioned in BOQ) free of cost which are specifically required for 420kV circuit breaker and are proprietary

in nature. List of such special tools and tackles shall be clearly listed along with the technical offer. Any special tool which is not listed in the list but are required during the erection/commissioning of circuit breakers shall also be supplied free of cost by the supplier.

In case, special tools & tackles which is proprietary in nature is not required for erection/testing/commissioning or for smooth operation of circuit breaker, supplier has to submit a certificate mentioning that no special tools & tackles is required for circuit breaker.

1.8 TITLE BLOCK

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

- a) Project Name : 400 kV Switchyard at 5X800MW Yadadri TPS
- b) Customer Name : Telangana State Power Generation Corp. Ltd.
- c) Consultant Name : TCE, Bangalore
- d) Contractor : BHEL
- e) Customer LOA no. : ED/TPC/SE-III/YADADRI TPS(5X800MW)/D.No. 102/17, Dated: 17/10/2017

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.

The drawings / documents submitted shall be project and product specific and shall incorporate all project details and title block of the customer as detailed in Section 1, 2 & 3.

Date of Submission of first lot of drawings will be counted only from the date of submission of reasonably correct drawings. The drawings/ documents, as follows shall be used for providing engineering manufacturing clearance and furthermore, these shall be used for delay analysis, if any from the bidder.

- 1) General Arrangement
- 2) Scheme drawings
- 3) Bill of Materials
- 4) Wiring diagram
- 5) Mechanism Housing assembly
- 6) Marshalling box details
- 7) Interrupter insulator
- 8) Support insulator

- 9) Support structure & ladder
- 10) Foundation bolt drawing
- 11) Type test reports
- 12) GTP for CB
- 13) GTP for CSD

The following documents are to be submitted for Circuit Breaker Accessories and Mandatory Spares.

- 1) Catalogues/data sheet for Circuit breaker accessories
- 2) Mandatory spare list

The schedule for submission and resubmission shall be in line with details provided in Section-3.

The successful bidder shall have to extend all possible supports like timely submission/re-submission of drawings, visit to end customer to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer approval. The bidder shall submit the GTP of circuit breakers in the format provided by customer. The format shall be provided to successful bidder.

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 gasketed 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 and 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 of minimum 300L capacity 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. It shall be ground mounted.
- 1.13 The cubicle shall be IP-55, of gasketed 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 mm² 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 75x10 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) Two (2) times rated phase to ground voltage at lockout pressure for 15 minutes
- v) Rated phase to ground voltage test at zero-gauge pressure for 8 hours..
- vi) 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 hexafluoride.
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

1.19 TECHNICAL PARAMETERS OF CIRCUIT BREAKER OPERATIONAL ANALYZER WITH DCRM

Item	Specification
Functional Requirement	1. The instrument should be suitable for measuring the operation timing of main, PIR and auxiliary contacts (wet & dry) as well as coil currents. 2. It should measure the Dynamic Contact Resistance of main & arcing contacts as well as travel measurement (with external travel transducer) of operating mechanism. 3. The instrument should be suitable for testing the CBs upto 420 kV as per applicable standards and standard testing procedures. 4. The test results should have repeatability, consistency & immunity to electromagnetic interference in live switchyard upto 420 kV levels.
No. of Channels	1. Main Contact Channels:24 (4 Main + 4 PIR per pole on 3 pole simultaneously) 2. Aux. Contact Channel:06 wet & 06 Dry 3. DCRM/Test Current Channels:12 set (6 Channel for resistance + 6 channel for current) 4. Travel Channel:06 5. Coil Current Channel:06
Sampling Speed	Upto 20 kC
Accuracy	1. Timing : $\pm 1\%$ of reading 2. Coil Current: $\pm 1\%$ of reading 3. R : $\pm 2\%$ of reading 4. Travel: $\pm 1\%$ of reading
Measurement Range:	1. Timing: 0-4 s 2. R: 0-8 m Ω . 3. Coil Current:0-25 A
Resolution	Timing: 0.1 ms
DCRM Test Current	100 A.(Minimum)
Test Leads and accessories	One complete set of cables of sufficient length (min 20metre) with suitable clamps & connectors, compatible with the instruments should be provided for successfully carrying out the test in sub-station. Additionally, all the required accessories should be provided for the smooth functioning of kit. Further hard carrying case (which should be robust/ rugged enough) for ensuring proper safety of the kit during transportation shall have to be provided.
Travel Transducers	Three nos. of travel transducers along with clamp/fixtures to suit 420kV CBs of ABB/GE/BHEL/CGL/SIEMENS make. The voltage class and make shall be intimated after award of order during document approval.
Design/Engg.	The complete equipment along with complete accessories must be designed/ engineered by Original Equipment Manufacturer.
Power Supply	It shall work on single phase 230 Volts $\pm 10\%$, 50 Hz $\pm 5\%$ supply with standard socket.
Operating Temperature	0 to +50 deg C
Relative humidity	Max. 90% non-condensing.
Protection/ Control	Against short circuit, over voltage, improper ground connection over load & transient surges, the kit should have alarm/cut-off features to protect the instrument. Also the kit should have facility of stopping automatically on power failure.
Cooling	Necessary in built cooling arrangement should be provided to dissipate the heat

Arrangement	generated during testing. No external coolant/ accessory shall have to be required.
Weight	It should be highly portable and trolley mounted for smooth movement in live switchyards.
Software	The software should be suitable for automatic testing & report generation, signature as well as trend analysis. The kit should have facility to store and communicate with windows based computer for exporting the test data.
PC Interface	It shall include supply of one laptop PC of Dell/Lenovo/HP make with latest specifications such as Core i5 Intel Processor, 4GB RAM, 320GB or better HDD, 15" TFT screen, Combo 24xCD R/W Drive i.e. having CD read / write facility complete with required cables and connectors with preloaded operating MS Window 7 professional or better with latest version application software require for storage analysis and record management.
Environment	The test kit shall be compatible for EMI/EMC/Safety environment requirement as per IEC.
Warranty/ Guarantee	Warranty/Guarantee Period: Min 01 year from the date of successful & complete commissioning at sub-station. All the materials, including accessories, cables, laptops etc. are to be covered under warranty/guaranty period. If the kit needs to be shifted to supplier's works for repairs within warranty/guaranty period, suppliers will have to bear the cost of spares, software, transportation of kit for repair at test lab/ works
Calibration Certificate	Unit shall be duly calibrated before supply and the date of calibration shall not be older than two month from the date of supply of Kit.
Training	Supplier shall have to ensure that the kit is made user friendly. Apart from the detailed demonstration at site, the supplier shall also have to arrange necessary training to End user engineers, where kit is being supplied.
Commissioning, handing over the Instrument	Successful bidder will have to commission the instrument to the satisfaction of end user. The supplied instrument, failed during the demonstration at site shall be rejected and no repairs are allowed.
After sales service	Bidder will have to submit the documentary evidence of having established mechanism in India for prompt services.

1.20 CONTROL SWITCHING DEVICE (CSD)

Existing Circuit Breaker shall be equipped with controlled switching with consequent optimization of switching behavior, when used in:

Switching of Bus Reactors
Switching of Station Transformers
Switching of Generator Transformers

The controller shall be provided in Main & Tie circuit breakers of Transformers.

The controlling relay shall also record and monitor the switching operations and make adjustments to the switching instants to optimize the switching behavior as necessary. It shall provide self diagnostic facilities, signaling of alarms and enable downloading of data captured from the switching events.

Requirements:

The circuit breaker with controlled switching as indicated in single line diagram shall meet the following requirement:

1. The Switching controlled Device shall be used to reduce increased over voltages, re ignition between circuit breaker contacts that may be caused by normal switching of high voltage circuit breakers and hence optimize the stresses on circuit breaker while switching the circuit. The switching controlled device will be called device henceforth.
2. The device shall be such that only switching commands (for operating purpose) are processed in the device. Open command triggered by protection on fault shall be forwarded directly to the breaker. In these cases switching instance is not controlled.
3. Circuit breaker should be able to be switched while switching controlled device is not in operation e.g. during maintenance work or power supply is not connected, a bypass shall be provided to the device. In these cases the switching commands will then be forwarded directly to the circuit breaker via this Bypass. The switching time will not be controlled with these switching operations.
4. The device shall meet the requirements of IEC-60255-4 Appendix 'E' class III regarding HF disturbance test, and fast transient test shall be as per IEC-61000 – 4 level III and insulation test as per 60255 – 5.
5. The device shall have functions for switching ON & OFF the circuit breakers.
6. The device shall get command to operate the breakers manually or through auto re-close relay at random. The controller shall be able to analyze the current and voltage waves available through the signals from secondaries of CTs & CVTs for the purpose of calculation of optimum moment of the switching the circuit breaker and issue command to circuit breaker to operate.
7. The device shall also have an adaptive control feature to consider the next operating time of the breaker in calculation of optimum time of issuing the switching command and optimize the switching behavior as necessary. In calculation of next operating time of the breaker the controller must consider all factors that may affect the operating time of the breaker.

8. The device should have display facility at the front for the settings and measured values.
9. The device shall have self monitoring facility.
10. The device shall be suitable for operation considering transient and dynamic state values of the current and voltage from the secondary of the CTs and CVTs.
11. The device should be PC compatible for the setting of various parameters. During the switching operations, current and voltage waveforms and other parameters shall be recorded and saved together with calculated values. Recorded waveform shall be downloaded on to PC for evaluation purpose. It shall also enable downloading of data captured from the switching events. Window based software for this purpose shall be supplied by the contractor to be used on owner's PC.
12. It shall have self monitoring facilities. Faults which impair the functioning of the device or peripheral components, failure of trip voltage or sensors shall be displayed visually and shall give alarm.
13. The device shall be designed to operate correctly and satisfactorily with the excursion of auxiliary A/C & DC voltages and frequency as specified elsewhere in the specification.
14. The device shall have time setting resolution of 0.1 ms or better.
15. The device shall have sufficient number of output/input potential free contacts for connecting the monitoring equipment and annunciation system available in the control room. Necessary details shall be worked out during engineering the scheme.
16. Supply of all the necessary accessories required for the successful operation of controlled switching device shall be in the scope of supplier of the device.

1.21 SF6 GAS FILTERING, DRYING, STORAGE AND RECYCLING PLANT

This shall include all the necessary devices for measurement of purity, moisture content, decomposition products etc. of SF6 gas. Mixing with air/oil/moisture during above process should be proved to be nil during testing.

The plant shall be complete with accessories and fittings so that SF6 gas from the breaker can be directly filled in the plant storage reservoir.

In case purging of the equipment before filling with SF6 gas is desirable, then the required equipment for dry gases etc. shall be furnished as a part of the plant.

The capacity of the plant shall be such as to handle and store 300Kg. of SF6 gas.

The SF6 gas handling plant shall be complete with all the necessary pipes, coupling flexible tubes, valves for coupling, gas valves, gas cylinders, safety devices, gas purity monitoring devices, regulators, vacuum pump, pressure gauges/switches, hose pipes etc. to the equipment.

The design and construction of the plant, valves, coupling, connections shall be such that leakage of the SF6 gas shall be minimum. Similarly, valves, couplings and pipe work shall

be so arranged that accidental loss of gases to the atmosphere shall be minimum.

SF6 gas decomposition analysing equipment and instruments should have capacity for performing the following functions:

- a) Moisture content measurement or alternatively dew point measurement
- b) The air content measurement
- c) Sensitivity should not be affected by dust, humidity, heat & wind etc.

The make of the plant shall be Dilo make.

ANNEXURE-B

FITTINGS & ACCESSORIES

A. Circuit Breaker

A.1 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 (Yadadri site)

1. Portable SF6 gas evacuation and filling system of minimum 300L capacity with necessary gas valves, gas cylinders, safety devices, gas purity monitoring devices, regulators, vacuum pump, pressure gauges/switches, hose pipes etc. (One set) (Dilo Make)
2. Portable SF6 gas leaked detectors (4 sets)
3. Operational analyser with DCRM to record contact travel, speed and for making measurement of operating timings, synchronisation of contacts in all poles as per clause no. 1.19 of section -2 of technical specification. (One set)



Project: 5x800 MW YADADRI THERMAL POWER STATION.
Customer: TELANGANA STATE POWER GENERATION CORPORATION LTD

Section-3: Project Details & General Specifications

Rev. No. 02

SECTION - 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

GENERAL TECHNICAL REQUIREMENTS

1.0 PROJECT DETAILS

Customer	:	M/s Telangana State Power Generation Corporation Ltd.
Project Title	:	5x800MW Yadadri Thermal Power Station
Project Location	:	Veerlapalem Village, Damercherla Mandal, Nalgonda District, Telangana
Nearest Railway station	:	Vishnupuram railway station.
Nearest Road Head	:	NH-9 is at 45km North SH-2 is at 7km South
Nearest Airport	:	Hyderabad (about 120 Km) Chief Engineer (O&M), 5X800MW Yadadri Thermal Power
Postal Address	:	Station, TSGENCO, Village - Veerlapalem, Mandal- Dameracheral, Dist. – Nalgonda, 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%
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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
1.	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	63 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 CLEARANCE (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 part 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 CODES FOR PIPE SERVICE

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 thoroughly 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 painting 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-galvanized. 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, STORING 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's 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.

1.16 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.	<u>For approval</u>	<u>No of Copies</u>
	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 and O & M Manuals	4
C.	<u>As Built Drawings</u>	
	Hard copies of Drawings	15
	CDs	4

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.

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

ANNEXURE – B

Technical Pre-Qualifying Requirements

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 zero date of Yadadri (17.10.2017).

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 / C2M2	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)	63 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)	63	YES/NO	
	ii. DC Component (%)	As per IEC	YES/NO	
14	Rated short circuit Making Current (kAp)	157.5	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	63 kA	YES/NO	
18	Rated operating duty	O-0.3 Sec –CO -3 min – CO	YES/NO	
19	Out of phase breaking current	15.75 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 type tests as per section 1 & IEC 62271 – 100, not older than 5 years are available with bidder		YES	
f)	All type tests shall be conducted without cost and delivery implication to BHEL if reports are found technically unacceptable by the customer		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	10 NO + 10 NC 1 NO	YES	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
	Contact for remate position	1 NO		
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 of technical specification		YES/NO	
o)	Circuit Breaker accessories included in scope of supply as per section 1 of technical specification		YES/NO	
p)	Supervision of Erection, testing and commissioning included in scope		YES/NO	