



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	SK	SK	RS/DM
TITLE 400 kV /132kV CIRCUIT BREAKER				SIGN	Sh	Sh	Sh
				DATE	05.09.17 5	06/09/17	09/09/17
				GROUP	TBEM	W.O. No	86009

CUSTOMER	Tamilnadu Transmission Corporation Limited (TANTRANSCO)
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PROJECTS	765/400kV AIS S/S Ariyalur
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Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS				
				Distribution	TBMM	TBQM	TBCM	TBTS	
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CHECKLIST FOR TECHNICAL EVALUATION

Along with the Technical Bids of the offers, the Bidder should submit this checklist confirming the inclusion of the enclosures as listed below. (Shall tick as ✓)

Sr No	Documents to be enclosed	Bidder to check & confirm
1	Copy of Unpriced BOQ as enclosed in the Technical Specification to confirm that bidder has quoted in the same format as per Section-1	
2.	Schedule of Technical Deviation format duly signed.	
3.	Supporting documents as asked in the Technical Requirement documents as per clause no. 1.5 of Section-1 <i>(List of Documents to be mentioned as Annexure)</i>	
4.	Checklist of Technical parameters as per Section-5 duly filled and signed.	
5.	Compliance to Technical specification as per TS	

NOTE:- If the Bidder fails to submit any of the documents as asked in the above check list, their bid is likely to be rejected / not evaluated.

The above checklist is verified for:-

NIT Ref No. :

Name of Equipment :

Name of Project :

Name of Bidder :

Signed with Seal of Bidder.

Date

PROJECT : 765/400kV Ariyalur Substation	
Customer : TANTRANSCO	
Technical Specification of 400kV/ 132kV Circuit breakers	TB-394-316-111
Section-1: Scope, Specific Technical Requirements & BOQ	REV.00

SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.1 SCOPE:-

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch and erection & commissioning supervision of 400kV/132kV Circuit Breakers complete with accessories as listed under this specification.

This section covers the specific technical requirements of Circuit Breakers. This constitutes minimum technical parameters for the above item as specified by the customer (TANTRANSCO). 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 & Bill of Quantities.

Section- 2A: Amendment of Equipment specification Section 2B

Section- 2B: Equipment specification

Section-3 : General technical requirements for all equipments under the project.

Section-4 : Guaranteed Technical Particulars

Section-5 : Technical Checklist

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

The equipment is required for the following project:

Customer : Tamilnadu Transmission Corporation Limited (TANTRANSCO)

Project : 765/400kV AIS S/S Ariyalur

1.2 SPECIFIC TECHNICAL REQUIREMENTS:-

1.2.1 400 kV Circuit Breaker

TECHNICAL PARAMETERS	
Rated voltage kV (rms)	420
Rated frequency (Hz)	50
No.of poles	3
Design ambient Temperature (deg. C)	50
Rated insulation levels	
Full wave impulse withstand voltage (1.2/50 micro sec.)	
-between line terminals and ground (kVp)	± 1425
-between terminals with circuit breaker open(kVp)	± 1425 kVp impulse on one terminal and 240kVP power frequency voltage of opposite polarity on other terminal

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One minute power frequency dry withstand voltage	
-between line terminals and ground kV (rms)	520
-between terminals with circuit breaker open kV (rms)	610
Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	
-between line terminals and ground (kVp)	± 1050
-between terminals with circuit breaker open(kVp)	900 kVp impulse on one terminal and 345kVP power frequency voltage of opposite polarity on other terminal
Max. radio interference Voltage (microvolts) for frequency between 0.5 MHz and 2 MHz at 266 kVrms	1000
corona extinction voltage (kV rms) with circuit breaker in all positions	320 (min)
Minimum creepage distance:	
Phase to ground (mm)	10500
Between CB terminals (mm)	10500
System neutral earthing	Effectively Earthed
Seismic acceleration	0.3g horizontal
Thermal 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)	6000
Rated continuous current at design Ambient temperature	3150A
Rated short circuit current Breaking capacity at rated Voltage (with percentage DC component as per IEC - 62271-100 corresponding to Minimum opening time under operating conditions specified)	63 kA for 1 Sec
Symmetrical interrupting capability (kA rms)	63 kA rms for 1 Sec
Rated short time making current(kAp)	157.5kAP
Short time current carrying capability (kArms)	63 kArms for 1 Sec
Out of phase breaking current capacity (kArms)	15.75kArms
Rated line/cable charging interrupting current at 90 deg. Leading power factor angle (Arms)	600A
(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)	
Pre –Insertion resistor requirement	
Rating(Ohms)	400(maximum)
Minimum pre-insertion time(ms)	8
Opening of PIR contacts	(a)PIR contacts should open immediately after closing of main circuits Or (b) Atleast 5 ms prior to opening of main contacts at rated air/gas

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Customer : TANTRANSCO

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REV.00

	pressure, where the PIR contacts remains closed
Total break times as per IEC (ms)	45
Rated break time as per IEC (ms)	40
Total closing time (ms) Max.	150
Rated operating duty cycle	O-0.3 sec.-CO-3 min-CO
Reclosing	1 ph & 3 ph auto reclosing
Operating mechanism	Spring/hydraulic or its combination
Trip coil and closing coil voltage	220 volt DC with variation as specified in section-3
Noise level at base and(max) upto 50 m.(distance from base of breaker)	140 db max
Rated terminal load	as per IEC
Temperature rise over the design ambient temperature	as per IEC -62271-100
First pole to clear factor	1.3
Auxiliary contacts (Besides requirement of specification , supplier shall wire up these contacts for future use of customer)	(10NO+ 10NC) per pole
Number of terminals in common control cabinet	all contacts & control circuits to be wired out upto common control cabinet plus 24 terminals exclusively for Owner's use
Maximum allowable switching over-voltage under any switching condition.	2.3 p.u
Max. difference in the instants of closing / opening of contacts (ms)	
Within a pole	2.5ms
Between poles opening	3.3ms
Between poles closing	5ms
Plinth level of switchyard	300mm above FGL
Center -line of bus bar for equipment connection from the base of support structure (i.e. plinth level)	8000 mm
Galvanising on CB Structure	610 gms. per square metre

1.2.2 132 kV Circuit Breaker

TECHNICAL PARAMETERS	
Rated voltage kV (rms)	145
Rated frequency (Hz)	50
No.of poles	3
Design ambient Temperature (deg. C)	50
Rated insulation levels	

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Full wave impulse withstand voltage (1.2/50 micro sec.)	
-between line terminals and ground (kVp)	± 650
-between terminals with circuit breaker open(kVp)	± 650
One minute power frequency dry withstand voltage	
-between line terminals and ground kV (rms)	275
-between terminals with circuit breaker open kV (rms)	275
Max. radio interference Voltage (microvolts) for frequency between 0.5 MHz and 2 MHz at 92kVrms	500
corona extinction voltage (kV rms) with circuit breaker in all positions	105 (min)
Minimum creepage distance:	
Phase to ground (mm)	3625
Between CB terminals (mm)	3625
System neutral earthing	Effectively Earthed
Seismic acceleration	0.3g horizontal
Thermal 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
Rated continuous current at design Ambient temperature	1250A
Rated short circuit current Breaking capacity at rated Voltage (with percentage DC component as per IEC -62271-100 corresponding to Minimum opening time under operating conditions specified)	31.5 kA for 1 Sec.
Symmetrical interrupting capability (kA rms)	31.5 kA rms for 1 Sec.
Rated short time making current(kAp)	80kAP
Short time current carrying capability (kArms)	31.5 kArms for 1 Sec.
Rated line/cable charging interrupting current at 90 deg. Leading power factor angle (Arms)	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)	
No. of trip coil	2 per pole
No. of closing coil	1 per pole
Total break times	65
Rated break time as per IEC (ms)	60
Total closing time (ms) Max.	150
Rated operating duty cycle	O-0.3 sec.-CO-3 min-CO
Reclosing	3 ph auto reclosing for 3 phase
Operating mechanism or a combination of these	spring
Trip coil and closing coil voltage	220 volt DC with variation as specified in section-3
Noise level at base and(max) upto 50 m.(distance from base of breaker)	140 db max
Rated terminal load	As per IEC

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Temperature rise over the design ambient temperature	as per IEC -62271-100
First pole to clear factor	1.3
Auxiliary contacts (Besides requirement of specification , supplier shall wire up these contacts for future use of customer)	5NO+ 5NC
Number of terminals in common control cabinet	all contacts & control circuits to be wired out upto common control cabinet plus 24 terminals exclusively for Owner's use
Maximum allowable switching over-voltage under any switching condition.	As per IEC
Max. difference in the instants of closing / opening of contacts (ms)	
Between poles at rated control voltage rated operating and quenching media pressure	3.3ms
Rated small inductive current switching capability with overvoltage less than 2.3 p.u.(A)	0.5 to 10
Plinth level of switchyard	300mm above FGL
Galvanising on CB Structure	610 gms. per square metre

1.3 Bill of Quantities:-

SI No.	Description of Item	Unit	Qty.
A	Main Item		
1.	400 KV, 3150A , 63 KA for 1Sec, 3 phase Outdoor SF6 Circuit Breaker Without PIR and without CSD with Corona Shielding, support structure, inter pole cables, cable gland, operating mechanism, Insulator base frame, control boxes and all accessories complete in all respect	Set	5
2.	400 KV, 3150A ,63 KA for 1Sec, 3 phase Outdoor SF6 Circuit Breaker With PIR (Pre insertion resistor) and without CSD with Corona Shielding, support structure, inter pole cables, cable gland, operating mechanism, Insulator base frame, control boxes and all accessories complete in all respect	Set	8
3.	132kV, 1250A, 31.5kA for 1 sec 1 phase Circuit Breaker (for NGR by passing) Without PIR and without CSD with Corona Shielding, support structure, inter pole cables, cable gland, operating mechanism, Insulator base frame, control boxes and all accessories complete in all respect	set	6
4.	Foundation bolt of 400kV CB structure , platform, ladder (if applicable) and marshalling box(if applicable) 1Set= 1No. 3 Phase 400kV CB	Set	13

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5.	Foundation bolt of 132kV CB structure , platform, ladder (if applicable) and marshalling box(if applicable) 1Set=1 No. 1 Phase 132kV CB	Set	6
B	Mandatory Spares		
1.	SF6 gas filling adopter	No.	1
2.	One Complete pole of 400 KV, 3150A ,63 KA for 1 Sec SF6 Circuit Breaker Without CSD and without PIR with operating mechanism box without support Structure	No.	1
C	Services		
1.	Supervision of erection, testing and commissioning of all 400kV Circuit breaker, with Special tools and test instruments 1Lot=1 no. 3 phase CB	Lot	13
2.	Supervision of erection, testing and commissioning of all 132kV Circuit breaker, with Special tools and test instruments 1Lot=1 no. 1 phase CB	Lot	6

Note-1: Quantity is subject to change by $\pm 25\%$.

Note-2: The terminal connector of CB shall be in BHEL scope.

Note-3: Operation analyser of Circuit Breaker is not in Bidder Scope.

Note-4: Inter pole cabling between Circuit breaker and common marshalling box shall be **Non Plug** in type.

Note -5: Inter pole cable schedule shall be provided by bidder during detailed engineering stage.

1.4 TYPE TESTS

Bidder shall submit valid type test reports (As per relevant IEC/IS standard) for the tests carried out within last ten years **from the date of opening of the tender** (i.e. 30.09.2016). The reports should have been conducted on identical or similar equipment/components to those offered. In case type test reports are more than 10 years old (from the date of opening of the tender) 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. The type test if conducted shall be witnessed by BHEL/Customer.

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1.5 QUALIFYING REQUIREMENT (Applicable for 400 kV & 132kV CB):-

1.5 (i) (a) The manufacturer(s) whose SF6 Circuit Breaker are offered should have manufactured, type tested and supplied **345kV or** above class circuit breaker of (i.e. 40kA or above fault level for 345kV voltage class) which must be in satisfactory operation* for at least two(2) years as on the date of award of contract(i.e. 31.03.2017) provided further that:

@ (i) (b) the offered 400kV class Circuit Breaker should have been manufactured, type tested (to specified fault level i.e. 63kA for 1s) and which must be in satisfactory operation* as on the originally scheduled date of award of contract (i.e. 31.03.2017).

OR

the offered 400kV class Circuit Breaker should have been manufactured and type tested (to specified fault level i.e. 63kA for 1s) as on the originally scheduled date of bid opening (i.e. 30.09.2016) and extended performance guarantee of additional two (2) years over and above the performance guarantee period specified for the Circuit Breaker for which a declaration by the bidder is made in the bid.

Note: @ Clause applicable for 400kV class Breaker for fault level more than 40kA only.

OR

1.5 (ii) who have manufactured, type tested and supplied 220kV or above class circuit breaker and have established its manufacturing facilities in India, based on technological support of a parent company or collaborator for the circuit breaker provided that the parent company (Principals) or collaborator(s) meets criteria stipulated under clause 1.5 (i) (a) & (b) \$ mentioned above. Further the 400kV class circuit breaker manufacturer shall furnish the following document alongwith the bid;

Note: \$ (i) (b) applicable for 400kV Class Breaker for fault level more than 40kA only

(i) a legally enforceable undertaking (jointly with the parent company or collaborator) to guarantee quality, timely supply, performance and guarantee obligations as specified for the circuit breakers;

And

(ii) a confirmation letter from the parent company or collaborator alongwith the bid stating that stating that parent company or collaborator shall furnish performance guarantee for an amount of 10 % of the ex-work cost of such equipment (s). This performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the Bidder.

* Satisfactory Operation means certificate issued by employer certifying operation without any adverse remarks.

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1.6 QUALITY PLAN:-

Bidder to follow valid TANTRANSCO approved Quality Plan. It will be the bidder's responsibility to get its QP approved directly from the ultimate customer.

1.7 SPECIAL TOOLS AND TACKLES:-

Bidder shall supply all special tools and tackle (other than maintenance tools mentioned in BOQ) free of cost which are specifically required for 400kV/132kV Circuit Breakers and are proprietary in nature. List of such special tools and tackle should be clearly listed along with the technical offer. Any special tool which is not listed in the list but required during the erection/commissioning of Circuit Breakers shall also be supplied free of cost by the supplier.

In case , special tools and 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 and tackles is required for Circuit Breakers.

1.8 SUPERVISION OF ERECTION , TESTING & COMMISSIONING:-

Bidder shall quote lump-sum price for installation and commissioning of all offered breakers. Supplier's testing engineer shall bring SF6 gas leak detector, SF6 gas filling adopter, timing kit and Transducer for operational analyzer (if required).

Following Instruments shall be made available by BHEL to testing engineer

- a) DCRM (Operational analyser) Kit
- b) 5kV Insulation tester
- c) 1kV Insulation tester
- d) Single phase variac
- e) Dew Point meter
- f) Capacitance and Tan Delta Kit
- g) Contact Resitance measurement kit
- h) 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.

SECTION - 2A

Amendment of section - 2B

Pre-bid Queris

765/400KV AIS SUB STATION WITH ASSOCIATED AUTO TRANSFORMERS, SWITCHGEARS, REACTORS, ACCESSORIES, CONTROL PANELS, SUBSTATION AUTOMATION SYSTEM, CONTROL ROOM AND CIVIL WORKS COMPLETE AT ARIYALUR IN VILLUPURAM DISTRICT			
Sr. No.	Volume / Section	Clause No.	Bidder's Query TANTRANSCO REPLY
24	Section - 35	Clause (I) (page 306)	We understand online oil and winding digital temperature monitor shall be optic fibre based and shall be required to provide as per Clause 10.8.3 i.e. Optical sensors. Kindly confirm.
25	Section-04, Circuit Breaker 2B	Clause No. 7.1.2 (page 342)	Operating mechanism shall be accessible from a ladder – platform. Please confirm the acceptance.
26	Section-04, Circuit Breaker 2B	Clause No. 7.1.5 (page 342)	spring charging handle shall be accessible from a ladder – platform. Please confirm the acceptance.
27	Section-04, Circuit Breaker 2B	Clause No. 12 (page 345)	Operating mechanism shall be accessible only from the front. Load bearing member shall be 3 mm and other parts of cabinet shall be of 2 mm. Please confirm the acceptance.

Ladder is included in scope.

SECTION ~~2A~~ 2B

CIRCUIT BREAKERS (400kV and 132kV)

1.0 GENERAL

1.1 The circuit breakers and accessories shall conform to IEC: 62271 – 100, IEC: 60694 and other relevant IEC / IS standards except to the extent explicitly modified in the specification and shall also be in accordance with requirements specified herein.

1. IS - 13118 Specification for circuit breakers.
2. IS - 2629 Recommended practice for Hot Dip galvanized Iron and Steel.
3. IS - 4379 Identification of the contents of industrial gas cylinders.
4. IS - 7311 Seamless high carbon steel cylinders for permanent and high pressure liquefied gases.
5. IS - 2147 Degree of protection provided for enclosures for low voltage switchgear and control gear.
6. IS - 2099 High voltage porcelain bushings.
(IEC 2331)
7. IS - 802 Code of practice for use of structural steel in overhead
(Part-1) trans. Line towers.
8. IS - 375 Marking and arrangements for switchgear bus bar, main connections and auxiliary wirings.
9. IEC - 62271-100 Specification for alternating current circuit breakers.
(replacing IEC-60056, 1987)
10. IEC - 60325 Specification for three phase induction motors.
11. IEC - 60376 Specification and acceptance of new supply of sulphur
376A, 376B Hexafluoride.
12. IEC - 60060 High voltage test techniques.
13. IEC -60071 Insulation co-ordination.
(Part 1 & 2)
14. IEC – 60270 Partial discharge measurements
15. IS5561 Electric Power Connectors
16. IS 9135 – Guide for testing of Circuit Breakers with respect of out of phase switching.

17. IS: 10601- Dimensions of terminals of high voltage switchgear and control gear.
18. IS: 12729 – General requirements for switchgear and control gears for voltages exceeding 1000V
19. IS: 13516 – Methods of synthetic testing of high voltage AC circuit breakers.
20. IS: 14658 – High voltage AC circuit breakers – Guide for short circuit and switching test procedures for metal closed and dead tank circuit breaker.
21. IS: 14674 – High voltage alternating circuit breakers – Guide for seismic qualifications of high voltage AC breaker.
22. IS: 8828 – Miniature air break circuit breaker for AC circuits for voltages not exceeding 1000V
23. IS: 13947 – Contactors for voltages not exceeding 1000V dc or 1200V dc
24. IS: 2544 - Porcelain post insulators for systems with nominal voltages greater than 1000V
25. IS: 694 – PVC cables up to 1000V.
26. IS: 2148 – Cable glands
27. IS: 8337 – Cable lugs.

1.2 800/420 KV circuit breakers offered would be of sulphur hexafluoride (SF₆) type only with spring/hydraulic or its combination operating mechanism and of class C2-M2 as per IEC. However for reactor switching, circuit breaker shall be M2 class.

1.3 The circuit breaker shall be complete with terminal connectors, operating mechanism ,control cabinets, inter pole cable, cable accessories like glands, terminal blocks, marking ferrules, lugs, pressure gauges, density monitors (with

graduated scale) for SF6 gas control part connectors, galvanized support structure for CB, their foundation bolts and all other circuit breaker accessories required for carrying out all the functions the CB is required to perform.

All necessary parts to provide a complete and operable circuit breaker including installation such as main equipment, terminals, control parts, connectors and other devices whether specifically called for herein or not shall be provided.

1.4 The support structure of circuit breaker as well as that of control cabinet shall be hot dip galvanized. All other parts shall be painted as per shade 697 of IS – 5.

1.5 The circuit breakers shall be designed for use in the geographic and metrological conditions.

The SF6 Breakers shall conform to the latest revisions and amendments thereof.

Besides the above, the standard minimum safety clearances stipulated in IE Rules 1956 shall also be complied with.

2.0 DUTY REQUIREMENTS:

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

2.2 The circuit breakers shall meet the duty requirements for any type of fault of fault location also for line switching when used on a 800/ 420 KV effectively grounded system and perform make and break operations as per the stipulated duty cycles satisfactorily.

2.3 The breaker shall be capable of interrupting the steady state and transient magnetizing current corresponding to Auto transformers.

2.4 The circuit breaker shall also 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 (Kilometric 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.

iv) 800/420 KV breakers shall be able to switch in and out the shunt reactor for any value from 50 MVAR up to 240 MVAR without giving rise to overvoltage more than 2.3 p.u. Laboratory test and or field test reports in support of the same shall be furnished along with the bid.

2.5 The breakers shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energisation of lines with trapped charges. The breaker shall also withstand the voltage specified under clause 18 of the Chapter.

2.6 Pre Insertion Resistor(Wherever Applicable):

800/420 kV circuit breakers wherever specified shall be provided with single step preinsertion closing resistors to limit the switching surges to a value of less than 1.9 p.u for 800 kV and 2.3 p.u. for 420 kV respectively. The value of the pre-insertion resistor and the duration of pre-insertion time shall be as given in clause 18.0 of this chapter. the resistor shall have thermal rating for the following duties:

i) TERMINAL FAULT

Close 1 Min Open Close open..... 2 min close 1 Min
..... open close open.

ii) RECLOSING AGAINST TRAPPED CHARGES

Duty same as under (i) above. The first, third and fourth closures are to be on deenergised line while second closing is to be made with lines against trapped charge of 1.2 p.u. of opposite polarity.

iii) OUT OF PHASE CLOSING

One closing operation under phase opposition that is with twice the voltage across the terminals.

iv) No allowance shall be made for heat dissipation of resistor during time interval between successive closing operations. The resistors and resistor supports shall perform all these duties without deterioration.

Calculations and test reports of resistors proving thermal rating for duties specified above shall be furnished during detailed engineering. The calculations shall take care of adverse tolerances on resistance values and time settings.

3.0 TOTAL BREAK TIME:

3.1 The total break time as specified under this chapter shall not be exceeded under any of the following duties:

i) Test duties T10, T30, T60, T100a, T100s (TRV as per IEC: 62271-100)

ii) Short line fault L75, L90 (--- do ---)

3.2 The bidder may please note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage (70-110%),. While furnishing the proof of the total break time of complete circuit breaker, the Bidders may specifically bring out the effect of non-simultaneity between contacts within a pole or between poles and show how it is covered in the guaranteed total break time.

3.3 The values guaranteed shall be supported with the type test reports.

4.0 CONSTRUCTIONAL FEATURES:

The features and constructional details of circuit breakers shall be in accordance with requirements stated hereunder.

4.1 Contacts

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

4.2 If multi break interrupters are used, these shall be so designed and augmented that a uniform voltage distribution is developed across them. Calculations/test report in support of the same shall be furnished. The thermal and voltage withstand of the grading elements shall be adequate for the service conditions and duty specified.

4.3 The SF6 Circuit Breaker shall meet the following additional requirements:

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

b) All gasketed surfaces shall be smooth, straight and reinforced, if necessary, to minimize distortion and to make a tight seal, the operating rod

connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals. The SF6 gas leakage should not exceed 1% per year. In case the leakage under the specified conditions is found to be greater than 1% after one year of commissioning of circuit breaker, the manufacturer will have to supply free of cost, the total gas requirement for subsequent ten (10) years, based on actual leakage observed during first year operation after commissioning.

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

d) Each pole shall form an enclosure filled with SF6 gas independent of two other poles and the SF6 gas density of each pole is monitored.

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

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

f) Each circuit breaker shall be capable of withstanding a vacuum of minimum 8 millibars without distortion or failure of any parts.

g) Sufficient SF6 gas including that will be required for gas analysis during testing shall be provided to fill all the circuit breakers installed. In addition spare gas shall be supplied in separate unused cylinders.

h) Suitable SF6 gas filling adopter one number each for each voltage rating (765/400KV) shall be supplied along with breaker.

(i) One number portable / Hand held SF6 gas leakage detector shall be supplied for the entire lot of breakers.

j) Portable SF6 filling unit with Vacuum pump.

4.4 Provisions shall be made for attaching an operational analyzer after installation of circuit breakers at site to record contact level, speed and making measurement of operating timings, Pre-insertion timings of closing resistors if used, synchronization of contacts in one pole.

5.0 SULPHUR HEXAFLUORIDE GAS (SF6 GAS):

a) The SF6 gas shall comply with IEC 376, 376A and 376B and shall be suitable in all respects for use in the switchgear under the operating conditions.

b) The high pressure cylinders in which the SF6 gas is shipped and stored at site shall comply with requirements of the relevant standards and regulations.

c) Test: SF6 gas shall be tested for purity, dew point, air, hydrolysable fluorides and water content as per IEC 376, 376A and 376B and test certificates shall be furnished indicating all the tests as per IEC 376 for each lot of SF6 gas. Gas bottles should be tested for leakage during receipt at site.

d) SF6 gas Cylinder

6.0 INSULATORS:

a) The porcelain of the insulators shall conform to the requirements

b) The mechanical characteristics of insulators shall match with the requirements specified under this chapter.

c) All insulators shall conform to IEC- 61624 (for pressurized hollow column insulators) and IEC-233 (for others). All routine and sample tests shall be conducted on the hollow insulators as per these standards with requirements and procedures modified as under:

i) Pressure test as a routine test.

ii) Bending load test as a routine test.

iii) Bending load test as a sample test on each lot.

iv) Burst pressure test as a sample test on each lot.

v) In addition to the above ultrasonic test shall be carried out as additional routine test

d) Hollow porcelain for pressurized columns/chambers should be in one integral piece in green and fired stage.

7.0 OPERATING MECHANISM AND CONTROL:

7.1 General requirements:

7.1.1 Circuit breaker shall be operated by spring/hydraulic or its combination. The mechanism shall be housed in a weather proof and dust proof control cabinet.

7.1.2 The operating mechanism shall be strong rigid, not subject to rebound and shall be readily accessible for maintenance for a man standing in ground.

7.1.3 The mechanism shall be anti pumping and trip free (as per IEC definition) under every method of closing.

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

7.1.5 A mechanical indicator shall be provided to show open and close position of the breaker. It shall be located in a position of the breaker where it will be visible to a man standing on the ground level with the mechanism housing closed. An operation counter shall also be provided in the central cabinet. A plat form for manual operation / Spring charging and for routine check must be provided for breakers of all voltage class.

For Manual spring charging operation through operating handle. it is desired that mechanism box may be mounted at adequate height and gear ratio shall be so chosen that one man standing at ground level/safe platform and is able to manually charge the spring without much effort.. The operating handle for charging the spring shall be inserted from side of mechanism box and not from bottom. The spring charging facility shall have ease of operation and the movement of handle shall be in vertical plane only. The Bidder should enclose G.A. Drawings with the above provision.

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

7.1.7 The bidder shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker. The instruction manuals shall contain exploded diagrams with complete storage handling, erection, commissioning, troubleshooting, servicing and overhauling instructions.

7.2 Control:

7.2.1 The close and trip circuit shall be designed to permit use of momentary contact switches and push buttons.

7.2.2 Each breaker pole shall be provided with two (2) independent tripping circuits, pressures switches and coils each to be fed from separate DC Sources and connected to a different set of protective relays.

7.2.3 The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However provisions shall be made for local electrical control. For this purpose a local/remote selector switch and close and trip control switch/push buttons shall be provided in the Breaker central control cabinet.

7.2.4 The trip coils be suitable for trip circuit supervision during both open and close position of breaker. The trip circuit supervision relay would be provided on relay panels.

7.2.5 Closing coil and associated circuits shall operated correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip coil and associated circuit shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage. However, even at 50% of rated voltage the breaker shall be able to operate. If additional elements are introduced in the trip coil circuits, their successful operation and reliability for similar applications on outdoor circuit breakers shall be clearly brought out in the additional information schedules.

7.2.6 Density meter contact and pressure switch contact shall be suitable for direct use as permissive in closing and tripping circuits. Separate contacts have to be used for each of tripping and closing circuits. If contacts are not suitably rated and multiplying relays are used then fail safe logic/schemes are to be employed. DC supplies for all auxiliary circuits shall be monitored and provision shall be made for remote annunciations and operation lockout in case of DC failures. Density monitors are to be so mounted that the contacts do not change on vibration during operation of circuit Breaker.

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

8.0 Spring operated mechanism:

a) 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.

b) 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.

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

d) 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 sec for full charging of the closing spring.

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

f) 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.

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

h) 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.

Hydraulically operated mechanism:

a) Hydraulically operated mechanism shall comprise of operating unit with power cylinder, control valves, high and low pressure reservoir, motor.

b) The hydraulic oil used shall be fully compatible for the specified temperature range.

c) The oil pressure switch controlling the oil pump and pressure in the high pressure reservoir shall have adequate number of spare contacts to be used for continuous monitoring of low pressure, high pressure etc.

d) The mechanism shall be suitable for at least two close open operations after failure of AC supply to the motor starting at pressure equal to the lowest pressure of auto reclose duty plus pressure drop for one close open operation.

e) The mechanism shall be capable of operating the circuit breaker correctly and performing the duty cycle specified under all conditions with the pressure of hydraulic operated fluid in the operating mechanism at the lowest permissible pressure before make up. The opening time at the lowest pressure for a particular operation shall not exceed the guaranteed operating time within any value of trip coil supply voltage as specified.

f) Trip lockout shall be provided to prevent operations of the circuit breaker below the minimum specified hydraulic pressure. Alarm contacts for loss of Nitrogen shall be provided.

g) All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage at a minimum of 1.5 times maximum working pressure.

9.0 SUPPORT STRUCTURE:

a) The structure design shall be such that during operation of circuit breaker vibrations are reduced to minimum.

b) The contractor shall provide suitable platform with steps on both sides of the circuit breaker for easy accessibility for monitoring the density/pressure of gas and for local operation.

10.0 TERMINAL CONNECTOR PAD:

The circuit breaker terminal pads shall be made up of high quality electrolytic copper or aluminum. The terminal pad shall have protective covers which shall be removed before interconnections. The terminal connectors of the 800 KV breaker shall be suitable for 4.5" Aluminium tube of expansion type and 420 KV breaker shall be suitable for 4" Aluminium tube of expansion type.

11.0 INTERPOLE CABLING:

11.1 All cables to be used by contractor shall be as per IS-1554 (1100 Volts Grade). All cables within & between circuit breaker poles shall be supplied by the CB manufacturer.

11.2 Only multi stranded conductor shall be used. Minimum size of the conductor shall be 2.5 sq.mm (Copper).

11.3 The cables shall be with oxygen index Min. 29 and temp index as 250°C as per relevant standards.

12.0. OPERATING MECHANISM HOUSING :

The operating mechanism housing/control cabinet shall conform to the requirement specified below.

Operating mechanism and all accessories shall be enclosed in a weather-proof cabinet of sheet steel construction, the thickness of which shall not be less than 3mm. **Hinged doors giving access to the mechanism and panel wiring at the front and rear shall be provided.** The enclosure shall conform to the degree of protection IP-55.

Suitable space heaters shall be mounted in the housing to prevent condensation. Heaters shall be controlled by differential thermostat so that the cubicle temperature is always, maintained approximately 10 deg C above the outside air temperature. ON/OFF switch and fuse shall be provided for the heaters. Heaters shall be suitable for 240 V AC single phase supply. The heater leads shall be covered with porcelain material up to sufficient length to avoid melting of insulation of the leads.

Adequate number of cable glands shall also be provided along with control cabinet. The number of terminals provided shall be adequate enough to wire out all contacts and control circuits with 10% extra terminals.

13.0. INTERLOCKS ALARMS AND INDICATIONS :

13.1. Potential free contacts shall be provided, duly wired upto to the operating mechanism housing/control cabinet for the following alarms and indications.

ALARMS :

- (a) Low pressure of SF6 gas.
- (b) Auto reclosing lock out for low pressure of gas
- (c) General lock-out for SF6 gas.
- (d) Pole discrepancy
- (e) Auxiliary AC/DC failure.

INDICATIONS :

- (a) Breaker on off (Both Electrical/Mechanical)
- (b) Spring charged (Both Electrical/Mechanical)
- (c) Mechanical operation counter.

13.2. It is proposed to electrically interlock the circuit breaker with TANTRANSCO's associated air break isolating switches in accordance with switchyard safety interlocking scheme. All spare contacts in Auxiliary switch will be brought out. Sufficient spare terminal preferably minimum 60 terminals in a separate terminal block may be provided in the central control cubicle for wiring 10 NO + 10 NC spare contact from each pole. All accessories required on breaker side for satisfactory operation of the scheme shall be deemed to be included in the scope of supply of this specification.

13.3. The operating mechanism housing, control cabinets, support structure etc. shall be provided with two separate earthing terminals suitable for bolted connection to mild steel flat to be provided.

14.0 CONTROLLED SWITCHING REQUIREMENTS

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

a. for 765 kV

- Switching of transformer
- Switching of shunt reactor

The controller shall be provided in Circuit breaker of switchable line reactor and in Main & Tie circuit breakers of Transformers and Bus reactors.

b. for 400 kV

- Switching of shunt reactor.

The controller shall be provided in Circuit breaker of switchable line reactor and in Main & Tie circuit breakers of Bus reactors.

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.

14.1 Technical Requirement for controlled switching device.

a) The controller shall be designed to operate at the correctly and satisfactorily with the excursion of auxiliary A/C & DC voltages and frequency.

b) The controller 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.

c) The controller shall have functions for switching ON & OFF the circuit breakers.

d) The controller 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.

e) The controller 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. In calculation of next operating time of the breaker the controller must consider all factors that may affect the operating time of the breaker such as, but not limited to, ambient temperature, hydraulic/pneumatic pressure of the operating mechanism, control voltage variation, SF6 gas density variations etc. Schematic drawing for this purpose shall be provided by the contractor. The accuracy of the operating time estimation by the controller shall be better than + 0.5 ms.

f) The controller should have display facility at the front for the settings and measured values.

g) The controller should be PC compatible for the setting of various parameters and down loading of the settings and measured values date time of switching etc. Window based software for this purpose shall be supplied by the contractor to be used on the owner's PC.

h) The controller shall have self-monitoring facility.

i) The controller shall be suitable for current input of 1 amp from the secondary of the CTs. and 110 V (Ph to Ph) from the CVTs. The controller shall also take care of transient and dynamic state values of the current from the secondary of the CTs and CVTs.

j) The controller shall have time setting resolution of 0.1 ms or better.

k) The controller 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.

15.0 FITTINGS AND ACCESSORIES

15.1 Following is a partial list of some of the major fittings and accessories to be furnished by the contractor in the central control cabinet. Number and exact location of these parts shall be indicated in the bid:

- i) Cable glands (double compression type). Lugs ferrules etc
- ii) Local/ remote change over switch.
- iii) Operation counter.
- iv) Pressure gauges.
- v) Control switches to cut off control power supply
- vi) Fuses as required.
- vii) The number of terminals provided shall be adequate enough to wire out all contacts and control circuits plus 24 terminals spare for future use.
- viii) Antipumping relay.
- ix) Pole discrepancy relay.
- x) D.C Supervision relays.
- xi) Rating and diagram plate in accordance with IEC incorporating year of manufacture.
- xii) one number Adopter for each voltage rating (765 KV, 420 KV) for SF6 Gas filling (Breaker to filling hose)

16.0 ADDITIONAL DATA TO BE FURNISHED ALONGWITH THE OFFER:

- a) Drawing showing contacts in close arc initiation full arcing, arc extinction and open position.
- b) The temperature v/s pressure curves for each setting of density monitor along with details of density monitor.
- c) Method of checking the healthiness of voltage distribution devices (condensers) provided across the breakers at site.

d) Data on capabilities of circuit breakers 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.

e) The effect of non-simultaneity between poles and also show how it is covered in the guaranteed total time.

f) Sectional view of non-return coupling is used for SF6 pipes.

g) Details & type of filters used in interrupter assembly and also the operating experience with such filters.

h) Details of SF6 gas.

i) The test methods used in controlling the quality of gas in the circuit breakers particularly purity & moisture content.

ii) Proposed tests to assess the conditions of the SF6 within a circuit breaker after period of service particularly with regard to moisture contents of the gas.

17.0 TESTS:

17.1 The circuit breaker along with its operating mechanism shall conform to IEC: 62271 -100.

17.2 The test reports of the type test and following additional type tests shall also be submitted for purchaser's review:

i) Corona extinction voltage test.

ii) Out of phase closing test as per IEC: 62271-100

iii) Line charging breaking current for providing parameters as per IEC:62271-100

iv) Test to demonstrate the power frequency withstand capability of breaker in open condition at Zero Gauge pressure (Ref. Clause 4.1.1) and lockout pressure.

v) Seismic withstand test (As per annexure B of chapter GTR) in unpressurised condition.

vi) Verification of the degree of protection.

vii) Low & high temperature test (if applicable)

- viii) Humidity test (if applicable)
- ix) Static Terminal load test.
- x) Critical current test (if applicable)
- xi) Switching of shunt Reactors.

17.3 Routine Tests:

Routine tests as per IEC: 62271-100 /latest IS shall be performed on all circuit breakers.

In addition to the mechanical and electrical tests specified by IEC- the following tests shall also be performed.

1) Speed curves for each breaker shall be obtained with the help of a suitable operation analyzer 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/hydraulic pressure etc.). The tests shall show the speed of contacts directly at various stages of operation etc. This shall also be performed at site for which the necessary operation analyzer along with necessary transducers, cables, console, etc. Where included in scope of supply shall be furnished and utilized. In case of substations where operation analyzer is existing the bidder shall utilize the same. However necessary adopter and transducers etc., if required shall have to be supplied by the bidder.

2) Measurement of Dynamic Contact resistance measurement for arcing & main contacts, signature of Dynamic contact resistance measurements shall be taken as reference for comparing the same during operation and maintenance in order to ascertain the healthiness of contacts.

3) Routine tests on Circuit breakers with Controlled switching equipment as per IEC.

17.4 SITE TESTS:

All routine tests except power frequency voltage dry with stand test on main circuit breakers shall be repeated on the completely assembled breaker at site.

18.0 TECHNICAL PARAMETERS:

A. 800 KV CIRCUIT BREAKER:

Sl.No	Description	Requirement
1	Rated continuous current (A) at design	3150

	Ambient temperature	
2	Rated Short circuit current breaking Capacity at rated voltage	50 KA with percentage DC Component as per IEC -56 corresponding to minimum Opening time under operating Conditions specified
3	Symmetrical interrupting capability (kA rms)	50
4	Rated short circuit making current (kA peak)	125
5	i) Short time current carrying capability for one sec. (kA rms) ii) Out of phase breaking current capacity (kA rms)	50 12.5
6	Rated operating duty	0-0.3 sec CO -3 min CO Cycle
7	Reclosing	Single Phase & three phase auto closing
8	First pole to clear factor	1.3
9	Rated line charging interrupting current at 90 deg. Leading power factor angle A (rms)	900
	(The breaker shall be able to interrupt the rated line charging current with test voltage Immediately before opening equal to the product of $U/\sqrt{3}$ & 1.4 as per IEC: 62271-100	
10	Temperature rise over the design ambient temperature	As per IEC: 62271 -100
11	Total break time as per IEC (ms)	45
12	Rated break time as per IEC (ms)	40
13	Total closing time (ms)	Not more than 150.
14	Operating mechanism	Spring/hydraulic or its combination
15	Max. difference in the instants of	

	Closing/opening of contacts	
	i) Within a pole (ms)	2.5
	ii) Between poles (opening)(ms)	3.3
	iii) Between poles (closing)(ms)	5.0
	The above shall be at rated control voltage and rated operating and quenching Media pressures	
	Trip coil closing coil voltage	220 V DC with variation as specified
	Noise level at base and upto 50 m (distance from base of breaker	140 dB MAX
	Rated terminal load	As per IEC
	Auxiliary contacts	Besides requirement of Specification, The bidder shall wire up 10 NO +10 NC Contacts for future use of purchaser per phase
	No of terminals in common control cabinet	All contacts & control circuits to be Wired out up to common control Cabinet plus 24 terminals exclusively for Purchaser's use.
	Maximum allowable switching overvoltage Under any switching condition	1.9 p.u
16	Pre-insertion resistor requirement	
	Rating (ohms)	450 (Maximum)
	Minimum Electrical pre-insertion time (ms)	9
	Opening of PIR contacts	PIR Contacts should open immediately after closing of main circuits or Atleast 5 ms

		prior to opening of main contacts at rated air/gas pressure, where the PIR Contacts remain closed.
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B. 420 KV CIRCUIT BREAKER:

Sl.No	Description	Requirement
1	Rated continuous current (A) at design Ambient temperature	3150
2	Rated Short circuit current breaking Capacity at rated voltage	63 KA with percentage DC Component as per IEC -56 corresponding to minimum Opening time under operating Conditions specified
3	Symmetrical interrupting capability (kA rms)	63
4	Rated short circuit making current (kA peak)	157.5
5	i) Short time current carrying capability for one sec. (kA rms) ii) Out of phase breaking current capacity (kA rms)	63 15.75
6	Rated operating duty	0-0.3 sec CO -3 min CO Cycle
7	Reclosing	Single Phase & three phase auto closing
8	First pole to clear factor	1.3
9	Rated line charging interrupting current at 90 deg. Leading power factor angle A (rms)	600
	(The breaker shall be able to interrupt the rated line charging current with test voltage Immediately before opening equal to the product of $U/\sqrt{3}$ & 1.4	

	as per IEC: 62271-100	
10	Temperature rise over the design ambient temperature	As per IEC: 62271 -100
11	Total break time as per IEC (ms)	45
12	Rated break time as per IEC (ms)	40
13	Total closing time (ms)	Not more than 150.
14	Operating mechanism	Spring/hydraulic or its combination
15	Max. difference in the instants of Closing/opening of contacts i) Within a pole ii) Between poles (opening) iii) Between poles (closing)	 2.5 3.3 5.0
	The above voltage shall be at rated control voltage and rated operating and quenching Media pressures	
	Trip coil closing coil voltage	220 V DC with variation as specified
	Noise level at base and upto 50 m (distance from base of breaker)	140 dB MAX
	Rated terminal load	As per IEC
	Auxiliary contacts	Besides requirement of Specification, The bidder shall wire up 10 NO +10 NC Contacts for future use of purchaser per phase
	No of terminals in common control cabinet	All contacts & control circuits to be Wired out up to common control Cabinet plus 24 terminals exclusively for Purchaser's use.

	Maximum allowable switching overvoltage Under any switching condition	2.3 p.u
16	Pre-insertion resistor (if required)	
	Rating (ohms)	400 (Maximum)
	Minimum Electrical pre-insertion time (ms)	8
	Opening of PIR contacts	PIR Contacts should open immediately after closing of main circuits or Atleast 5 ms prior to opening of main contacts at rated air/gas pressure, where the PIR Contacts remain closed.

19.0 TESTING AND COMMISSIONING:

19.1 An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field Q.P/Instructions of the equipment Supplier or purchaser without any extra cost to the employer. The contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the employer for approval.

- a) Insulation resistance of each pole.
- b) Check adjustments, if any suggested by manufacturer.
- c) Breaker closing and opening time.
- d) Slow and power closing operation and opening.
- e) Trip free and anti pumping operation
- f) Minimum pick-up voltage of coils.
- g) Dynamic Contact resistance measurement.
- h) Functional checking of compressed air plant and all accessories.

- i) Functional checking of control circuits interlocks trapping through protective relays and auto reclose operation.
- j) Insulation resistance of closing and tripping coils
- k) Resistance of closing and trapping coils
- l) SF6 Gas leakage check
- m) Dew point Measurement
- n) Calibration of pressure switches and gas density monitor.
- o) Checking of mechanical "CLOSE" interlock, wherever applicable

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SECTION – 3

GENERAL TECHNICAL REQUIREMENTS

3.0 FOREWORD

The provisions under this section are intended to supplement general requirements for the materials, equipment's and services covered under other sections.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a) Customer : M/s Tamil Nadu Transmission Corporation Limited

b) Project Title : 765/400KV AIS SUB STATION AT ARIYALUR

c) Transport facilities : Road/Rail

Physical and other parameters:

3.1.1 Location of the substation

3.1.2 Nearest Railway station : Tindivanam
Railway : Southern Railway

3.1.3 Meteorological data

- | | |
|---|----------------|
| (i) Atmosphere | : Polluted |
| (ii) Maximum ambient temperature | : 50°C |
| (iii) Minimum ambient temperature | : 20°C |
| (iv) Maximum daily average ambient air temperature | : 45° C |
| (v) Maximum yearly average ambient air temperature | : 32° C |
| (vi) Maximum Humidity (%) | : 100% |
| (vii) Average thunder storm days per annum | : 50 |
| (viii) Average rainy days per annum | : 65 |
| (ix) Average annual rainfall (mm) | : 750 mm |
| (x) No. of months during which tropical monsoon condition prevail | : 3 |
| (xi) Maximum wind pressure | : 150 Kgf/Sqmm |
| (xii) Altitude above MSL | : <1000M |

(xii) Basic Wind Speed

: 39 m/s (Zone -2)

However for design purpose, ambient temperature should be considered as 50° C and relative humidity as 100%.

3.1.4 System Parameter

SL No	Description of parameters	765kV System	400 kV System
1.	System operating Voltage	765kV	400k V
2.	Maximum operating voltage of the system(rms)	800kV	420k V
3.	Rated Frequency	50HZ	50H
4.	Number of Phases	3	3
5.	Rated Insulation Levels (i)Full wave impulse withstand voltage.(1.2 to 50 micro sec) (ii)Switching impulse withstand voltage(250/2500 micro sec) dry and wet. (iii) One minute power frequency dry withstand voltage (rms)frequency dry withstand voltage (rms)	2100kVp 1550kVp 830kV	1550kVp 1050kVp 630kV
6.	Corona extinction voltage	508kV	320kV
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV, and 266kV rms for 400kV system	2500 microvolts	1000 microvolts
8.	Minimum creepage distance (25mm/kV)	20000 mm	10500 mm
9.	Rated short circuit current for 1 sec. Duration	50kA	63kA
10.	System neutral earthing	Effectively earthed	Effectively earthed
11.	Seismic acceleration	0.3g horizontal	0.3g horizontal
12.	Plinth level of switchyard	500mm above FGL <i>3.10</i>	300mm above FGL

3.1.5 AUXILIARY POWER SUPPLY :

Auxiliary electrical equipment's maintenance equipment's etc., shall be suitable for operation on the following supply system.

3 phase AC Supply	415V, 3 phase 4 wire 50 Hz, neutral grounded AC supply -10% to +10%, frequency +/- 5%
1 phase AC supply	240V, single phase, 50 Hz neutral grounded AC supply
DC supply	220, 2 wire DC supply + 10% to -15%, Ungrounded 48V, 2 wire DC supply , Positively earthed

3.2 GENERAL REQUIREMENT

3.2.0 ALL THE EQUIPMENTS / MATERIALS TO BE SUPPLIED SHOULD BE IN ACCORDANCE WITH RELEVANT LATEST / AMENDED IS/IEC, WHETHER IT HAS BEEN SPECIFICALLY MENTIONED IN THE SPECIFICATION OR NOT.

3.2.1 The bidder shall also furnish drawings for the following:

All EQUIPMENTS and type of clamps, fittings hardware's, insulators, bus bar . These designs / drawing shall be got approved by the purchaser before commencing the manufacture / construction / erection and are to be as per latest IS /IEC.

3.2.2 GENERAL:

The bidder shall be fully responsible for providing all equipment, materials system and services specified or otherwise which are required to complete the construction and successful commissioning of the substation in all respects.

Any other items not specifically mentioned in the specification but which are required for erection of materials/equipment under the scope of work, testing and commissioning are deemed to be included in the scope of the specification unless specifically excluded.

All items shall be supplied as per schedule and as specified in the relevant Indian standard of latest revision. The Technical specification of the main materials/equipment is furnished. The Technical specification contained herein for the materials are for the guidance of the tenderer.

The bidders are requested to procure the equipment's/materials/component only from reputed /qualified manufacturer as per Technical requirement stipulated in Section - I of Technical specifications. Approval of make of item shall be taken up by vendor from TANTRANSCO himself.

3.3 SPECIFIC REQUIREMENT

The bidder shall furnish make/manufacturer, catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification and get approval from competent authority before commencement of any work.

All steel materials, other than materials for earthing should be of galvanized if not specified.

3.4 STANDARD:

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 (as on the date of bid opening) of standards specified in each section.

The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.

The Bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.5 TYPE TEST:

The Type Test for all the equipments/materials used for this project should have been conducted in any approved Government/Govt. recognized laboratories conforming to latest IS/IEC. The above type test certificates should accompany the drawings of the materials equipments, duly signed under seal by the Institution, who have issued the type test certificate. The above type test should have been conducted not earlier than Ten years , subject to no change in design as on the originally scheduled date of technical bid opening i.e. **30.09.2016**

In case the type tests were conducted earlier than 10 (ten) years prior to the originally scheduled date of bid opening, the contractor shall repeat these test (s) at no extra cost to the purchaser.

However, in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the originally scheduled date of bid opening.

- i) Lightning Impulse Test
- ii) Switching Impulse Test
- iii) Multiple Chopped Impulse Test (For CT)
- iv) Chopped Impulse Test (For CVT)

In case the test reports are of these tests (for instrument transformers) as mentioned above are conducted earlier than 5 (five) years prior to the originally scheduled date of bid opening, the contractor shall repeat these test(s) at no extra cost to the BHEL. The original type test certificates shall be furnished for verification on request.

TANTRANSCO/BHEL reserves the right to demand repetition of some or all the type tests in the presence of purchaser's representative at no extra cost.

Non furnishing of type test certificates by the tenderers, will be liable for rejection.

3.6 MATERIALS AND WORKMANSHIP:

All the materials shall be of the best class and capable of satisfactory operation in the tropics with humid atmosphere conditions. Unless otherwise specified, they shall conform to the requirements of the appropriate ISS/IEC. The workmanship shall be of the best grade and the entire construction in accordance with the best modern practice.

The equipment shall be designed to facilitate inspection and repairs and to ensure satisfactory operation under atmosphere condition prevailing at site and under such sudden variation of load and voltage as may be met with under working conditions in the system including those due to faulty synchronizing and short circuit within the rating of the apparatus.

The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment.

All the equipment's should operate without undue vibration and with the least practicable amount of noise.

3.7 **INSPECTION** :

The inspection may be carried out by the TANTRANSCO/BHEL at any stage of manufacture. The supplier shall grant free access to TANTRANSCO's/BHEL representative at a reasonable time when the work is in progress. The TANTRANSCO/BHEL shall have access at all times to the works and all other places of manufacture/fabrication, where the equipments are being manufactured/fabricated and the bidder shall provide TANTRANSCO's/BHEL representative all facilities for unrestricted inspection of the works, raw materials, manufacture of all the accessories and for conducting necessary tests.

Inspection and acceptance of any equipment under this specification by the TANTRANSCO/BHEL shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective. The supplier shall keep the TANTRANSCO/BHEL informed in advance, about the manufacturing programme so that arrangement can be made for inspection.

The TANTRANSCO/BHEL , reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

The correct grade and quality of steel shall be used by the supplier. To ascertain quality of steel, the TANTRANSCO/BHEL may at his discretion get the material tested at an approved laboratory.

The bidder shall take an account the fabrication wastage while quoting the rates. The Employer will not accept any liability in connection with the wastage of steel during fabrication or otherwise. Steel shall be procured exclusively from the main producers. However, sections not rolled by main produces can be procured from reroller , provided rerolling of structural steel section is done rom billets/ingots of tested quality. Rerolled sections are duly tested as per relevant standards. Supplier should obtain approval of list of primary producers of Steel and Zinc before Proto assembly .

The BHEL/TANTRANSCO or his representative shall have the right to inspect and/or test the goods /works to confirm their conformity to the supplier. BHEL/TANTRANSCO shall notify the supplier in writing of the identity of any representatives authorized for these purposes.

The inspections and tests may be conducted on the premises of the supplier or his Sub vendor at the point of delivery and /or at the goods' final destination. Where tests are conducted in the premises of Supplier, all reasonable facility and assistance including access to drawings and production data shall be furnished at no charge to the BHEL.

Should any inspected or tested goods fail to conform to specifications, the BHEL/TANTRANSCO may reject them and the supplier shall either replace the rejected goods or make all alterations necessary to meet specification requirements free of cost to the BHEL/TANTRANSCO within one week of intimation.

The BHEL/TANTRANSCO's right to inspect, test and where necessary reject the goods after the goods; arrival at the site, shall in no way be limited or waived by reason of the goods having been previously inspected. Tested and passed by the BHEL/TANTRANSCO or his representative prior to the goods dispatch.

Not less than 15 (Fifteen) days advance intimation shall be given about the quantity of materials that will be ready for inspection by the officers of TANTRANSCO/ BHEL/Third agency authorized by the Corporation. The materials should not be dispatched without instruction from the Corporation.

3.8 GUARANTEE:

The supplier shall guarantee that the goods under the Contract are new, unused of the most recent or current models and incorporated all recent improvements in design and materials unless provided otherwise in the Contract. The supplier shall further guarantee that the goods supplied under this Contract shall have no defects arising from design, materials or workmanship, installation and erection, if that may develop under normal use of the supplied goods. The supplier shall also guarantee the performance of the works executed by him including the performance of all the materials/goods supplied by him.

BHEL shall promptly notify supplier in writing of any claims arising under guarantee in respect of goods. Upon receipt of such notice, the supplier shall, with all reasonable speed, repair or replace the defective works or parts thereof, free of cost at site. All the expenses towards transportation of defective parts to supplier's works and of repaired/replaced parts to site shall be borne by the Supplier.

If the Supplier, having been notified, fails to remedy the defects within 14 days, the BHEL will proceed to take such remedial action as may be necessary, at the supplier's risk and expenses. All expenses in this regard will be recovered from Supplier.

3.9 PRE COMMISSIONING TESTING (if applicable) :-

On completion of erection of equipment's and before charging each item of equipment's shall be thoroughly cleaned and inspected jointly by the TANTRANSCO and the BHEL for correctness and completeness of installation and acceptability for charging leading to initial pre commissioning test. The pre commissioning testing to be carried all equipment's in the presence of BHEL/ TANTRANSCO. Necessary tools, testing kits to be arranged by the Supplier.

3.10 DOCUMENTATION : All drawings shall conform to relevant international standards Organization (ISO) specification. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. units.

3.11 PAINING, GALVANISING:

All interiors and exteriors of all metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter and the surfaces treated by phosphating (e.g. seven tank phosphating sequences).

All metal surfaces exposed to atmosphere shall be given, in addition to the treatment, 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 otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade **No.697/631 of IS-5**.

Paint inside the metallic housing shall be of anti condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

All components shall be given adequate treatment of climate proofing as per **IS: 3202** so as to withstand corrosive and several service conditions.

All ferrous parts including all sizes of nuts, bolts, support channel structures, etc. as also the mechanism housing shall be hot dip galvanized conforming to latest version of IS : 2629 or epoxy painted. Spring washers shall be electro-galvanised.

All members of the structure members shall be hot dipped galvanised with a zinc coating of **610 gms. per square metre** . Galvanising shall be done after a work is completed, except that the nuts may be tapped or rerun after galvanization. The zinc coating shall be smooth, clean, of uniform thickness and free from defects. The preparation for galvanising itself shall not adversely affect the mechanical properties of the coated materials. The employer shall be at liberty to have the samples of zinc used, test checked in any laboratory at his own cost and reject the particular supply if it is below standard.

All galvanised material shall withstand test as per IS 2633-1972 or any other equivalent standard. The zinc used for galvanising fabricated material shall be of high grade Electrolytic zinc of 99.99% purity.

All nuts and pins shall be adequately locked. Nuts, bolts and pins used inside the transformer and tap-changer compartment where gaskets are not used shall be provided with spring washers or locknuts. Where galvanizing is specified, it shall be applied by the hot dipped process or by electro-galvanizing process and for all parts, other than steel wires, shall consist of a thickness of zinc coating equivalent to not less than 610gm of zinc per square meter of surface. The zinc coating shall be smooth, of uniform thickness and free from defects.

3.12 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 otherwise 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.

3.13 PROTECTION

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.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.14 FUNGI-STATIC 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.

3.15 DEGREE OF PROTECTION

The supplier shall propose following Degree of protection for those equipment/Items for which the degree of protection has not been specified in the specification for the approval of BHEL/TANTRANSCO. The decision of BHEL/TANTRANSCO shall be final. The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

- a) Installed outdoor: IP-55
 - b) Installed indoor in air conditioned area: IP-42
 - c) Installed in covered area IP:52
 - d) For LT switchgear (AC & DC distribution Boards): IP-54
- The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.16 RATING PLATES, NAME PLATES AND LABELS :-

The equipment's shall be provided with a rating plate or plates marked with but not limited to following data whatever needs to that particular equipment's.

- (a) Manufacturer's name or trade mark.
- (b) Serial number and type design making it possible to get all relevant information from the manufacturer.
- (c) Year of manufacture.
- (d) Rated voltage
- (e) Rated insulation level.
- (f) Rated frequency
- (g) Rated Normal current.
- (h) Rated short circuit breaking current
- (i) First pole to clear factor
- (j) Rated duration of short circuit
- (k) Rated auxiliary D.C. supply voltage of closing and opening devices.
- (l) Rated pressure of SF6 gas for operation and interruption.
- (m) Rated out of phase breaking current.
- (n) Rated supply voltage of auxiliary circuit.
- (o) Rated supply frequency of auxiliary circuits.
- (p) Purchase Order Number and Date.

The rating plate shall be visible in position of normal service and installation.
The rating plate shall be weather proof and corrosion proof.

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may be required by the BHEL/TANTRANSCO. The rating plate for each equipment shall be according to IEC requirements.

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Alternately two separate plates one with Hindi and other with English inscriptions may be provided. During approvals drawings of Rating/name plates/labels shall also be submitted.

3.17 EARTHING :

The operating mechanism housing, control cabinets, support structure etc. shall be provided with two separate earthing terminals suitable for bolted connection to 50x8mm mild steel flat to be provided for connection to station earth mat.

Circuit breakers, LA, Isolator, CVT, CT, BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat of Size 75X12 mm. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.18 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on

each side.

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm.copper flexible.
All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible.

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

TB sizes for incoming power supply shall be informed/confirmed during drawing approval stage.

3.19 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled Neoprene /EPDM gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary

to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required.

3.20 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment.

3.21 DELIVERY OF GOODS AND DOCUMENTS RELATED THERETO:

Delivery of goods shall be made by the supplier in accordance with the terms specified by the BHEL in its schedule of requirements.

3.22 INCIDENTAL SERVICES:

The Supplier is required to provide any or all the services broadly outlined in the Technical specification. Any other minor incidental service related to the scope of work like providing necessary assistance whether specifically mentioned or not must be carried out by the Supplier at his own cost. All tools, Tackles Plant etc., required for completion of above works shall be brought by the Supplier.

3.23 DISCREPANCIES BETWEEN DRAWING AND SPECIFICATION:

Should there be any discrepancy between the specifications and/or schedule of prices and/or drawings or any inconsistency, error or omission in either of them, reference must be made to the BHEL/TANTRANSCO for an explanation and the Supplier will be held responsible for any errors that may occur in the work through neglect of this precaution. The explanation of the BHEL/TANTRANSCO shall be final and binding on the Supplier.

3.24 LIST OF DRAWINGS AND DOCUMENTS :

The drawings for the equipments provided by the TANTRANSCO shall be followed strictly by the bidder while designing. For the rest of the equipments, the design is in the scope of the bidder and the

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same got approved by the TANTRANSCO.

The bidder shall furnish One sets of relevant descriptive and illustrative published literature pamphlets and the following drawings/documents for preliminary study along with the offer.

- (i) General outline drawings showing dimensions and shipping weights, quantity of insulating media, etc.
- (ii) Sectional views showing the general constructional features of the circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance.
- (iii) Schematic diagrams of breaker offered for control supervision and re-closing.
- (iv) Structural drawing, design calculations and loading data for support structures.
- (v) Foundation drilling plan and loading data for foundation design.
- (vi) The Type Test Reports
- (vii) Bill of materials shall be furnished along with drawings.

The supplier shall, within 1 weeks of placement of order submit Six sets of final version of all the above drawings for BHEL/TANTRANSCO's approval. The TANTRANSCO shall communicate its comments/approval on the drawings to the supplier within reasonable period. The Supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for TANTRANSCO's approval within two weeks from the date of comments.. However the drawing approval does not absolve the supplier from complying with the terms of the specification.

The following should be supplied to each consignee circle along with the initial supply of equipment's ordered.

- 1) Five copies of printed and bound volumes of operation, maintenance and erection manual in English along with the copies of approved drawings and type test reports etc.
- 2) Three sets of manuals detailed in item (1) shall be supplied to the TANTRANSCO/BHEL within one week from the date of approval of drawings.
- 3) The spares for the Equipment's ordered under the scope of the Contract should also be supplied to the consignee circle along with initial supply of the breakers.
- 4) It should be noted that if the above conditions are not fulfilled the initial payment will not be released.

3.25 QUALITY ASSURANCE PLAN :

The bidder shall invariably furnish following information along with his offer. (i) Statement giving list of important raw materials including but not limited to:

- (a) Contact material
- (b) Insulation
- (c) Porcelain
- (d) Sealing material
- (e) Contactor, limit switches, etc. in control cabinet.

Name of sub-supplier for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials in presence of bidder's representative,

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copies of test certificates.

- (ii) Information and copies of test certificates as in
- (i) above in respect of bought out accessories.
- (iii) List of areas in manufacturing process, where such inspections are normally carried out for quality control and details of such tests and inspections.
- (iv) Special features provided in the equipment to make it maintenance free.
- (v) List of testing equipment available with the Bidder for final testing of breakers vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule i.e. schedule of deviations from specified test requirements.

The supplier shall submit following information to the TANTRANSCO.

- 1) List of raw materials as well bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
- 2) Type test certificates of the raw material and bought out accessories.
- 3) Quality assurance plan (QAP) withhold points for TANTRANSCO inspection. The quality assurance plan and hold point shall be discussed between the employer and supplier before the QAP is finalized.

The supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled breaker.

3.26 **TEMPERATURE RISE :**

The maximum temperature attained by any part of the equipment when in service at site under continuous full load conditions and exposed to the direct rays of the sun shall not exceed 30 deg. Cover an ambient of 50 deg. C limits specified in relevant IEC. When the standard specify the limit of temperature rise these shall be exceeded when corrected for the difference between ambient temperature at site and that specified in the approved specifications. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

3.27 **FITTINGS AND ACCESSORIES :**

Following is a partial list of some of the major fittings and accessories to be furnished by contractor as an integral part of the equipment.

Operation mechanism housing complete with :

- (a) Locking arrangement.
- (b) Heaters equipped with automatic thermostatic control and control switch.
- (c) Cable glands.
- (d) Local/Remote change over switch.
- (e) Operation Counter.
- (f) Terminal Blocks.
- (g) Control switches to cut off control power supply.
- (h) MCCBs/MCBs are required with permanent identification marks for protection of D.C. circuits and A.C. circuits.
- (i) Two earthing terminals.

3.28 PACKING AND FORWARDING:

The equipment shall be packed in crates suitable for vertical/horizontal Transport, as the case may be and suitable to withstand handling transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit due to improper and inadequate packing and handling. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

The supplier shall provide such packing of the goods as is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit to their final destination as indicated in the Contract and exposure to extreme temperatures, salt and precipitation etc., during transport and open storage. Packing case size and weights shall be taken into consideration wherever appropriate, the remoteness of the 'goods' final destination and absence of heavy mechanized handling facilities, at all points in transit.

The packing, marking and documentation within and outside the package shall comply strictly with such special requirements as shall be expressly provided for in the Contract or in any subsequent instructions issued by BHEL.

3.29 SPECIFICATION FOR NITRYL BUTYL RUBBER

The gaskets are to be used in tanks exposed to Transformer mineral oil/SF6 at about 110° C.

1. Hardness should be Shore A 70 ± 5 .
2. Tensile Strength should be min. 10.8N/sq.mm (Minimum)
3. Elongation strength should be 270% (Minimum)

3.30 APPROVAL PROCEDURE

The scheduled dates for the submission of drawings as well as for, any data/information to be furnished by the Employer would be as per the following schedule. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the BHEL/TANTRANSCO. The following schedule shall be followed generally for approval.

i.	First Submission	7 days after LOI/PO
ii.	Approval/comments/by employer on Initial submission	Reasonable time
iii.	Resubmission	Within 7 days (whenever from date of comments required) Including both ways postal time.
iv.	Approval or comments	Within 2 weeks of receipt of resubmission.
v.	Furnishing of distribution copies	2 weeks from the date of last approval.

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Note: The supplier may please note that all resubmissions must incorporate, all comments given in the submission by the BHEL/TANTRANSCO failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer below mention Title block for Submission of Documents.

Title Block

Customer	M/s Tamil Nadu Transmission Corporation Limited
Project:	765/400KV Air Insulated substation Ariyalur
Contractor	BHEL

3.31 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

Drawings, GTP ,Type Test Reports and List of Past Supplies. Drawings & Documents

submitted at the time of offer shall be subject to review at contract stage.

3.31 DOCUMENTATION SCHEDULE

Following Documentation schedule to be followed per project.

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
				Prints	CDs
1	Drawings and Data Sheets	1	7	10	5
2	Drawings "As Built "	-	-	10	
3	Type Test Reports	1	7	10	
4	Erection Manuals	-	7	10	
5	Operation and Maintenance Manuals	-	7	10	
6	Manufacturing Quality Plan	-	7	10	
7	Field Quality Plan	-	7	10	
8	Inspection Test Reports	-	7	10	

Note: Drawings will also be submitted in CD/DVD in Latest AUTOCAD-2004 or Later version or any other CAD package along with conversion files for all major items. Final Documentation shall be submitted in bound volumes with details of Customer & Project etc. written on top.

SECTION-4

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF 420 KV ~~SW~~ AND 132KV GAS CIRCUIT BREAKERS

01.	Maker's name & country of manufacture	
02.	Manufacturer's type designation	
03.	Applicable technical standards	
04.	Rated voltage KV	
05.	Service Voltage KV	
06.	Rated continuous voltage for rated breaking capacity (c) Maximum kV (d) Minimum Kv	
07.	Type of circuit breaker	
08.	Ambient temperature assumed for designing (c) Maximum (d) Minimum daily (average)	
09.	Continuous current (c) Under site conditions Amps. (d) Rated Amps.	
10.	Rated short time current KA (RMS) (For 1 seconds)	
11.	Maximum rise of temperature over ambient for current rating under a) clause 9 above. b) clause 10 above.	
12.	Rated operating duty cycle	
13.	Interrupting capacity based on duty cycle in 12 above. (c) RMS value of AC component (d) Percentage DC component	
14.	Rated transient Recovery voltage (d) Method of representing TRV (e) Value of parameters (f) First pole to clear factor (d) Type of devices used to limit the rate of rise of re-striking voltage	
15.	Rated making capacity a) At higher Rated voltage (KA Peak) b) At lower rated voltage (KA Peak)	

16.	Rated line charging breaking current	
17.	Rated cable charging breaking current	
18.	Rated capacitor breaking current	
19.	Rated small inductive breaking current	
20.	Rated out of phase breaking current	
21.	Details of type test certificates enclosed.	
22.	No. of breaks in series per pole and type of devices, if any, used to obtain uniform voltage distribution between breaks.	
23.	Whether the breaker is suitable for control of generators, if so, give particulars.	
24.	Length of contact travel ,mm	
25.	Total length of break/pole ,mm	
26.	Rate of contact travel : At tripping : m/Sec. At closing : m/Sec.	
27.	Type of main contacts	
28.	Contacts resistance in micro ohms	
29.	Type of arcing - contacts and/or arc control device	
30.	Type of Auxiliary contacts	
31.	Materials of contacts (g) Main (h) Arcing (i) Auxiliary (j) Whether contacts are silver plated (k) Thickness of silver coating, mm/micron (l) Contact pressure kg/mm.	
32.	Insulation level of the breaker (d) One minute power frequency withstand voltage kV rms. (e) Impulse withstand test voltage kV (Peak) (f) Switching surge with stand test	
33	Radio Interference Voltage (i) Test Voltage (KV) (ii) RI level (Micro volt) Visual discharge voltage for falling power frequency voltage (KV)	

34.	Minimum clearance in air. (g) Between phases (live parts) mm (h) Between live parts and earth mm (i) Centre to centre distance between poles. Line to ground clearance	
35.	Whether the circuit breaker is fixed-trip or trip-free	
36.	Method of Tripping (d) Normal (e) Emergency	
37.	Type of closing mechanism	
38.	Normal voltage for closing (a) Satisfactory operation range (f) Pick up range volts	
39.	(i) Power at normal voltage of closing mechanism Watts. (ii) Power at 85% of normal voltage watts.	
40.	Type of tripping mechanism.	
41.	Normal voltage of tripping coils volts.	
42.	(i) Power at normal voltage for tripping coils Watts. (ii) Power at 70% normal voltage for tripping coils - watts. (iii) Minimum trip voltage in percentage. Of normal control voltage.	
43.	Arc duration at 100% interruption capacity. (c) Opening time in milli second measured from instant of application of power to opening device upto arcing contacts beginning to separate. (d) Total interrupting time measured from instant of trip coil energisation to arc extinction. (i) At 10% rated interrupting capacity. (ii) At rated interrupting capacity.	

	© Closing time measured from instant of application of power to closing device upto arcing contacts touching, in milli seconds. (d) Minimum reclosing time at full rated interrupting capacity from the instant of trip coil energisation. (j) Minimum dead time for 3 ph. Reclosing. (k) Make time. (l) Max. difference in the instant of losing/opening of contacts in ms. At rated control voltage and rated operating and quenching media pressure.	
44.	Creepage distance to ground (total/protected)	
45.	(d) Recovery voltage when circuit breaker tested at 100% rated breaking capacity. KV inst. (e) Rate of rise of re-striking voltage at (i) For 30% breaking capacity kV/micro sec. (ii) For 100% breaking capacity kV/micro secs. (f) Maximum over voltage factor of the circuit breaker when switching off. (i) Unloaded transformers. (ii) Loaded transformers. (iii) Open circuited lines.	
46.	When switching off asynchronous system. (c) Maximum current KV (d) Maximum recovery voltage between contacts of one pole KV	
47.	No. of operation the circuit breaker is capable of performing w/o inspection/replacement of contacts or other main parts. (c) At rated current. (d) At current corresponding to 100% rated breaking capacity. ©At current corresponding to 50% rated breaking capacity.	
48.	No. of operation the circuit breaker is capable of performing w/o replacing of gas. (c) At rated current (d) At 100% rated breaking capacity	

SECTION - 5

CHECK LIST FOR 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	400 kV	132kV	YES/NO	Remarks
1	Type/class of Circuit Breaker	Outdoor SF6,	Outdoor SF6,	YES/NO	
2	Standard Applicable	IEC 62271 - 100	IEC 62271 - 100	YES/NO	
3	Rated Voltage (kV rms)	420	145	YES/NO	
4	Operating Mechanism	Spring/hydraulic or its combination	Spring	YES/NO	
5	Rated Current				
	Under normal condition (A)	3150A	1250A	YES/NO	
	Max fault level	63 kA for 1 Sec.	31.5kA , 1 Sec.	YES/NO	
6	Phase to phase spacing	6000	NA	YES/NO	
7	Rated frequency (Hz)	50	50	YES/NO	
8	Support structure along with Foundation bolts are included in supply	Included	Included	YES/NO	
9	Special tools and tackles (if applicable) as per clause 1.7 of Section-1 are included in the quoted price of Main Item	Included	Included	YES/NO	
10	Inter pole cables are included in the supply	Included	Included	YES/NO	
11	Type of inter pole cabling of circuit breakers and up to common Marshalling Box	Plug In type	Plug In type	YES/NO	
12	Number of poles	3	1	YES/NO	
13	Whether All The 3 poles ganged electrically or mechanically	Electrically	NA	YES/NO	
14	Rated short circuit breaking capacity at rated Voltage (kA)	63 kA for 1 Sec.	31.5 kA for 1 Sec.	YES/NO	
15	Rated short circuit Making Current (kAp)	157.5kAP	80	YES/NO	
16	Total break time as per IEC (ms) (less than)	45 ms	65ms	YES/NO	
17	Rated break time as per IEC (less than)	40 ms	60 ms	YES/NO	

PROJECT : 765/400kV Ariyalur Substation , Customer : TANTRANSCO
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Sl. No.	Parameters	400 kV	132kV	YES/NO	Remarks
18	Total closing time (ms) not exceeding	150 ms	150 ms	YES/NO	
19	First pole to clear factor	1.3	1.3	YES/NO	
20	Rated operating duty	O-0.3 Sec – CO -3 min – CO	O-0.3 Sec – CO -3 min – CO	YES/NO	
21	Out of phase breaking current(kArms)	15.75kArms	As per IEC	YES/NO	
22	Rated line charging interrupting current at 90 deg leading power factor angle current	600A	As per IEC	YES/NO	
23	Temperature rise over ambient temperature of 50°C	As per IEC: 62271-100	As per IEC: 62271-100	YES/NO	
24	Reclosing	Single and three phase auto reclosing	----	YES/NO	
25	Auxiliary contacts (besides requirement of specification, spare contacts (wire up) for future use of customer)	10NO+10NC	5NO+50NC	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	275	YES/NO	
	ii. Between terminals with breaker contacts open (kV rms)	610	275	YES/NO	
b)	1.2/50- micro second impulse withstand test voltage				
	i. Between live terminals and ground (kVp)	±1425	±650	YES/NO	
	ii. Between terminals with breaker contacts open (kVp)	±1425kVp(-/+ 240kVp)	±650	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)	900kVp / (-345kVp)	---	YES/NO	
d)	Corona extinction voltage (kV rms)	320(min).	--	YES/NO	

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Sl. No.	Parameters	400 kV	132kV	YES/NO	Remarks
e)	Maximum radio interference voltage for Frequency between 0.5 MHz and 2 MHz in all position	1000 (max) at voltage 266 kV rms.	500 (max) at voltage 92 kV rms.	YES/NO	
f)	Minimum creepage distance				
	i) Phase to ground (mm)	10500	3625	YES/NO	
	ii) Between terminals (mm)	10500	3625	YES/NO	
	Breaking capacity of auxiliary contacts	2A DC with circuit time constant of not less than 20 ms	2A DC with circuit time constant of not less than 20 ms	YES/NO	
27	Pre-insertion resistor requirement				
	Rating (ohms)	400 (Max)	---	YES/NO	
	Minimum pre-insertion time (ms)	8ms	---	YES/NO	
28	Galvanizing on CB Structure	610 gms. per square meter	610 gms. per square meter	YES/NO	
29	General				
a)	Whether OGA drawing enclosed	Enclosed	Enclosed	YES/NO	
b)	Inter pole cabling included in Scope alongwith required Glands, Lugs etc. Termination chart shall be submitted along with the drawings. (cable shall be supplied in one length & suitable lugs shall be supplied as loose items)	Provided	Provided	YES/NO	
c)	TBs for auxiliary supply	Provided	Provided	YES/NO	
d)	L/R switch	Provided	Provided	YES/NO	
e)	Control Cabinet –				
	Degree of Protection	IP 55 (Min.)	IP 55 (Min.)	YES/NO	
f)	Mandatory spares included in scope of supply as per section 1	Included	Included	YES/NO	
g)	Supervision of Erection, testing and commissioning included in scope	Included	Included	YES/NO	
h)	Bidder to comply requirements as per Technical Specification	Complied	Complied	YES/NO	
i)	Bidder will be responsible of getting approval from customer	Yes	Yes	YES/NO	
30	Transducers/ adopter included in scope of supply as per cl. No. 1.8 of section 1	Yes	Yes	YES/NO	
31	All valid Type test reports as per clause no.1.4 available as on	Yes, available	Yes, available	YES/NO	

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Sl. No.	Parameters	400 kV	132kV	YES/NO	Remarks
	30.09.17				
32	Conduction of type test (if any)	Free of cost/chargeable	Free of cost/chargeable	YES/NO	
33	Ladder/ Maintenance platform as per section 2	Yes, available	Yes, available	YES/NO	

Date:
Place:
Phone:
Fax:
E-mail:
Mobile:
Website: