BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NEW DELHI

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TITLE	420/245/132 kV Circuit Breaker			DATE	25/09/13		
				GROUP	TBEM		
				W.O. No	83003		

CUSTOMER	TAMIL NADU TRANSMISSION CORPORATION LIMITED
PROJECT	400/110 KV Substation at Thappagundu & 400/230-110 KV Substation at Anikadavu

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Rev.	Date	Altered	Checked	Approved	REVISION DETAILS

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SECTION – 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENT AND QUANTITIES

1. SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 420kV 245kV & 132kV Circuit Breaker.
This section covers the scope and quantities of 420kV 245kV & 132kV Circuit Breaker. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification. For environmental conditions, refer Section-3 carefully.

The specification comprise of following sections:

Section-1: Scope, specific technical requirements & Bill of Quantities.
Section-2: Equipment specifications
Section-3: General technical requirements for all equipments under the project.
Section-4: Guaranteed Technical Particulars

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

The equipment is required for the following projects:

Name of the Customer : M/s Tamil Nadu Transmission Corporation Limited
Name of the Project : 400/110kV S/S at Thappagundu
400/230-110 KV Substation at Anikadavu

2. SPECIFIC TECHNICAL REQUIREMENTS

2.1. 420 kV SF6 Circuit Breaker

Sl.No	Description	Requirement
1.	Rated Voltage kVrms	400
2.	Highest System Voltage(kV)	420
3.	Type	Outdoor SF6

4.	Rated Frequency(Hz)	50
5.	No. Of poles	3
6.	No. Of Trip Coils	2
7.	Design ambient temperature (deg. C)	50
8.	Height of concrete plinth	300 mm
9.	Minimum height of the lowest part of the support insulator from ground level (mm)	2550 mm
10.	Mounting	Hot dip galvanized/Epoxy painted steel support structure
11.	Full wave impulse withstand voltage (1.2/50 micro sec.) -between line terminals and ground (kVp) -between terminals with circuit breaker open (kVp)	 ± 1425 ± 1425kVp Impulse on one terminal & 240kVp power frequency voltage of opposite polarity on other terminal
12.	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet -between line terminals and ground (kVp) -between terminals with circuit breaker open (kVp)	 ± 1050 900kVp Impulse on one terminal &s 345kVp power frequency voltage of opposite polarity on other terminal

13.	One minute power frequency dry withstand voltage -between line terminals and ground (kVrms) -between terminals with circuit breaker open (kVrms)	 520 610
14.	Corona extinction voltage (kVrms) with circuit breaker in all position(min)	320
15.	Max. radio interference Voltage (microvolts) for frequency between 0.5 MHz and 2 MHz at 266 kVrms	1000
16.	Minimum creepage distance: -Phase to ground (mm) -Between CB terminals (mm)	 10500 10500
17.	Phase to phase spacing	7000mm
18.	System neutral earthing	Effectively Earthed
19.	Rated continuous current (A) at design Ambient temperature	3150
20.	Rated Short circuit current breaking Capacity at rated voltage	63 KA with percentage DC Component as per IEC -62271-100 corresponding to minimum Opening time under operating Conditions specified
21.	Symmetrical interrupting capability (kA rms)	63
22.	Rated short circuit making current (kA peak)	157.5
23.	i) Short time current carrying capability for one sec. (kA rms) ii) Out of phase breaking current capacity (kA rms)	63 15.75
24.	Rated operating duty	O-0.3 sec CO -3 min CO Cycle
25.	Reclosing	Single Phase & three phase auto closing
26.	First pole to clear factor	1.5

27.	Type of Tripping	Trip free
28.	Rated line charging interrupting current at 90 deg. Leading power factor angle A (rms)	400
29.	(The breaker shall be able to interrupt the rated line charging current with test voltage immediately before opening equal to the product of U/√3 & 1.4 as per IEC: 62271-100)	
30.	Temperature rise over the design ambient temperature	As per IEC: 62271 -100
31.	Total break time as per IEC (ms)	45
32.	Rated break time as per IEC (ms)	40
33.	Total closing time (ms)	Not more than 150.
34.	Operating mechanism	spring – spring
35.	Max. difference in the instants of Closing/opening of contacts i) Within a pole ((ms) ii) Between poles (opening) (ms) iii) Between poles (closing)(ms)	 2.5 3.3 5.0
36.	Trip coil closing coil voltage	220 V DC with variation as specified
37.	Noise level at base and upto 50 m (distance from base of breaker	140 dB(MAX)
38.	Seismic acceleration	0.3g
39.	Rated terminal load	As per IEC
40.	Auxiliary contacts	Besides requirement of Specification, The bidder shall wire up 10NO +10 NC Contacts for future use of purchaser per phase
41.	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.
42.	Thermal Rating of Auxiliary contacts	10A at 220V DC
43.	Breaking Capacity of Auxiliary Contacts	5A DC with circuit time constant not less than 20mm

44.	Maximum allowable switching overvoltage Under any switching condition	2.3 p.u
45.	Pre Insertion resistor Requirement i) Rating(ohms) ii) Minimum pre- insertion time(ms) iii) Opening of PIR contacts	 400 8 PIR contacts should open immediately after closing of main circuits. OR Atleast 5ms prior to opening of main contacts at rated air/gas pressure, where the PIR contacts remain closed.
46.	Capacitance Current switching Line Charging Cable Charging Capacitor Banks	Conforming to Class C1 as per IEC 62271-100
47.	Mechanical Endurance Test	Conforming to class M1 as per IEC 62271-100

2.2. 245 KV SF6 CIRCUIT BREAKER

Sl.No.	ITEM	REQUIREMENTS
1.	Rated voltage (KV rms) (nominal)	230
2.	Highest System Voltage	245 KV
3.	Frequency (Hz).	50
4.	Design ambient temperature (deg. C)	50
5.	No. Of Trip Coil	2
6.	Neutral grounding	Solidly earthed
7.	Continuous current rating	2000 A
8.	Type KV	Outdoor SF6

9.	Mounting	Hot dip galvanized/Epoxy painted steel support structure
10.	Number of Poles	3
11.	Type of operation	Individually Operated single Poles
12.	Height of concrete plinth	300 mm
13.	Minimum height of the lowest part of the support insulator from ground level (mm)	2550 mm
14.	Operation mechanism	Spring – Spring (Motor operated spring charged)
15.	Auto reclosing duty	Single and three phase
16.	Rated operating duty cycle	O-0.3 Sec.-CO-3Min-CO as per IEC – 62271-100
17.	First pole to clear factor	1.3
18.	Type of tripping	Trip free
19.	Maximum closing time (ms)	150 ms
20.	Maximum total break time (ms) At rated breaking capacity	Less than 60 ms
21.	1.2/50 microsecond impulse withstand voltage (dry) (KVp)	1050
22.	1 minute power frequency withstand voltage (KV rms) (wet)	460
23.	Max. radio interference voltage (micro volts) at 1.1 times maximum phase voltage	500
24.	Minimum corona extinction voltage (KV rms)	176
25.	Rated breaking current capacity : (i) Line charging at rated voltage at 90 degrees leading power factor	125 A

	(ii) Short circuit current : (a) AC component (KA) (b) % DC component	 40 Corresponding to minimum Opening time as per IEC – 62271-100
26.	Rated short circuit making current capacity (KA)	100
27.	Permissible limit of temperature rise	As per IS applicable
28.	Max. acceptable difference in the instants of closing/opening of contacts : (i) Within a pole (ms) (ii) Between poles (ms)	 3.3 5
29.	Min. creepage distance of support insulator (mm)	6125
30.	Short time current carrying capability for three seconds (KA)	40
31.	Rating of auxiliary contacts	10 A at 220V DC
32.	Breaking capacity of auxiliary contacts	5 A DC with the circuit time constant less than 20ms at the rated voltage.
33.	Noise level at base and upto 50metres	140 dB (max.)
34.	Seismic acceleration	0.3g
35.	Auxiliary contacts	Besides requirement of Specification, The bidder shall wire up 10NO +10 NC Contacts for future use of purchaser per phase
36.	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.

37.	Maximum allowable switching overvoltage Under any switching condition	As per IEC
38.	Capacitance Current switching Line Charging Cable Charging Capacitor Banks	Conforming to Class C1 as per IEC 62271-100
39.	Mechanical Endurance Test	Conforming to class M1 as per IEC 62271-100

2.3 132 KV SF6 CIRCUIT BREAKER

Sl.No.	ITEM	REQUIREMENTS
1.	Rated voltage (KV rms) (nominal)	110 KV
2.	Highest System Voltage	132KV
3.	Frequency (Hz).	50
4.	Design ambient temperature (deg. C)	50
5.	No. Of Trip Coil	2
6.	Neutral grounding	Solidly earthed
7.	Continuous current rating	2000 A
8.	Type KV	Outdoor SF6
9.	Mounting	Hot dip galvanized/Epoxy painted steel support structure
10.	Number of Poles	3
11.	Type of operation	Gang operated poles
12.	Height of concrete plinth	300 mm
13.	Minimum height of the lowest part of the support insulator from ground level (mm)	2550 mm

14.	Clearances (a) Centre to Centre distance between poles (b) Line to Ground	 1700 mm 4572 mm
15.	Operation mechanism	Spring – Spring (Motor operated spring charged)
16.	Auto reclosing duty	Single and three phase
17.	Rated operating duty cycle	O-0.3 Sec.-CO-3Min-CO as per IEC – 62271-100
18.	First pole to clear factor	1.3
19.	Type of tripping	Trip free
20.	Maximum closing time (ms)	150 ms
21.	Maximum total break time (ms) At rated breaking capacity	Less than 60 ms
22.	1.2/50 microsecond impulse withstand voltage (dry) (KVp) (i) To earth (KVp) (ii) Across open contacts with impulse on one terminal and power frequency voltage on opposite terminal (KVp/KV rms)	 550 550
23.	1 minute power frequency withstand voltage (KV rms) (wet)	230
24.	Max. radio interference Voltage (microvolts) for frequency between 0.5 MHz and 2 MHz	500 (at 92kV rms)
25.	Minimum corona extinction voltage (KV rms)	As per IEC
26.	Rated breaking current capacity : (i) Line charging at rated voltage at 90 degrees leading power factor	50 A
	The breaker shall be able to interrupt the rated line charging current with test voltage immediately before opening equal to the product of U/√3 & 1.4 as per IEC: 62271-100)	

27.	Rated breaking current capacity : ii) Short circuit current : AC component (KA) DC component	 40 Corresponding to minimum Opening time as per IEC – 62271-100
28.	Rated short circuit making current capacity (KA)s	78.75
29.	Permissible limit of temperature rise	As per IS applicable
30.	Max. acceptable difference in the instants of closing/opening of contacts : (i) Within a pole (ms) (ii) Between poles (ms)	 5 10
31.	Min. creepage distance of support insulator (mm)	3400
32.	Short time current carrying capability for three seconds (KA)	40
33.	Rating of auxiliary contacts	10 A at 220V DC
34.	Breaking capacity of auxiliary contacts	5 A DC with the circuit time constant less than 20ms at the rated voltage.
35.	Noise level at base and upto 50metres	140 dB (max.)
36.	Seismic acceleration	0.3g
37.	Auxiliary contacts	Besides requirement of Specification, The bidder shall wire up 10NO +10 NC Contacts for future use of purchaser per phase
38.	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.
39.	Maximum allowable switching overvoltage Under any switching condition	As per IEC

40.	Capacitance Current switching Line Charging Cable Charging Capacitor Banks	Conforming to Class C1 as per IEC 62271-100
41.	Mechanical Endurance Test	Conforming to class M1 as per IEC 62271-100

3. BILL OF QUANTITIES

As per Annexure-A.

4. SUPERVISION CHARGES FOR ERECTION TESTING & COMMISSIONING

Bidder shall quote lump-sum price for supervision of erection Testing and commissioning of all the offered circuit breakers **with special tools and test instruments* in Bidder scope**

'*' - *The following instruments/kits shall be brought out at site by Bidder/supplier:*

i) Time Interval meter (Timing kit)

The following instruments/kits shall be provided by BHEL at site:

i) DCRM
ii) Dew Point Meter
iii) Megger
iv) Multimeter

5. TYPE TESTING

All the tests as per relevant IS/IEC shall be carried out.

The Type Test for offered 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 five (05) years as on the date of technical bid opening , which is 05/4/13 for Anikadavu & 10/4/13 for Thappagundu substations.

The original type test certificates shall be furnished for verification at detailed engineering stage.

6. TECHNICAL QUALIFYING REQUIREMENT

The qualified manufacturer should have manufactured, Type tested and supplied at least 50% of the required quantity (for each project) of the Circuit Breaker (of the same voltage level as offered and short Circuit Rating of at least 40kA for 3s for 420kV and 40kA for 3s for 245kV & 132kV) to Electricity Boards/Power Utilities in India in any one year during the last five years as on 05/4/13 for Anikadavu & 10/4/13 for Thappagundu substations. The same should have been in satisfactory operation for a minimum period of two years as on date 05/4/13 for Anikadavu & 10/4/13 for Thappagundu substations.

Further the qualified manufacturer should have type tested the Circuit Breaker from Government / Government recognized laboratories confirming to IS/IEC only.

7. INSPECTION & TESTING

All the equipments shall be inspected prior to dispatch in line with relevant IS, approved GTP/ drawing and technical specification, BHEL/ customer approved QAP.

Annexure-1

Bill of Quantities

A. 400/110kv Thappagundu Substation

A.1 420kV Circuit Breaker

S. No.	Description	Unit	Quantity
1	420 KV, 3150 A, 63 KA for 1s Outdoor SF6 Breaker without Pre Insertion Resistor with supporting structure and other accessories, complete in all respects	Set	8
2	420 KV, 3150 A, 63 KA for 1s Outdoor SF6 Breaker with Pre Insertion Resistor with supporting structure and other accessories, complete in all respects.	Set	3
3	Suitable SF6 gas filling adopter for 420kV Circuit Breaker	No	1
4	Portable/ Hand held SF6 gas leakage Detector	No	1
5	Portable SF6 gas Filling Unit with Vacuum Pump	No	1
6	SF6 gas (15% of the Main quantity of all 420kV Circuit Breakers)	LOT	1
7	Circuit Breaker Analysing Kit (Multi break)	No	1
8	Lump Sum Supervision Charges for Erection Testing & commissioning of one No. 420kV Circuit breaker.	No.#	11
9	Supervision charges for erection, testing and commissioning of 420kV Circuit Breaker (on man-day basis)	Day*	1

A.2 132kV Circuit Breaker

S. No.	Description	Unit	Quantity
1	132 KV, 2000A, 40 KA for 3s Outdoor SF6 Breaker with supporting structure and other accessories, complete in all respects	Set	13
2	Suitable SF6 gas filling adopter for 132kV Circuit Breaker	No	1
3	SF6 gas (15% of the Main quantity of all 132kV Circuit Breakers)	LOT	1
4	Lump Sum Supervision Charges for Erection Testing & commissioning of one No. 132kV Circuit Breaker.	No.#	13
5	Supervision charges for erection, testing and commissioning of 132kV Circuit Breaker (on man-day basis)	Day*	1

B. 400/230-110kV Anikadavu Substation

B.1 420kV Circuit Breaker

S. No.	Description	Unit	Quantity
1	420 KV,3150 A, 63 KA for 1s Outdoor SF 6 Breaker without Pre Insertion Resistor with supporting structure and other accessories, complete in all respects	Set	8
2	420 KV, 3150 A, 63 KA for 1s Outdoor SF 6 Breaker with Pre Insertion resister with supporting structure and other accessories, complete in all respects	Set	6
3	Suitable SF6 gas filling adopter for 420kV Circuit Breaker	No	1
4	Portable/ Hand held SF6 gas leakage Detector	No	1
5	Portable SF6 gas Filling Unit with Vaccume Pump	No	1
6	SF6 gas (15% of the Main quantity of all 420kV Circuit Breakers)	LOT	1
7	Circuit Breaker Analysing Kit (Multi break)	No	1
8	Mandatory Spare: 420 KV,3150 A, 63 KA for 1s Outdoor SF6 Breaker without Pre Insertion Resistor with supporting structure and other accessories, complete in all respects	Set	1
9	Lump Sum Supervision Charges for Erection Testing & commissioning of one No. 420kV Circuit Breaker.	No.#	14
10	Supervision charges for erection, testing and commissioning of 420kV Circuit Breaker (on man-day basis)	Day*	1

B.2 245kV Circuit Breaker

S. No.	Description	Unit	Quantity
1	245 KV, 2000A, 40 KA for 3s Outdoor SF6 Breaker with supporting structure and other accessories, complete in all respects	Set	10
2	Suitable SF6 gas filling adopter for 245kV Circuit Breaker	No	1
3	SF6 gas (15% of the Main quantity of all 245kV Circuit Breakers)	LOT	1
4	Lump Sum Supervision Charges for Erection Testing & commissioning of one No. 245kV Circuit Breaker.	No.#	10
5	Supervision charges for erection, testing and commissioning of 245kV Circuit Breaker (on man-day basis)	Day*	1

B.3 132kV Circuit Breaker

S. No.	Description	Unit	Quantity
1	132 KV, 2000A, 40 KA for 3s Outdoor SF6 Breaker with supporting structure and other accessories, complete in all respects	Set	7
2	Suitable SF6 gas filling adopter for 132kV Circuit Breaker	No	1
3	SF6 gas (15% of the Main quantity of all 132kV Circuit Breakers)	LOT	1
4	Lump Sum Supervision Charges for Erection Testing & commissioning of one No. 132kV Circuit Breaker.	No.#	7
5	Supervision charges for erection, testing and commissioning of 132kV Circuit Breaker (on man-day basis)	Day*	1

Notes:

1. **'#' –** Supervision charges shall be quoted on **lump sum** basis only**.** Bidder shall estimate required no. of man-days for supervision based on his own experience & shall submit a checklist for input wrt site readiness. It will be the sole responsibility of the bidder to obtain site readiness checklist before deputing any of his personnel at site.

2. **'*' -** In case of any delay on account of BHEL, after deputing personnel at site, bidder shall also quote supervision charges for one man-day.

3. The circuit breaker shall be complete with operating mechanism (spring type), 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, 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.

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

SECTION – 2

EQUIPMENT SPECIFICATIONS

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 (IEC 2331)	High voltage porcelain bushings.
7.	IS - 802 (Part-1)	Code of practice for use of structural steel in overhead 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 - 325	Specification for three phase induction motors.
11.	IEC - 376	Specification and acceptance of new supply of sulphur 376A, 376B Hexafluoride.
12.	IEC - 60	High voltage test techniques.

13.	IEC - 71 (Part 1 & 2)	Insulation co-ordination.
14.	IEC – 270	Partial discharge measurement
15.	IS 5561	Electric Power Connectors
16.	IS 9135	Guide for testing of Circuit Breakers with respect of out of phase switching
16.	IS:10601 -	Dimensions of terminals of high voltage switchgear and control gear.
17	IS: 12729 –	General requirements for switchgear and control gears for Voltages exceeding 1000V
18.	IS:13516 –	Methods of synthetic testing of high voltage AC circuit breakers.
19.	IS:14658 –	High voltage AC circuit breakers – Guide for short circuit and switching test procedures for metal closed and dead tank circuit breaker.
20	IS: 14674 –	High voltage alternating circuit breakers – Guide for seismic qualifications of high voltage AC breaker.
21	IS: 8828 –	Miniature air break circuit breaker for AC circuits for voltages not exceeding 1000V
22	IS: 13947 –	Contactors for voltages not exceeding 1000V dc or 1200V dc
23	IS: 2544 -	Porcelain post insulators for systems with nominal voltages greater than 1000V
24	IS: 694 –	PVC cables upto 1000V.
25	IS: 2148 –	Cable glands
26	IS: 8337 –	Cable lugs.

1.2 420/245/132 KV circuit breakers offered would be of sulphur hexafluoride (SF6) type only with spring - spring operating mechanism and of class C1-M1 as per IEC.

1.3 The circuit breaker shall be complete with terminal connectors, operating mechanism (spring type), 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 420 /245/132 KV effectively grounded system and perform make and break operations as per the stipulated duty cycles satisfactorily.

2.2.1 PRE INSERTION RESISTER (If applicable)

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 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 Section-1 GTP 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.

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) 400 KV breakers shall be able to switch in and out the 400 KV shunt reactor for any value from 50 MVAR up to 80 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 with stand the voltage specified in section 1 of this Section.

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 1,2,3,4,5 (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.

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 resisters 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.

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 charged mechanism for all rating of breakers. This is mandatory requirement. 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 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.

7.2 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 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.

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.

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.

11.4 Adequate length of cables to be provided so that cable can be routed through trenches below CB.

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 weatherproof 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 inter-locking 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 FITTINGS AND ACCESSORIES

14.1 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. for interpole cables.
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.

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.

15.0 ADDITIONAL DATA TO BE FURNISHED DURING DETAILED ENGINEERING :

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 healththiness 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.

16.0 TESTS:

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

16.2 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 clause no: 17.9 of this chapter.

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.

16.3 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. shall be furnished and utilized by bidder. 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.

16.4 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.

17.0 TESTING AND COMMISSIONING:

An indicative list of tests is given below. Supplier shall perform any additional test based on specialties of CB as per Field QP/ instruction of the equipment manufacturer or Purchaser without extra cost to purchaser. The supplier shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish list of instruments to BHEL/TANTRANSCO 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

SECTION – 3

GENERAL TECHNICAL REQUIREMENTS

3.0 Foreword

The provision under this section is intended to supplement general requirements for the materials, equipment 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 : 400/110 KV Substation at Thappagundu & 400/230/110 KV Substation at Anikadavu
c) Transport facilities : Road/Rail
d) Site location : THAPPAGUNDU IN THENI DISTRICT, MADURAI REGION & ANIKADAVU IN TIRUPPUR DISTRICT, COIMBATORE REGION

The following system parameters shall prevail:

Nominal system voltage	**400 kV**	**230kV**	**110 kV**
Highest system voltage	420 kV	245kV	132 kV
Frequency	50 Hz	50 Hz	50 Hz
Minimum creepage	25mm/kV	25mm/kV	25mm/kV
System Earthing	Effectively Earthed	Effectively Earthed	Effectively Earthed

SITE CONDITIONS

3.1.1 Ambient Temperature
a) Ambient air temp. (max.) : 50 deg C
B) Max Temp. for design : : 50 deg C
b) Ambient air temp. (min.) : 20 deg C
c) Max, Daily average ambient air temp. : 45 deg C
d) Max. yearly average ambient air temp. : 32 deg C

3.1.2 Max. humidity : 100% Max.

3.1.3 Average thunder storm days per annum : 50

3.1.4 Average rainy days per annum : 90

3.1.5 Average Annual rainfall : 1000 mm

3.1.6 No. of months during which tropical monsoon condition prevail: 5
3.1.7 Max, wind Pressure : 150kg/sqmm
3.1.8 Max wind speed : 39m/s
3.1.8 Altitude above MSL : 1000 m

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

AUXILIARY POWER SUPPLY

3 phase AC Supply	415V, 3 phase 4 wire 50 Hz, neutral grounded AC supply -15% to +10%
1 phase AC supply	240V, single phase, 50 Hz neutral grounded AC supply
DC supply	220, 2 wire DC supply + 10% to –15% 48V, 2 wire DC supply

3.2 GENERAL REQUIREMENT

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

3.2.1 The supplier shall also furnish drawings for the following:

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

3.2.1 GENERAL:

3.2.1.1 The bidders 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.

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

3.2.1.3 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/equipments is furnished. The Technical specification contained herein for the materials are for the guidance of the tenderer.

3.2.1.4 The Tenderers are requested to procure the equipments/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

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

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

3.4 SPECIFIC TECHNICAL REQUIREMENTS: / Drawing submission

The successful bidder shall submit all drawings and documents as per clause no. 3.29 along with the list of drawings within 7 days after placement of order to BHEL.

3.5 STANDARD:

The goods supplied under this contract shall conform to the standards mentioned in the Technical Specifications and when no applicable standard is mentioned, to the standard specified by the Institution of Central / State Government or internationally recognized Institutions shall be applicable and such standards shall be the latest issued by the concerned institution.

3.6 TEST CERTIFICATE:

Copies of all test certificates relating to material to be procured by the Supplier for the works shall be forwarded to BHEL.

3.7 Inspection clause :

3.7.1 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.

3.7.2 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:

3.8.1 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.

3.8.2 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.

3.8.3 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 equipments and before charging each item of equipments 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 equipments in the presence of Board Engineers. Necessary tools, testing kits are to be arranged by the Supplier.

3.10 PACKING:

3.10.1 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.

3.10.2 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.

3.11 COLOUR SCHEME AND CODES FOR PIPE SERVICE/PANELS

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

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.
Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.
All the steel works shall be thoroughly cleaned of rust , scale , oil , grease, dirt and scarf by pickling , emulsion cleaning , etc. The sheet steel shall be phosphated /oven dried and then painted with two coats of zinc rich primer paints . After application of the primer, two coats of finished synthetic enamel paint shall be applied. The colour of the finished coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS 5 /RAL 7032 for all switchboard /MCC/distribution board , control panels etc.
Sufficient quantities of touch paint shall be furnished for application at site. All the indoor cubicles shall be the same as exterior surface and for other miscellaneous items, colour scheme will be approved by the BHEL/TANTRANSCO.

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 GALVANIZING

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 610 gm of zinc per square metre of surface.The zinc coating shall be smooth, of uniform thickness and free from defects.

3.16 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.

3.17 RATING PLATES, NAME PLATES AND LABELS

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.

Alternately two separate plates one with Hindi and other with English inscriptions may be provided.

During approvals drawings of Rating/name plates/lables shall also be submitted.

3.18 EARTHING

Circuit breakers, LA, Isolator, CVT, CT, BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. 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.

3.19 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 drwawing approval stage.

TBs should be suitable for cable sizes all cable sizes.

3.20 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 3.0 mm thick cold rolled or 3 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 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 atleast 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 atleast 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

3.21 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.

3.22 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.

3.23 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.

3.24 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.

3.25 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 Employer. 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.

Note: The supplier may please note that all resubmissions must incorporate, all comments given in the submission by the Employer 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 enclosed sheet for details of Title block.

3.26 TITLE BLOCK

Following Title Blocks to be used in drawings at the time of drawing approvals

For Thappagundu

Customer	M/s Tamil Nadu Transmission Corporation Limited

Project:	400/110 KV Substation at Thappagundu
Contractor	BHEL

For Anikadavu

Customer	M/s Tamil Nadu Transmission Corporation Limited
Project:	400/230-110 KV Substation at Anikadavu
Contractor	BHEL

3.27 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

1) Drawings
2) Guaranteed Technical Particulars
3) Type Test Reports
4) List of Part Supplies with rating

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

3.28 DOCUMENTATION SCHEDULE

Following Documentation schedule to be followed per project.

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	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.

APPENDIX-A

SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations/variations/exceptions from the specification:

SECTION	CLAUSE NO. / PAGE NO.	STATEMENT OF DEVIATION / VARIATIONS / EXCEPTIONS

In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract is deemed to be in compliance with the specification.

If there is NIL deviation, even then the format to be filled as **NIL DEVIATION**

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Place

Date

Signature of the authorized representative of

Bidder's name …….

Designation …….

Company seal …….

APPENDIX-B

BIDDER'S UNDERTAKING FOR TYPE TEST REPORTS

Bidder shall take type test report, MQP, and drawing approval from TANTRANSCO without any commercial / delivery implication to BHEL. In case type test reports are not acceptable to customer due to any technical reason, the same shall be conducted free of cost.

Place Signature of the authorized representative of

Bidder 'name----------

Date

Designation----------

Company seal ----------

SECTION - 4

GUARANTEED TECHNICAL PARTICULARS FOR CIRCUIT BREAKERS

- TANTRANSCO datasheet for Circuit Breaker as attached.

GTP OF 420 KV OUTDOOR SF6 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 (a) Maximum kV (b) Minimum Kv	
07.	Type of circuit breaker	
08.	Ambient temperature assumed for designing (a) Maximum (b) Minimum daily (average)	
09.	Continuous current (a) Under site conditions Amps. (b) 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. (a) RMS value of AC component (b) Percentage DC component	
14.	Rated transient Recovery voltage (a) Method of representing TRV (b) Value of parameters (c) 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 curre6n74t	
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.	

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 (a) Maximum KV (b) Minimum KV	
07.	Type of circuit breaker	
08.	Ambient temperature assumed for designing (a) Maximum (b) Minimum daily (average)	
09.	Continuous current (a) Under site conditions Amps. (b) Rated Amps.	
10.	Rated short time current KA (RMS) (For 3 seconds)	
11.	Maximum rise of temperature over ambient for current rating under clause 10 above.	
12.	Rated operating duty cycle	
13.	Interrupting capacity based on duty cycle in 12 above. (a) Symmetrical at rated voltage (b) RMS value of AC component (a) Percentage DC component Asymmetrical at rated voltage	
14.	Rated transient Recovery voltage (a) Method of representing TRV (b) First pole to clear factor Type of devices used to limit the rate of rise of re-striking voltage	
15.	Rated making capacity	
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 (a) Main (b) Arcing (c) Auxiliary (d) Whether contacts are silver plated (e) Thickness of silver coating, mm/micron (f) Contact pressure kg/mm.	
32.	Insulation level of the breaker (a) One minute power frequency withstand voltage kV rms. (b) Impulse withstand test voltage kV (Peak)	
33.	(i) Whether capacitor trip device is provided. (ii) If so, brief description of the same.	
34.	Minimum clearance in air. (a) Between phases (live parts) mm (b) Between live parts and earth mm (c) Centre to centre distance between poles. (d) Line to ground clearance (Any deviation from Cl.13.2 is liable for rejection)	

35.	Whether the circuit breaker is fixed-trip or trip-free	
36.	Method of closing (a) Normal (b) Emergency	
37.	Type of closing mechanism	
38.	Normal voltage for closing (a) Satisfactory operation range (b) 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. (a) Opening time in milli second measured from instant of application of power to opening device upto arcing contacts beginning to separate. (b) Total interrupting time measured from instant of trip coil energisation to arc extinction. (i) At 10% rated interrupting capacity. (ii) At rated interrupting capacity. (c) 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. (e) Minimum dead time for 3 ph. Reclosing. (f) Make time.	

	(a) 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.	(a) Recovery voltage when circuit breaker tested at 100% rated breaking capacity. KV inst. (b) Rate of rise of re-striking voltage at (i) For 30% breaking capacity kV/micro sec. (ii) For 100% breaking capacity kV/micro secs. (c) 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. (a) Maximum current KV (b) 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. (a) At rated current. (b) At current corresponding to 100% rated breaking capacity. (c) At current corresponding to 50% rated	
48.	No. of operation the circuit breaker is capable of performing w/o replacing of gas. (a) At rated current (b) At 100% rated breaking capacity	
49.	(a) Weight of complete circuit breaker kg. (includ ing gas) (b) Impact loading for foundation, design, to in clude dead load plus impact value of opening at maximum interrupting rating, in terms of equivalent static load kg. (c) Over all dimensions : (a) Weight - mm (b) Width - mm	

	(e) Length - mm Mounting frame details – mm	
50.	For spring charged operating mechanism a) whether manual spring charging is possible or not b) During manual charging of spring whether there is automatic provision to cut off a.c.power to motor c)Is it possible to have slow closing and opening, for maintenance purpose d)In case of failure of power supply to motor, is it possible to have O.C.O sequence	
51	Whether manual emergency tripping device has been provided.	
52.	Sulpur Hexaflouride gas i) physical properties (ii) density at 20 x c (iii) electric strength (iv) compatibility (v) toxic impurities if any (vi) standard sizes of cylinders preferred size of cylinders. (vii) Maximum filling, ratio for tropical country. (viii) Nominal pressure of Sf6 gas inside circuit breaker (ix) Minimum operating pressure. (x) Pressure at which gas pressure switch will give (a)Fill up signal (b)Lock out operation (xi) Qty. of SF6 gas per pole in kg. Whether pressure gauge is provided for visible indication of SF6 gas pressure.	
53.	Insulators for breakers chamber and support : (a) type (b) make (c) insulation class (d) one minute dry power frequency withstand voltage (e) flash over voltage (f) Full wave impulse withstand voltage	

	(g) switching surge withstand voltage (h) corona discharge voltage (i) nature of die-electric medium employed in the insulator (j) creepage distance total/protected (k) permissible safe cantilever loading on the in-stalled insulators.	
54.	Whether all routine/acceptance tests as per latest relevant, standards will be carried out on each circuit breakers.	
55.	Linking mechanism components like operating rod details.	
56.	Whether breaker mounting structure is included in suppliers scope.	
57.	Switch cubicle (a) Manufacturer's name (b) Indoor/outdoor application (c) Thickness of sheet steel (d) Degree of protection provided (as per IS 2147 or equivalent) (e) Bill of materials for the various equipment giv ing make, type etc. (f) Control wiring/power wiring materials of con ductor and size. Conductor solid/stranded	
58.	Particulars of drawing and type test report and literature enclosed.	
59.	Mechanical Endurance Test M1 Capacitive Current Breaking class C1	
60.	Foundation plan drawing conformation	
61.	Total expected life period of the equipment.	

SECTION - 5

CHECK LIST FOR 420kV, 245kV & 132 KV CIRCUIT BREAKERS

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

Sl. No.	Parameters	420 kV	YES/NO	245kV	YES/ NO	132 kV	YES/ NO	Remarks
1.	Type/class of Circuit Breaker	Outdoor SF6, C1M1		Outdoor SF6, C1M1		Outdoor SF6, C1M1		
2.	Manufacturer's type designation							
3.	Standard Applicable	IEC 62271 - 100		IEC 62271 - 100		IEC 62271 - 100		
4.	Rated Voltage (kV rms)	400		**230**		110		
5.	Highest system voltage(kV)	420		**245**		132		
6.	Design ambient temperature (deg. C)	50		50		50		
7.	Neutral Grounding	Effectively earthed		**Solidly earthed**		**Solidly earthed**		
8.	Rated Current							
9.	Continuous current rating (A)	3150 A		**2000A**		2000 A		
10.	Max fault level	63 kA for 1s		40 kA for 3s		40 kA for 3s		
11.	Phase to phase spacing	7000 mm		**4000mm**		3000 mm		
12.	Rated frequency (Hz)	50		**50**		50		
13.	Number of poles	3		**3**		3		

Sl. No.	Parameters	420 kV	YES/NO	245kV	YES/ NO	132 kV	YES/ NO	Remarks
14.	Type of operation	Individually Operated single pole		Individually Operated single pole		Gang operated poles		
15.	No. of independent tripping circuits, pressures switches and coils each connected to a different set of protective relays per pole	2		**2**		2		
16.	Rated breaking current capacity :							
	(i) Line charging at rated voltage at 90 degrees leading power factor	400		125 A		50A		
	ii) Short circuit current :	63 KA with percentage DC Component as per IEC -56 corresponding to minimum Opening time under operating Conditions specified						
	(a) AC component (KA)			40		40		
	(b) % DC component			Corresponding to minimum Opening time as per IEC – 62271-100		Corresponding to minimum Opening time as per IEC – 62271-100		
17.	Rated short circuit Making Current (kA)	157.5		**100**		78.75		

Sl. No.	Parameters	420 kV	YES/NO	245kV	YES/ NO	132 kV	YES/ NO	Remarks
18.	Rated break time as per IEC (ms)	40						
19.	Type of Tripping	**Trip free**		**Trip free**		**Trip free**		
20.	Max. Total break time(ms) At rated breaking capacity	45ms		Less than 60 ms		Less than 60 ms		
21.	Max. Closing time (ms)	150		**150**		150		
22.	Max. acceptable difference in the instants of closing/opening of contacts :							
23.	(i) Within a pole (ms)	2.5		**3.3**		5		
24.	(ii) Between poles (ms)	3.3(opening) 5.0(closing)		**5**		10		
25.	First pole to clear factor	1.5		**1.3**		1.3		
26.	Short time current carrying capability (kA)	63kA for 1 s		40kA for 3 s		40kA for 3 s		
27.	Rated operatingcycle duty	O-0.3 Sec –CO -3 min –CO cycle		O-0.3 Sec.-CO-3min-CO as per IEC – 62271-100		O-0.3 Sec.-CO-3Min-CO as per IEC – 62271-100		
28.	Out of phase breaking current capacity	15.75kA		**--**		---		
29.	Rated line charging breaking current (voltage factor of 1.4 p.u. (A)	As per IEC		As per IEC		As per IEC		

Sl. No.	Parameters	420 kV	YES/NO	245kV	YES/ NO	132 kV	YES/ NO	Remarks
30.	Maximum over voltage (p.u.) under any switching conditions	2.3		---		----		
31.	Permissible limit of temperature rise	As per IEC 62271-100		As per IEC 62271-100		As per IEC 62271-100		
32.	Rated voltage & pick up range for trip coil (V)	220 V DC, Range – 70 % to 120 %		220 V DC, Range – 70 % to 120 %		220 V DC, Range – 70 % to 120 %		
33.	Rated voltage & pick up range for closing coil (V)	220 V DC, Range 85 % to 120 %		220 V DC, Range 85 % to 120 %		220 V DC, Range 85 % to 120 %		
34.	Reclosing	Single and three phase auto reclosing		Single and three phase auto reclosing		Single and three phase auto reclosing		
35.	No. of Auxiliary contacts	As required plus 10 NO and 10 NC contacts per pole as spare.		As required plus 10 NO and 10 NC contacts per pole as spare.		As required plus 10 NO and 10 NC contacts		

Sl. No.	Parameters	420 kV	YES/NO	245kV	YES/ NO	132 kV	YES/ NO	Remarks
36.	Rating of auxiliary contacts	10 A at 220V DC		10 A at 220V DC		10 A at 220V DC		
37.	Breaking capacity of auxiliary contacts	5 A DC with the circuit time constant less than 20ms at the rated voltage.		5 A DC with the circuit time constant less than 20ms at the rated voltage.		5 A DC with the circuit time constant less than 20ms at the rated voltage.		
38.	Noise level at base and upto 50metres	140 dB (max.)		140 dB (max.)		140 dB (max.)		
39.	Seismic acceleration	0.3g		0.3g		0.3g		
40.	Rated terminal load	As per IEC		as per IEC		as per IEC		
41	**Dielectric withstand of complete Breaker**							
a)	One minute dry & wet power frequency withstand voltage			**460**		230		
	i. Between live terminal and ground (kV rms)	520		**-**				
	ii. Between terminals with breaker contacts open (kV	610		**-**				

Sl. No.	Parameters	420 kV	YES/NO	245kV	YES/ NO	132 kV	YES/ NO	Remarks
	rms)							
b)	1.2/50 microsecond impulse withstand voltage (dry) (KVp)			**1050**				
	i. To earth (kVp)	±1425				550		
	ii. Between terminals with breaker contacts open (kVp)	±1425(+240)				550		
c)	250/2500 micro second switching surge withstand test voltage			**-**		-		
	i. Between live terminals and ground (kVp)	±1050		**-**		-		
						-		
	ii. Between terminals with breaker contacts open (kVp)	1) 900(+345)		**-**		-		
d)	Corona extinction voltage (kV rms)	320		176		N.A.		
e)	Maximum radio interference voltage at 1.1 times maximum phase voltage for Frequency between 0.5 MHz and 2 MHz	1000 (max) at voltage 266 kV rms.		**500**		500 (at 92k V rms)		
(f)	Min. creepage distance of support insulator (mm)	10500		6125		3400		
(g)	Height of concrete plinth	300		300 mm		300 mm		

Sl. No.	Parameters	420 kV	YES/NO	245kV	YES/ NO	132 kV	YES/ NO	Remarks
(h)	Minimum height of the lowest part of the support insulator from ground level (mm)	2550 mm		2550 mm		2550 mm		
(i)	Clearances							
	(a) Centre to Centre distance between poles					1700 mm		
	(b) Line to Ground					4572 mm		
42	**Pre-insertion resistor requirement**							
	Rating (ohms)	400		-		-		
	Minimum pre-insertion time (ms)	8		-		-		
	opening of PIR contacts	PIR contacts should open immediately after closing of main circuits. OR Atleast 5ms prior to opening of main contacts at rated air/gas pressure, where the PIR contacts remain closed.		-		-		
43	**Operating Mechanism**							

Sl. No.	Parameters	420 kV	YES/NO	245kV	YES/ NO	132 kV	YES/ NO	Remarks
	a) Type of operating mechanism	Spring-spring		Spring -Spring (Motor operated spring charged)		Spring – Spring (Motor operated spring charged)		
	Mounting	Hot dip galvanized/Epoxy painted steel support structure		Hot dip galvanized/Epoxy painted steel support structure		Hot dip galvanized/Epoxy painted steel support structure		
44	**General**							
a)	Whether OGA drawing enclosed							
b)	Interpole cabling included in Scope alongwith required Glands, Lugs etc. Termination chart shall be submitted alongwith the drawings.							
c)	All Type Test Reports as per IEC 62271 – 100, not older than 5 years are available with bidder. If yes please attach a table depicting Test report No. , Test Date & Rating of Tested equipment.							
d)	**Whether GI support structure included in Supply**							
e)	**Whether foundation bolts for breakers and cabinets included in scope of supply**							

Sl. No.	Parameters	420 kV	YES/NO	245kV	YES/ NO	132 kV	YES/ NO	Remarks
f)	Min clearance in Air (mm) as per section-3							
	(i) Between Live Parts							
	(ii) Live Part to Earth							
	(iii) Live Part to ground with Support Structure / Stool							
g)	Control Cabinet –							
	Degree of Protection	IP 55 (Min.)		IP 55 (Min.)		IP 55 (Min.)		
	Type Tested for IP 55 within last **5** years							
h)	**Mandatory spares included in scope of supply as per Annexure-1**							
i)	**Whether vendor is meeting the qualifying requirement as per Section-1; please attach supply documents**							
j)	**Supervision of Erection, testing and commissioning included in scope**							
k)	**Bidder to comply customer requirements as per Technical Specification**							

Sl. No.	Parameters	420 kV	YES/NO	245kV	YES/ NO	132 kV	YES/ NO	Remarks
l)	**Bidder will be responsible of getting approval from customer**							