

**TAMILNADU GENERATION AND DISTRIBUTION CORPORATION
LIMITED (TANGEDCO)**

1X800 MW NORTH CHENNAI TPS, STAGE-III(BTG)

VOLUME – II

TECHNICAL SPECIFICATION FOR
GENERATOR CIRCUIT BREAKER (GCB)

SPECIFICATION NO: PE-TS-423-510-E001
REV-0



BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UTTAR PRADESH, INDIA – 201301

**TECHNICAL SPECIFICATION FOR
GENERATOR CIRCUIT BREAKER****1 X 800 MW NORTH CHENNAI TPS,
STAGE-III (BTG)****SPECIFICATION NO. PE-TS-423-510-E001****VOLUME II****CONTENTS SHEET****REVISION 0 | DATE: 06.06.2017****SHEET 1 OF 1****CONTENTS**

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SECTION – 'I'

SPECIFIC TECHNICAL REQUIREMENTS



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1.0 SCOPE OF ENQUIRY

- 1.1 This specification covers design, manufacture, assembly, inspection & testing at manufacturer's works, proper packing, delivery and supervision of E&C of Generator Circuit Breaker (GCB) as mentioned in different sections of this specification, complete with all accessories for efficient and trouble-free operation.
- 1.2 It is not the intent to specify completely herein all details of the design and manufacture. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation up to bidder's guarantee.
- 1.3 Standard technical requirements of the GCB are indicated in Section-II. Project specific requirements/changes are listed in Section-I.
- 1.4 The requirements of Section-I shall prevail and govern in case of conflict between the corresponding requirements of Section-I and Section-II.
- 1.5 The documents shall be in English language and MKS system of units.

2.0 BILL OF QUANTITIES:

- 2.1 Quantity requirements shall be as per BOQ-cum-price schedule as part of NIT.

3.0 SPECIFIC TECHNICAL REQUIREMENTS

<u>S.No.</u>	<u>Reference Clause No. of Section- II etc.</u>	<u>To be Read as</u>
1.0	5.02.00 (Type test)	All equipment offered should be of type-tested design. Offered model of GCB should have been type tested as per latest version of standard IEC/ IEEE 62271-37-013. Series isolator and earth switch should have been type tested as per IEC 62271-102. <i>Type test reports for similar machine as per applicable latest IEC/IEEE 62271-37-013 standards shall not be more than five years old from the date 29/01/2016.</i>
2.0	10.00.00	Training of Engineers not required and hence not to be quoted.

4.0 DOCUMENTATION

- 4.1 Documents required along with technical offer shall be as per Annexure-III.
- 4.2 Documents required after award of LOI shall be as per Annexure-IV.



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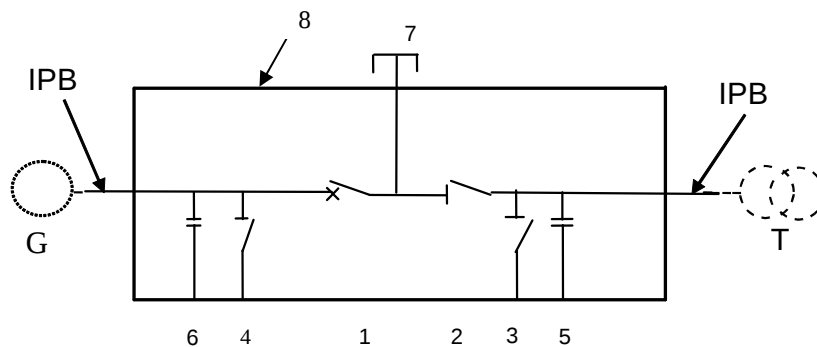
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ANNEXURE – I



- 1 Circuit-breaker
- 2 Disconnecter
- 3, 4 Earthing switches

- 5, 6 Surge capacitors
- 7 Short-circuiting/braking switch
- 8 System enclosure

SINGLE LINE CONFIGURATION OF GENERATOR CIRCUIT BREAKER



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ANNEXURE – II **GENERATOR, IPBD, GT, UT, ST (IF APPLICABLE), SYSTEM AND MOTOR DATA**

SL. NO.	DESCRIPTION	UNIT	VALUE
A	GENERATOR PARAMETERS		
1	RATED POWER	MVA	941.18 MVA
		MW	800 MW
	POWER UNDER VVO CONDITION	MVA	988MVA
		MW	840MW
2	RATED FREQUENCY	Hz	50
3	RATED VOLTAGE	KV	27
4	VOLTAGE VARIATION	%	±5
5	RATED POWER FACTOR		0.85
6	REACTANCE VALUE (SATURATED):		
7	SYNCHRONOUS REACTANCE, DIRECT AXIS, X_d	pu	1.818
8	TRANSIENT REACTANCE, DIRECT AXIS, X_d'	pu	0.233
9	SUB TRANSIENT REACTANCE, DIRECT AXIS, X_d''	pu	0.15
10	SYNCHRONOUS REACTANCE, QUADRATURE AXIS, X_q	pu	2.103(UNSAT)
11	TRANSIENT REACTANCE, QUADRATURE AXIS, X_q'	pu	0.641(UNSAT)
12	SUB TRANSIENT REACTANCE, QUADRATURE AXIS, X_q''	pu	0.155
13	ZERO SEQUENCE REACTANCE	pu	0.0895
14	NEGATIVE SEQUENCE REACTANCE	%	0.169
15	TOLERANCE IN GENERATOR REACTANCES	%	±15
16	STATOR RESISTANCE (R_a)	OHMS	0.001078(@20Deg C)
17	FIELD CURRENT AT GENERATOR RATED VOLTAGE AND POWER FACTOR	AMPS	5549
18	GENERATOR NEUTRAL EARTHING		High Resistance (Through Transformer loaded with Resistance on secondary)
19	NGT PARAMETERS PRIMARY VOLTAGE	KV	21000
	SECONDARY VOLTAGE	KV	0.5
	NGR (AT SECONDARY OF NGT)	OHMS	LATER
20	TIME CONSTANTS (SHORT CIRCUIT TIME CONSTANTS):		



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21	TRANSIENT TIME CONSTANT, DIRECT AXIS, T_d'	s	0.831
22	SUB TRANSIENT TIME CONSTANT, DIRECT AXIS, T_d''	s	0.031
23	TRANSIENT TIME CONSTANT, QUADRATURE AXIS, T_q'	s	0.519
24	SUB TRANSIENT TIME CONSTANT, QUADRATURE AXIS, T_q''	s	0.081
25	ARMATURE TIME CONSTANT	s	0.27
26	SPEED	rpm	3000
B	GENERATOR ISOLATED PHASE BUS DUCT (IPBD) DETAILS <u>[GCB to comply to these requirements]</u>		
1	Type		Isolated phase bus duct
2	Overall diameter of enclosure (Inside)	mm	1700 (Tentative)
3	Thickness of enclosure	mm	LATER
4	Phase-phase spacing	mm	2100 (Tentative)
5	Enclosure material		Al. alloy
6	Conductor material		Al. alloy
7	Conductor profile		Round
8	Cooling of IPBD		Natural
9	Pressurization System provided	Yes/No	Yes
10	Pressure of air inside the enclosure	mm of water col.mn	100 mm water column
11	Maximum temperature of enclosure at 50°C	°C	30
12	Maximum temperature of silver plated conductor joints at 50°C	°C	55
13	Maximum Allowable Temperature of Parts handled By operator in normal course of work duties	°C	As per IEC/IEEE 62271-37-013
C	GENERATOR TRANSFORMER PARAMETERS		
1	RATED MVA	MVA	330MVA/PH
2	HV SIDE VOLTAGE	KV	765/ $\sqrt{3}$
3	MAXIMUM HV VOLTAGE	KV	+5%
4	MINIMUM HV VOLTAGE	KV	- 5%
5	LV VOLTAGE	KV	27
6	FREQUENCY	HZ	50
7	X/R RATIO		50
8	SHORT CIRCUIT IMPEDANCE	P.U.	0.20 AT PRINCIPAL TAP
9	TOLERANCE IN SHORT CIRCUIT IMPEDANCE	%	10



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D	UNIT TRANSFORMER PARAMETERS (UT # 1A)		
1	RATED MVA	MVA	90
2	NUMBER OF WINDINGS (2 / 3)		3
3	HV SIDE VOLTAGE	KV	27
4	MAXIMUM HV VOLTAGE	KV	+5%
5	MINIMUM HV VOLTAGE	KV	-5%
6	LV VOLTAGE	KV	11.5
7	FREQUENCY	HZ	50
8	X/R RATIO		34.1
9	SHORT CIRCUIT IMPEDANCE	P.U.	0.16
10	TOLERANCE IN SHORT CIRCUIT IMPEDANCE	%	10
11	MOTOR LOADS CONNECTED TO UNIT TRANSFORMNER	MVA	40(Tentative)
12	MOTOR RATED VOLTAGE	KV	11
13	MOTOR STARTING CURRENT (TIMES FULL LOAD CURRENT)	TIMES	450% FOR ALL 11kV MOTORS
E	UNIT TRANSFORMER PARAMETERS (UT # 1B)		
1	RATED MVA	MVA	90
2	NUMBER OF WINDINGS (2 / 3)		3
3	HV SIDE VOLTAGE	KV	27
4	MAXIMUM HV VOLTAGE	KV	+5%
5	MINIMUM HV VOLTAGE	KV	-5%
6	LV VOLTAGE	KV	11.5
7	FREQUENCY	HZ	50
8	X/R RATIO		34.1
9	SHORT CIRCUIT IMPEDANCE	P.U.	0.16
10	TOLERANCE IN SHORT CIRCUIT IMPEDANCE	%	10
11	MOTOR LOADS CONNECTED TO UNIT TRANSFORMNER	MVA	18 (Tentative)
12	MOTOR RATED VOLTAGE	KV	11
13	MOTOR STARTING CURRENT (TIMES FULL LOAD CURRENT)	TIMES	450% FOR ALL 11kV MOTORS
F	STATION TRANSFORMER PARAMETERS		
1	RATED MVA	MVA	125/62.5/62.5
2	NUMBER OF WINDINGS (2 / 3)		3
3	HV SIDE VOLTAGE	KV	230/11.5/11.5



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4	MAXIMUM HV VOLTAGE	KV	+5%
5	MINIMUM HV VOLTAGE	KV	-5%
6	LV VOLTAGE	KV	11.5
7	FREQUENCY	HZ	50
8	X/R RATIO		42
9	SHORT CIRCUIT IMPEDANCE	P.U.	HV-LV1-0.24 HV-LV2-0.24 LV1-LV2-0.48
10	TOLERANCE IN SHORT CIRCUIT IMPEDANCE	%	±10%
11	MOTOR LOADS CONNECTED TO STATION TRANSFORMNER	MVA	NIL
12	MOTOR RATED VOLTAGE	KV	N.A.
13	MOTOR STARTING CURRENT (TIMES FULL LOAD CURRENT)	TIMES	N.A.
G	SYSTEM PARAMETERS		
1	RATED VOLTAGE	KV	765, 230
2	MAXIMUM VOLTAGE	KV	803, 242
3	MINIMUM VOLTAGE	KV	727, 220
4	RATED FREQUENCY	HZ	50
5	MAXIMUM THREE PHASE SHORT CIRCUIT CURRENT	KA	50, 40
6	X/R RATIO		30, 14

NOTES: PLEASE REFER ATTACHED SINGLE LINE DIAGRAM FOR CONFIGURATION



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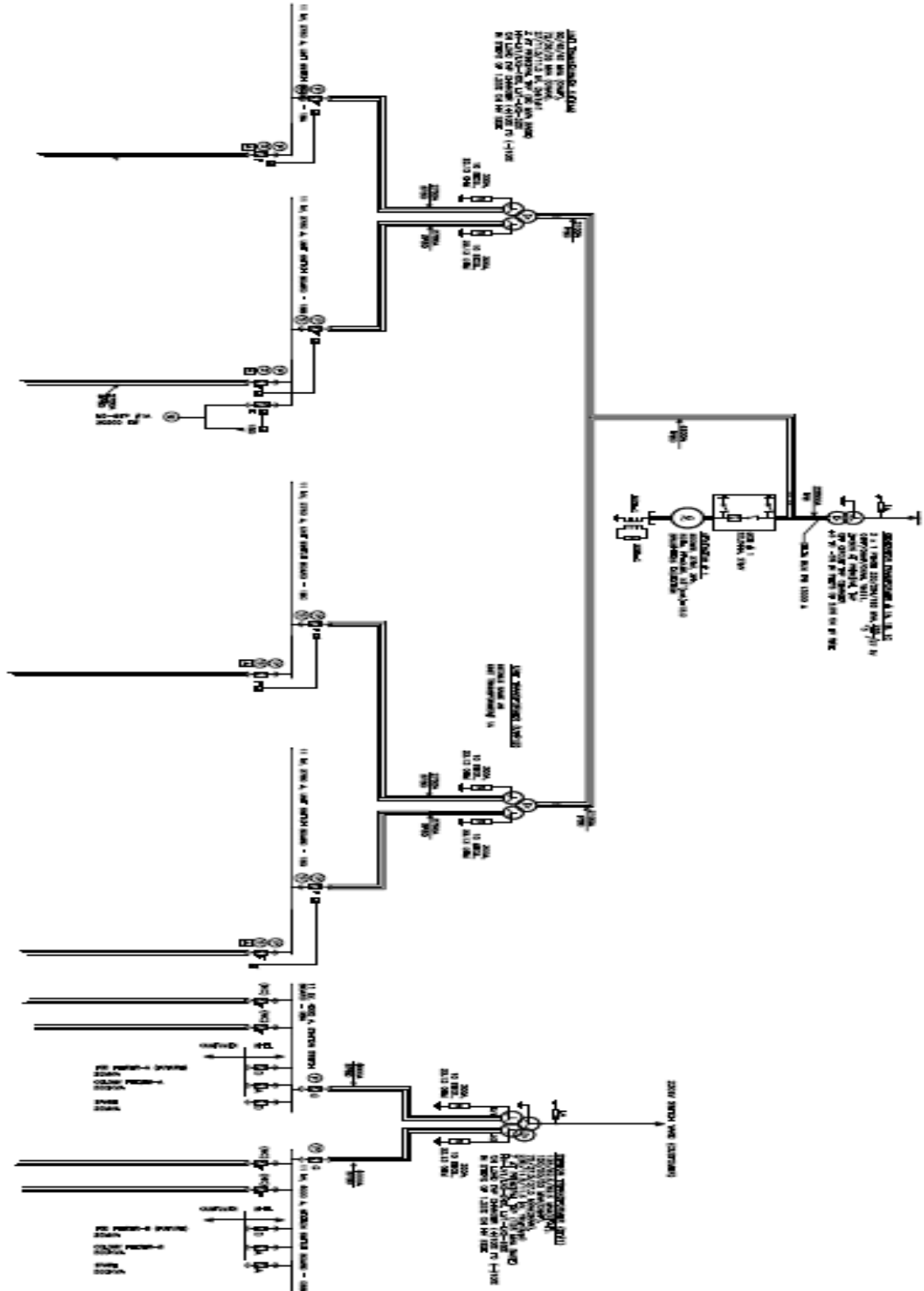
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- a] Filled in Data Sheet -B.
- b] Technical leaflet/ catalogue.
- c] Correction curves/ tables to arrive at current rating of GCB and series isolator at various ambient temperatures.
- d] Complete detailed calculation for short circuit capability of GCB for Generator Side and system side fault contribution.
- e] General Arrangement drawing of GCB showing various dimensions, space required for operation and maintenance, weight etc.
- f] Summary of Type tests certificates indicating key test results, clause & standard reference, date and place of testing.
- g] Write up on operating mechanism of GCB.
- h] Schedule of deviations.
- i] Schedule of BOQ cum price schedule. (Unpriced)
- j] Schedule of start-up and commissioning spares. (Unpriced)
- k] Schedule of Mandatory spares. (Unpriced)
- l] Schedule of O&M spares (Recommended) for 3 years of plant operation. (Unpriced)
- m] Schedule of special tools and tackles. (Unpriced)
- n] Reference list.

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SL. No.	DOCUMENT TITLE	DWG. / DOCUMENT No.	CATEGORY
1	TECHNICAL DATASHEET FOR GENERATOR CIRCUIT BREAKER	PE-V0-423-510-E001	APPROVAL
2	GA AND FOUNDATION PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-423-510-E002	APPROVAL
3	CONTROL & SCHEME DRAWING FOR GENERATOR CIRCUIT BREAKER	PE-V0-423-510-E004	APPROVAL
4	NAME PLATE FOR GENERATOR CIRCUIT BREAKER	PE-V0-423-510-E005	APPROVAL
5	SIZING CALCULATIONS INCLUDING SHORT CIRCUIT CALCULATIONS AS PER IEEE	PE-V0-423-510-E007	APPROVAL
6	SF6 PRESSURE SCHEME GENERATOR CIRCUIT BREAKER	PE-V0-423-510-E009	APPROVAL
7	FIELD QUALITY PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-423-510-E010	INFORMATION
8	TYPE TEST CERTIFICATES OF GENERATOR CIRCUIT BREAKER	PE-V0-423-510-E011	INFORMATION
9	O/M MANUALS FOR GENERATOR CIRCUIT BREAKER	PE-V0-423-510-E012	INFORMATION
10	EQUIPMENT LIST OF GENERATOR CIRCUIT BREAKER	PE-V0-423-510-E110	INFORMATION
11	LIST OF MANDATORY SPARES	PE-V0-423-510-E112	APPROVAL
12	MANUFACTURING QUALITY PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-423-510-E901	APPROVAL

Note:

1. The above list of drawings and documents is indicative.
2. Document schedule shall be as per NIT
3. The vendor after LOI shall submit drawings/documents in requisite number of copies as per NIT.



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DATA SHEET -A

<u>SL.NO.</u>	<u>PARAMETER</u>	<u>UNIT</u>	<u>VALUE</u>
1.00	Generator Circuit Breaker details		
1.01	Minimum continuous current rating at 50 °C	A	22244
1.02	Rated voltage	kV	27
1.02(a)	Voltage Variation	%	±5
1.02(b)	Rated Frequency	Hz	50
1.02(c)	Frequency Variation	%	(+)3 to (-)5
1.02(d)	Voltage & frequency variation (absolute sum)	%	5
1.03	No. of poles	Nos.	3
1.04 (a)	Rated short time withstand current	kA	160KA
1.04 (b)	Duration	sec	1 sec
1.05 (a)	Rated symmetrical breaking capability (i)System Source fault (ii)Generator Source fault	kA	(i) As per latest IEC/IEEE 62271-37-013 (ii) As per latest IEC/IEEE 62271-37-013
1.05 (b)	Rated making current capability (i)System Source fault (ii)Generator Source fault	kApeak	(i) As per latest IEC/IEEE 62271-37-013 (ii) As per latest IEC/IEEE 62271-37-013
1.06	One-minute power frequency withstands voltage	kV(RMS)	As per latest IEC/IEEE 62271-37-013
1.07	Impulse withstand voltage	kV(Peak)	As per latest IEC/IEEE 62271-37-013
1.08	Location of GCB	Indoor / Outdoor	Indoor
1.09	Quantity of GCB	Nos.	1
1.10	Quantity of Earth Switch per GCB	Nos.	2
1.11	Quantity of Series Isolator per GCB	Nos.	1
1.12	Connection for Gas Turbine Starting circuit required	Yes/No	No.
1.13	Configuration of Earth Switch, Series Isolator & Short circuiting connection with switch		As per Annexure – I of Section-I
1.14	Interrupting Medium		SF6



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1.15	Type of cooling		Natural / Forced
1.16	Type of operating mechanism		Motorized or Hydraulic Spring Charged
1.17	Rated Short Circuit duty Cycle		CO-30MIN –CO
1.18	Continuous current duty Cycle		O-3 MIN-CO-3 MIN –CO
2.00	<u>Auxiliary supplies</u>		
2.01	DC	V	220
2.02	AC [Any single phase power for lighting and heating circuits to be derived by vendor from this supply]	Phase, Wire, Hz	415V, 3 phase, 4 wire and 240V, 1 phase, 2 wire, 50 Hz. Any single phase power for lighting and heating circuits to be derived by vendor from this supply
3.00	<u>Requirement of potential free Auxiliary Contacts for Purchaser's use:</u> (In addition to those required for own operation and indications)		
3.01	Total number of contacts furnished for GCB		
	a. Normally Open (NO) numbers	Nos.	12 Minimum
	b. Normally Close (NC) numbers	Nos.	12 Minimum
3.02	Total number of contacts furnished for Disconnecting switch		
	c. Normally Open (NO) numbers	Nos.	6 Minimum
	d. Normally Close (NC) numbers	Nos.	6 Minimum
3.03	Total number of contacts furnished for Earth switch		
	e. Normally Open (NO) numbers	Nos.	6 Minimum
	f. Normally Close (NC) numbers	Nos.	6 Minimum
4.00	Trip Coils		
4.01	No. of Trip Coils provided	Nos.	2
4.02	Voltage rating of Trip coil	V	220V DC
4.03	Minimum operating voltage of trip coil	% rated voltage	70%
5.00	Wiring (copper wiring)		
5.01	Internal Wiring	Sq.mm.	1.5 sq.mm.
5.02	Motor Circuit	Sq.mm.	2.5 sq.mm. or higher as per requirement of motor ratings
6.00	<u>Type Tests</u>		
6.01	Validity period of type test reports		Type test reports for similar machine as Per applicable latest standards shall not be more than five years old from the date 29/01/2016



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6.02	Type tests to be conducted for this contract, despite availability of valid & acceptable test certificates	Yes/ No	No
6.03	If yes, list of type tests to be conducted		NA
7.00	<u>Mandatory Spares</u>		
7.01	Mandatory Spares to be quoted for this contract	Yes/ No	Yes
7.02	If yes, list of mandatory spares		AS PER BOQ-CUM-PRICE SCHEDULE



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DATA SHEET -B

TECHNICAL PARTICULARS

[TO BE SUBMITTED ALOGWITH TECHNICAL OFFER]

SL.NO.		UNIT	SPECIFIED	OFFERED
	GENERATOR CIRCUIT BREAKER			
1.01	a. Manufacturer			
	b. Country of Manufacture			
	c. Type Designation			
1.02	Applicable Standard		Latest IEC/ IEEE 62271-37-013	
1.03	Rated voltage (kV)			
1.04	Rated frequency	Hz	50	
1.05	Rated continuous current (A) at ambient temperature of: 40°C 50°C			
1.06	Interrupting medium		SF6	
1.07.01	Rated short time withstand current	kA		
1.07.02	Duration	sec		
1.08	Breaking capability			
i)	System source fault			
	a) Rated symmetrical breaking current	kA rms		
	b) Rated asymmetrical breaking current	kA rms		
	c) DC component			
	d) Rated making current	kApeak		
	e) Suitability of GCB checked		Yes/ No	
ii)	Generator source fault			
	a) Rated symmetrical breaking current	kA rms		
	b) Rated asymmetrical breaking current	kA rms		
	c) DC component			
	d) Rated making current	kApeak		
	e) Suitability of GCB checked		Yes/ No	
1.09	Rated short circuit duty cycle		CO -30 - CO	
1.10	Rated impulse withstand voltage	kVpeak		
1.11	Rated Power frequency `dry test` withstand voltage: Earth : Across the pole :	kVrms kVrms		



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1.12	Type of cooling		Natural/ Forced	
1.13	Maximum allowable temperature of main contacts	Deg. C	105/90	
1.14	Degree of protection of breaker enclosure		Air leakage < 2%	
1.15	Whether canopy is required, if GCB is installed outdoor			
1.16 a)	Voltage rating of motor driven pumps (in hydraulic mechanism)	V		
1.16 b)	Power rating of motor driven pumps	kW		
1.16 c)	No. of motor driven pump	Nos.		
1.17 a)	Voltage rating of fans (in forced cooling)	V		
1.17 b)	Power rating of fan motor	kW		
1.17 c)	No. of fan motor	Nos.		
1.18	Does GCB has provision of lockout features for open and close conditions of GCB?			
1.19	Stored energy of GCB is suitable for how many CO operations?			
1.20	Maximum current under natural cooled conditions which can be carried by GCB at following ambient temperatures: --°C --°C --°C --°C 50°C	A		
1.21	Nominal Ratings of the basic model quoted: Normal current : Normal voltage : System source Fault current : Generator source Fault current : Making current : Dielectric withstand voltage :	A kV kA kA kApeak kVrms, kVpeak		
1.22	Circuit breaker closing time	msec		
1.23	Circuit breaker break time	msec		
1.24	Whether specified safety interlocks and locking features provided as per the specification?			



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1.25	Type of operating mechanism provided			
1.26	No. of poles: Whether three poles of the circuit breaker are gang operated?			
1.27	Whether circuit breaker has anti pumping feature?			
1.28	Whether circuit breaker has trip free mechanism?			
1.29	Whether lockout feature provided for the circuit breaker?			
1.30	Whether separate SF6 gas monitors provided for each of the three phases of the circuit breaker?			
1.31	No. of SF6 gas monitors provided for each GCB			
1.32	a) No. of trip coils provided b) Voltage rating of trip coil c) Minimum operating voltage of trip coil	V V		
1.33	Emergency current rating during loss of coolant at 50°C ambient (if applicable)	A		
1.34	Time available at rated current before load reduction	min		
1.35	Rate at which load current should be reduced	A/sec		
1.36	Reduced continuous operating current	A		
1.37	Rated short circuit duty cycle			
1.38	Rated permissible tripping time	msec		
1.39	Maximum permissible temperature rise of main contacts and conducting joints for continuous rating over the ambient air temperature of 50 deg C: Copper: Silver: Silver alloy:	 Deg C Deg C Deg C		
1.40	Minimum creepage distance	mm		
1.41	Clearance in air of live parts - phase to earth	mm		
1.42	a) Control circuit suitable for aux. supply voltage of b) Mechanism motor suitable for aux. supply voltage of	V V		



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1.43	Value of capacitor included in GCB on generator transformer side	nF/phase		
1.44	Value of capacitor included in GCB on generator side	nF/phase		
1.45	a) DOP of GCB local control panel b) Is DOP type test certificate for GCB LCP enclosed?			
1.46	Whether cable glands and lugs are included as per the specification?			
1.47	Whether all interconnecting cables between various equipment of GCB and associated devices in bidder's scope are included?			
1.48	Whether sufficient quantity and types of spares are included for start up & commissioning of specified no. of GCBs?			
1.49	No. of series isolators provided per GCB on: Gen. trfr. side:			
1.50	No. of earth-switches provided per GCB on: Gen. trfr. side: Generator side:			
1.51	Catalogues attached for GCB: for series isolator: for earth-switch:			
1.52	Earth switch			
	a) Manufacturer			
	b) Country of manufacture			
	c) Type designation			
	d) Reference Standard			
	e) Rated service voltage	kV		
	f) Rated frequency	Hz		
	g) Rated normal current at 50 deg C	A		
	h) Rated short time withstand current	kArms		



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	i) Rated peak withstand current j) Rated power frequency withstand voltage k) Rated impulse withstand voltage l) No. of poles per switch m) No. of control mechanism per switch n) Ambient air temp. limits o) Control circuit suitable for aux. supply voltage of? p) Mechanism motor suitable for aux. supply voltage of?	kA_{peak} kV kV Deg C V V		
1.53	Series isolator			
	a) Manufacturer b) Country of manufacture c) Type designation d) Reference Standard e) Rated service voltage f) Rated frequency g) Rated normal current at 50 deg C h) Is series isolator fully compatible with GCB in respect of normal current ratings at various ambient temperatures? i) Rated short time withstand current j) Rated peak withstand current k) Rated power frequency withstand voltage l) Rated impulse withstand voltage	kV Hz A kArms kA_{peak} kV kV		



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	m) No. of poles per switch n) No. of control mechanism per switch o) Ambient air temp. limits p) Control circuit suitable for aux. supply voltage of? q) Mechanism motor suitable for aux. supply voltage of?	Deg C		
1.54	a) Whether all type tests have been conducted on GCB as per latest IEC/IEEE 62271-37-013? b) Have all the type tests been carried out at independent test laboratories?			
1.55	Summary of Type test reports for GCB enclosed as Annex. No.			
1.56	Whether the offer includes performance of all site tests specified in the spec.?			
1.57	a) Whether all type tests have been conducted on series isolator as per IEC 62271-102? b) Summary of Type test reports for series isolator enclosed as Annex. No.			
1.58	a) Whether all type tests have been conducted on earth-switch as per IEC 62271-102? b) Summary of Type test reports for earth-switch enclosed as Annex. No.			
1.59	<u>Requirement of potential free Auxiliary Contacts for Purchaser's use:</u> (In addition to those required for own operation and indications)			
1.59.01	Total number of contacts furnished for GCB			
	a. Normally Open (NO) numbers	Nos.		
	b. Normally Close (NC) numbers	Nos.		
1.59.02	Total number of contacts furnished for Disconnecting switch			
	c. Normally Open (NO) numbers	Nos.		
	d. Normally Close (NC) numbers	Nos.		
1.59.03	Total number of contacts furnished for Earth switch			



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	e. Normally Open (NO) numbers	Nos.		
	f. Normally Close (NC) numbers	Nos.		
1.60	Trip Coils			
1.60.01	No. of Trip Coils provided	Nos.		
1.60.02	Voltage rating of Trip coil	V		
1.60.03	Minimum operating voltage of trip coil	% rated voltage		
1.61	Wiring (copper wiring)			
1.61.01	Internal Wiring	Sq.mm.		
1.61.02	Motor Circuit	Sq.mm.		



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DATA SHEET –C

TECHNICAL PARTICULARS

[TO BE SUBMITTED AFTER AWARD OF CONTRACT]

SL.NO.		UNIT	SPECIFIED	OFFERED
	GENERATOR CIRCUIT BREAKER			
1.01	a. Manufacturer			
	b. Country of Manufacture			
	c. Type Designation			
1.02	Applicable Standard		IEC/ IEEE 62271-37-013	
1.03	Rated voltage (kV)			
1.04	Rated frequency	Hz	50	
1.05	Rated continuous current (A) at ambient temperature of: 40°C 50°C			
1.06	Interrupting medium		SF6	
1.07.01	Rated short time withstand current	kA		
1.07.02	Duration	sec		
1.08	Breaking capability			
i)	System source fault			
	a) Rated symmetrical breaking current	kA rms		
	b) Rated asymmetrical breaking current	kA rms		
	c) DC component			
	d) Rated making current	kApeak		
	e) Suitability of GCB checked		Yes/ No	
ii)	Generator source fault			
	a) Rated symmetrical breaking current	kA rms		
	b) Rated asymmetrical breaking current	kA rms		
	c) DC component			
	d) Rated making current	kApeak		
	e) Suitability of GCB checked		Yes/ No	
1.09	Rated short circuit duty cycle		CO -30 - CO	
1.10	Rated impulse withstand voltage	kVpeak		
1.11	Rated Power frequency `dry test` withstand voltage: Earth : Across the pole :	kVrms kVrms		



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1.12	Type of cooling		Natural/ Forced	
1.13	Maximum allowable temperature of main contacts	Deg. C	105/90	
1.14	Degree of protection of breaker enclosure		Air leakage < 2%	
1.15	Whether canopy is required, if GCB is installed outdoor			
1.16 a)	Voltage rating of motor driven pumps (in hydraulic mechanism)	V		
1.16 b)	Power rating of motor driven pumps	kW		
1.16 c)	No. of motor driven pump	Nos.		
1.17 a)	Voltage rating of fans (in forced cooling)	V		
1.17 b)	Power rating of fan motor	kW		
1.17 c)	No. of fan motor	Nos.		
1.18	Does GCB has provision of lockout features for open and close conditions of GCB?			
1.19	Stored energy of GCB is suitable for how many CO operations?			
1.20	Maximum current under natural cooled conditions which can be carried by GCB at following ambient temperatures: --°C --°C --°C --°C 50°C	A		
1.21	Nominal Ratings of the basic model quoted: Normal current : Normal voltage : System source Fault current : Generator source Fault current : Making current : Dielectric withstand voltage :	A kV kA kA kApeak kVrms, kVpeak		
1.22	Circuit breaker closing time	msec		
1.23	Circuit breaker break time	msec		
1.24	Whether specified safety interlocks and locking features provided as per the specification?			



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1.25	Type of operating mechanism provided			
1.26	No. of poles: Whether three poles of the circuit breaker are gang operated?			
1.27	Whether circuit breaker has anti pumping feature?			
1.28	Whether circuit breaker has trip free mechanism?			
1.29	Whether lockout feature provided for the circuit breaker?			
1.30	Whether separate SF6 gas monitors provided for each of the three phases of the circuit breaker?			
1.31	No. of SF6 gas monitors provided for each GCB			
1.32	a) No. of trip coils provided b) Voltage rating of trip coil c) Minimum operating voltage of trip coil	V V		
1.33	Emergency current rating during loss of coolant at 50°C ambient (if applicable)	A		
1.34	Time available at rated current before load reduction	min		
1.35	Rate at which load current should be reduced	A/sec		
1.36	Reduced continuous operating current	A		
1.37	Rated short circuit duty cycle			
1.38	Rated permissible tripping time	msec		
1.39	Maximum permissible temperature rise of main contacts and conducting joints for continuous rating over the ambient air temperature of 50 deg C: Copper: Silver: Silver alloy:	Deg C Deg C Deg C		
1.40	Minimum creepage distance	mm		
1.41	Clearance in air of live parts - phase to earth	mm		
1.42	a) Control circuit suitable for aux. supply voltage of b) Mechanism motor suitable for aux. supply voltage of	V V		



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1.43	Value of capacitor included in GCB on generator transformer side	nF/phase		
1.44	Value of capacitor included in GCB on generator side	nF/phase		
1.45	a) DOP of GCB local control panel b) Is DOP type test certificate for GCB LCP enclosed?			
1.46	Whether cable glands and lugs are included as per the specification?			
1.47	Whether all interconnecting cables between various equipment of GCB and associated devices in bidder's scope are included?			
1.48	Whether sufficient quantity and types of spares are included for start up & commissioning of specified no. of GCBs?			
1.49	No. of series isolators provided per GCB on: Gen. trfr. side:			
1.50	No. of earth-switches provided per GCB on: Gen. trfr. side: Generator side:			
1.51	Catalogues attached for GCB: for series isolator: for earth-switch:			
1.52	Earth switch			
	a) Manufacturer			
	b) Country of manufacture			
	c) Type designation			
	d) Reference Standard			
	e) Rated service voltage	kV		
	f) Rated frequency	Hz		
	g) Rated normal current at 50 deg C	A		
	h) Rated short time withstand current	kArms		



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	i) Rated peak withstand current j) Rated power frequency withstand voltage k) Rated impulse withstand voltage l) No. of poles per switch m) No. of control mechanism per switch n) Ambient air temp. limits o) Control circuit suitable for aux. supply voltage of? p) Mechanism motor suitable for aux. supply voltage of?	kA_{peak} kV kV Deg C V V		
1.53	Series isolator			
	a) Manufacturer b) Country of manufacture c) Type designation d) Reference Standard e) Rated service voltage f) Rated frequency g) Rated normal current at 50 deg C h) Is series isolator fully compatible with GCB in respect of normal current ratings at various ambient temperatures? i) Rated short time withstand current j) Rated peak withstand current k) Rated power frequency withstand voltage l) Rated impulse withstand voltage	kV Hz A kArms kA_{peak} kV		



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	m) No. of poles per switch n) No. of control mechanism per switch o) Ambient air temp. limits p) Control circuit suitable for aux. supply voltage of? q) Mechanism motor suitable for aux. supply voltage of?	kV Deg C V V		
1.54	a) Whether all type tests have been conducted on GCB as per latest IEC/IEEE 62271-37-013? b) Have all the type tests been carried out at independent test laboratories?			
1.55	Summary of Type test reports for GCB enclosed as Annex. No.			
1.56	Whether the offer includes performance of all site tests specified in the spec.?			
1.57	a) Whether all type tests have been conducted on series isolator as per IEC 62271-102? b) Summary of Type test reports for series isolator enclosed as Annex. No.			
1.58	a) Whether all type tests have been conducted on earth-switch as per IEC 62271-102? b) Summary of Type test reports for earth-switch enclosed as Annex. No.			
1.59	<u>Requirement of potential free Auxiliary Contacts for Purchaser's use:</u> (In addition to those required for own operation and indications)			
1.59.01	Total number of contacts furnished for GCB			
	a. Normally Open (NO) numbers	Nos.		
	b. Normally Close (NC) numbers	Nos.		
1.59.02	Total number of contacts furnished for Disconnecting switch			
	c. Normally Open (NO) numbers	Nos.		
	d. Normally Close (NC) numbers	Nos.		
1.59.03	Total number of contacts furnished for Earth switch			



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	e. Normally Open (NO) numbers	Nos.		
	f. Normally Close (NC) numbers	Nos.		
1.60	Trip Coils			
1.60.01	No. of Trip Coils provided	Nos.		
1.60.02	Voltage rating of Trip coil	V		
1.60.03	Minimum operating voltage of trip coil	% rated voltage		
1.61	Wiring (copper wiring)			
1.61.01	Internal Wiring	Sq.mm.		
1.61.02	Motor Circuit	Sq.mm.		



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ANNEXURE – A

I) LIST OF O & M SPARES (3 YEARS OF OPERATION)

Sl. No.	Item Description	Unit	Quantity	Remarks
1.	SF6 density meter/leakage detector	No.	1	
2.	Circuit Breaker Closing Coil	No.	1	
3.	Circuit Breaker Trip Coil	No.	2	
4.	Isolating switch, selector switch, breaker control switch, position indicators, contactor/relays, push button, timer	%	5	5% of the total quantity, Minimum 1 no. of each type & rating
5.	Power and control fuses/circuit breakers of Different rating	%	5	5% of the total quantity, Minimum 1 no. of each type & rating
6.	Indicating lamp	%	10	10% of the total quantity, Minimum 1 no. of each colour & type
7.	Auxiliary switch assembly	Set	1	1 set each for circuit breaker and switches
8.	Motor kit (as applicable)	No.	1	
9.	Hydraulic Oil For Operating Mechanism (as applicable)	Can	2	
10.	Carbon Cleaning Brush	Set	2	

II) STARTUP & COMMISSIONING SPARES (MINIMUM REQUIREMENT)

Sl. No.	Item Description	Unit	Quantity	Remarks
1.	Consumables like Lubrication Grease etc.	Set	1	
2.	Hand Cranking Device for earthing switches and disconnectors	No.	1	

NOTE: Other spares, as applicable, as per manufacturer's standard shall be supplied for successful erection, commissioning and testing of GCB at site.

III) SPECIAL TOOLS AND TACKLES (MINIMUM REQUIREMENT)

Sl. No.	Item Description	Unit	Quantity	Remarks
1.	Lifting beam, shackles and straps	Set	1	
2.	Emergency Operating Lever	No.	1	
3.	Foundation Bolts	Set	1	

ANNEXURE-V

Generator Circuit Breaker



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2.2.4 GENERATOR CIRCUIT BREAKER (GCB)

2.2.4.1 CODES AND STANDARDS

All equipment and materials furnished under this specification shall conform to the latest revisions of the applicable IEC- ISO- and IEEE-Standards. ^{**} In particular the following Standards shall apply:

International standards	Title
IEC 60694	Common Clauses for High-Voltage Switchgear and Control gear Standards
IEC 62271-100	High voltage switchgear and control gear
IEC 60529	Degree of protection provided for enclosures
IEC 61166-2	Guide for seismic qualification
DIN EN ISO 12944	Corrosion protection of steel structures by protective paint systems
IEEE Std. C37.013 ^{**}	IEEE Standard for AC High-Voltage Generator Circuit-Breakers Rated on a Symmetrical Current Basis.
IEC 62271-102	Alternating Current Disconnectors (Isolators) and Earthing Switches Earthing Switch
IEC 60044-1	Current Transformers
IEC 60044-2	Voltage Transformers Surge Protection Equipment
IEC 60099-4	Metal-Oxide Surge Arresters without Gaps for A.C.- Systems
IEC 60358	Coupling Capacitors and Capacitor Dividers.

**** Note:- IEEE standard C37.013-1997 shall be replaced with the latest applicable standard i.e. IEEE/IEC 62271-37-013-2015 elsewhere in the specification even if not specifically mentioned.**

2.2.4.2 SCOPE OF SUPPLY AND SERVICES

EQUIPMENT AND COMPONENTS TO BE SUPPLIED

The basic supply of the GCB to be provided by the Contractor shall include, but not necessarily be limited to, the following items and components:

- a) One (1) triple pole circuit breaker, comprising three (3) single phase enclosures all



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fully assembled on a common frame with operating mechanism.

- b) ~~One (1) triple pole mechanically-ganged motorized disconnectors for series isolation, one on each side of the GCB and each provided with a triple pole earth switch, mechanically and electrically interlocked with the disconnector position. The disconnector shall be operable only with open position of the GCB~~
- c) ~~Three (3) Heavy duty station class surge arresters with operation counter and with surge capacitors, suitable for (27) kV rated generator circuit breaker. DELETED~~
- d) ~~Three (3) sets of three (3) single phase voltage transformers on transformer side, each with one primary and two secondary windings. DELETED~~
- e) ~~Set of three (3) single phase voltage transformers on generator side, each with one primary and two secondary windings. DELETED~~
- f) ~~Three (3) Current transformers on transformer side having 3 cores. DELETED~~
- g) ~~Three (3) Current transformers on generator side having 3 cores. DELETED~~
- h) One (1) three phase short-circuiting and grounding device between the GCB and series disconnector, for performing pre-commissioning tests on generator and protection system.
- i) One (1) Local control panel/cabinet, common to all three phases, for control of GCB and associated disconnectors/earth switches, suitable for receiving commands from and transmitting status information to remote control panel/DCS.
- j) Miscellaneous bolting and gasket material required for all equipment and panels.
- k) Primer painting of external surfaces and corrosion protection of internal surfaces.
- l) Miscellaneous items for field erection, testing, pre-commissioning and performance testing.
- m) Continuous online monitoring device for GCB. (Part of BOQ-Cum-Price Schedule)
- n) Temporary elements, if required, for field erection and testing.
- o) Special tools for erection and maintenance. (Part of BOQ-Cum-Price Schedule)
- p) One (1) set of spare parts recommended for 3 years normal operation. (Part of BOQ-Cum-Price Schedule)



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2.2.4.3 GCB DESIGN AND CONSTRUCTIONAL FEATURE

1. General

- a) The circuit-breaker shall use SF6-gas as insulating- and interrupting medium. For current interruption the self-blast interrupting principle shall be applied. The arc voltage of the circuit-breaker shall be high enough to ensure current zeros in case of generator-source short-circuit currents with delayed current zeros.
- b) The circuit-breaker shall have two separate contact systems, one for load current carrying and one for arc interruption. The circuit-breaker shall be capable of interrupting currents under out-of-phase conditions with out-of-phase angles up to 180 degrees.
- c) The completely assembled circuit-breaker, including drive linkages and all other parts, shall have ample mechanical strength to withstand without damage all stresses incident to operation within the rated short-circuit current or the related required capabilities of the circuit-breaker, as well as stresses resulting from mounting, moving or maintaining the circuit-breaker in a proper manner.
- d) The time between the first and last pole to open or close shall not exceed 2ms. The circuit-breaker shall be electrical trip-free and prevent pumping.

2. Operating mechanism

- a) The circuit breaker operating mechanism shall be as per manufacturer standard. The operating mechanism shall be of hydraulic/spring type. The operating mechanism shall have two independent electric trip coils and dual pressure interlock switches. The two trip coils including associated circuit and interlocks shall be wired independently and completely redundantly. This shall operate on all poles (3 phase control). The operating mechanism shall have electrical trip-free and anti-pumping devices and shall be so connected that the closing mechanism will automatically become inoperative after and while the breaker is closed, regardless of the position of the control switch, but will not become inoperative until after the breaker has had ample time to complete the operation of closing. It shall be impossible to operate the closing mechanism again until the operator has first moved the breaker control to the neutral position.
- b) There shall be no objectionable rebound and the mechanism shall not require any critical adjustment. It shall be strong, rigid, positive and fast in operation.
- c) The operating mechanism shall be such that the failure of any auxiliary equipment will not prevent tripping and will not cause trip or closing operation of the power operated closing devices.



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- d) A mechanical indicator shall be providing to show open and close positions of breaker. It shall be located in a position where it will be visible to a man standing on the floor. An operation counter at 1000-1300 mm level shall also be provided. The counter readings shall be visible from the ground even with the mechanism housing closed.
- e) Closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage.
- f) Tripping coil shall operate correctly at all values of voltage between 70% and 110% of the rated voltage. **Trip coil supervision relay shall be provided as part of GCB.**
- g) Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by trip coils. Provision shall be made for local electrical control "Local/Remote" selector switch and closing and trip push buttons/control switch shall be provided in the breaker control cabinet. In addition local manual trip button shall be provided. For the purpose of tripping, two electrically independent trip circuits along with separate shunt trip coils shall be provided.
- h) The auxiliary switch of the breaker shall be positively driven by the breaker-operating rod.
- i) All three-breaker poles shall operate simultaneously. Pole discrepancy feature shall be provided to trip the broken out if all the poles do not close simultaneously.
- j) When tripping impulse is received the operating mechanism shall ensure the CB opening either with CB in fully closed nor in partially closed position.

Hydraulically operated Mechanism (if applicable):

- a) A hydraulically charged spring drive mechanism shall be furnished for the circuit breaker, complete with all control equipment. The only external requirement for operation shall be the electrical supplies. The mechanism shall operate the circuit breaker through a mechanical linkage, which operates all the three poles simultaneously.
- b) The hydraulic pump shall have 2 x 100% capacity.
- c) The capacity of energy facilities shall be of sufficient size to store at least 2 complete close-open operations.
- d) The design of the operating mechanism shall be co-ordinated with the circuitbreaker design to ensure positive opening of the circuit breaker and circuit interruption, whether the tripping impulse is received in the fully closed or any partially closed



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positions.

- e) For purposes of inspection and adjustment, means shall be provided to permit local operation of the circuit breaker. In addition, an emergency operating lever shall be supplied to allow manual opening and closing of the circuit breaker.
- f) The following clauses shall be applicable in addition to the above in case Pneumatic operated mechanism is offered.
- g) Protection shall be provided to take care of possible failure of the compressed air system that drives the breaker. Upon loss of the compressed air supply in the open position, the breaker shall remain locked in open position and shall not tend to close. Upon loss of the compressed air supply in the closed position, the breaker shall remain locked in closed position.
- h) Each three-phase circuit breaker shall have a compressed air plant complete with all associated pipework etc. The compressed air plant shall have 2x100% compressors and dryers (if required). The total stored energy in the air receiver offered shall be sufficient for 2CO operations. The receiver shall conform to BS-5169, BS - 5500 as relevant.

3. SF6 supervision

- a) 1. A SF6 gas density monitor shall be supplied for monitoring the three phases of the circuit breaker. The gas density monitor shall be equipped with a temperature compensated pressure switch and shall be adjustable.
- b) One contact of the pressure switch shall be provided to indicate that the gas density has reached a level where refilling the gas volume is necessary. Two additional contacts shall be provided, connected to each trip circuit, to prevent tripping of the circuit breaker when gas density falls below a level "too low" to successfully complete an operation of the circuit breaker at its ratings.
- c) Operating hydraulic pressure lock out annunciation shall be included in DCS. To avoid opening/closing of breaker during lockout necessary logic shall be included in GCB control circuit.
- d) For SF6 density control, a density monitoring system shall be provided. The system shall consists of temperature compensate pressure element provided with the following facilities:
 - i. SF6 density indication
 - ii. "SF6 low density " alarm (SF6 refilling is required)
 - iii. "SF6 very low density" (trip prevention on 1st tripping circuit)
 - iv. "SF6 very low density" (trip prevention on 2nd tripping circuit)



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4. Circuit-breaker control

For each circuit breaker, two trip coils shall be provided. One circuit (primary) will be wired in the normal circuit-breaker control scheme and the secondary circuit shall be used for backup protection. This secondary trip circuit will include all the interlocking associated with the primary circuit. Upon loss of drive energy, control power supply or SF6-gas/Vacuum, the breaker shall remain in the fully closed or open position.

5. Accessories

Each circuit-breaker shall be equipped with:

- i. operation counter
- ii. SF6 density monitor and SF6 pressure gauge
- iii. reliable, mechanical position indicator to indicate the open or closed position of the circuit-breaker.
- iv. manual operation device for maintenance purpose

6. Insulation

The circuit-breaker with contacts open and insulating gas at atmospheric pressure must be capable of withstanding 3 times the phase to ground voltage. This requirement is to assure that the circuit breaker in the open position is capable of withstanding voltages under conditions when the two systems are out-of-phase. All parts of the insulation structure, including those between phases to earth and across the open contacts, shall be of an inherently stable nature with a minimum susceptibility to dielectric tracking.

7. Control cubicle

- a. The control cubicle shall accommodate all the necessary equipment for local/remote changeover facilities, control, monitoring, supervision and interlocking of the system. A degree of protection of IP54 shall apply (IEC 60529).
- b. Control system shall be suitable for remote control & supervision of Circuit breaker, Disconnecters, Earth switches, etc.,

8. Conventional (wired) control equipment

- a) The control cubicle shall be provided with conventional, hard wired control and supervisory equipment. Clamp type terminals, halogen free cables and wires, rated at 120° Celsius with cross section 1.5mm² for internal wiring, 2.5mm² for motor circuits, ~~internal wiring of instrumentation transformers and 6mm² for instrument transformers, conventional apparatuses.~~ Terminal marking with connection designation of maximum 3 digits. An active mimic diagram with position indicators integrated in the lighted (LED's) push-button switches for the circuit-breaker, disconnector, earthing switch (es).



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- b) The control cubicle shall accommodate all the necessary equipment for local/remote changeover facilities, control, monitoring, supervision and interlocking of the system. ~~A minimum of 2NO and 2NC auxiliary contacts shall be provided for each of the individual system operating mechanism for TANGEDCO's use.~~ All spare auxiliary contacts on the proposed equipment shall be wired to terminal blocks. All terminals and control wires shall be identified in a proper manner. Installation of control cabinet shall be next to the breaker.
- c) Terminal block shall be 1100V grade and not more than 2 wires shall be terminated to any other terminal.
- d) Spare terminal of 20% of entire terminal shall be provided.

9. Nameplate

An anodized aluminium nameplate, black anodized and laser engraved, shall be attached to the generator switchgear. The nameplate shall be placed on the control cabinet.

10. Painting

- a. All surfaces of the circuit-breaker, operating mechanism and other parts exposed to possible corrosion shall be designed to prevent accumulation of moisture. The paint treatment shall be according with manufacturer's instructions.
- b. The circuit breaker shall be finished with 2 coats of battle ship grey (IS 632) epoxy based paint. Sufficient quantity of touch up paint shall be furnished .The tenderer shall furnish type and quantity of paint with spare for use of owner if necessary.

11. Conductors of active parts

- a) Conductors shall be of highly-conductive copper. All bus joints shall have silver-to-silver contact surfaces. Insulating supports shall meet the dielectric strength requirements specified, and shall be capable of withstanding the mechanical forces imposed by closing and opening operations and by the currents specified.
- b) All connections of the current path shall be made with bolted, flexible connectors, to be supplied by the isolated phase bus manufacturer. The generator switchgear manufacturer shall furnish to the isolated phase bus duct manufacturer all pertinent details including forces transmitted to the bus during circuit-breaker operations and the terminal configuration required for the design of the connections.

12. Generator circuit-breaker system enclosure

- a) The GCB system enclosure shall be designed for welded connections to the isolated



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phase bus enclosures. Each single phase enclosure shall be made out of aluminium and capable of carrying the induced sheath current equal to the current ratings specified. The phase enclosures shall have Degree of protection IP 65.

- b) In order to avoid pollution due to ingress of dust and moisture, the enclosure shall be designed to allow air tightness and to withstand a slight internal overpressure. Inspection windows shall be provided in each single phase enclosure to allow visual checks of the individual assemblies positions.

13. Earthing pads

Two Numbers of Copper or stainless steel earthing pads shall be provided on the generator switchgear, close to earth level. For the control cubicle an adequate earthing facility shall be provided.

14. Digital Input /Analog Input and Digital Output to DDCMIS

The following Input / Outputs shall be arranged in Generator Circuit breaker for remote closing and opening and to meet interfacing requirements of DDCMIS.

- i. Circuit breaker NO, NC auxiliary contacts.
- ii. Local remote selection.
- iii. Operation counter.
- iv. Circuit breaker close/open.

Any other parameters required for permissive to operate the generator circuit breakers shall be controlled and monitored at DDCMIS.

I. DISCONNECTOR

i. GENERAL

- a) A disconnector shall be provided ~~on both sides~~ in series with the circuit-breaker. The disconnector shall be of a telescopic unit with a sliding tubular contact, with an operating mechanism which operates through a mechanical linkage all three poles. The isolating gap of the disconnector shall be in air of atmospheric pressure and a window shall be provided in the GCB-system enclosure to allow visual checking of its position.
- b) The control of the disconnector including the interlocking circuit shall be accommodated in the GCB-system control cubicle. A local/remote switch and push-buttons for local control shall be provided.

ii. Operating mechanism

- a) The operating mechanism, operated by a 3-phase motor, shall be of a heavy duty



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construction type and shall be designed to complete its normal travel to either "open" or "close" position, once started, without holding the control switch continuously in that position. Stopping the travel between fully open and closed position is not acceptable.

- b) A key interlocking shall be available to allow different modes of operation to be selected. Mechanically driven semaphore shall be provided for signaling Close/open-position. A crank handle shall be provided for manual operation in case of emergency.

II. EARTHING SWITCHES

i. General

- a) Earthing switches shall be provided on both sides of the circuit-breaker. These shall be of blade type, air insulated, gang operated with motor drive, with their hinge point connected to earth and shall be integrated together with the circuit-breaker and disconnecter into each of the single phase tubular aluminium enclosure, forming a straight section in the run of the isolated phase bus. Making- or breaking capability is not required for the earthing switches. The earthing switches operation shall be interlocked with the circuit-breaker and disconnecter.
- b) The control of the earthing switches including the interlocking circuits shall be accommodated in the GCB-system control cubicle. A local/remote switch and push-buttons for local control shall be provided.

ii. Operating mechanism

- a) The operating mechanism, operated by a 3-phase motor, shall be of a heavy duty construction type and shall be designed to complete its normal travel to either "open" or "close" position, once started, without holding the control switch continuously in that position. Stopping the travel between fully open and closed position is not acceptable.
- b) A key interlocking shall be available to allow different modes of operation to be selected. Mechanically driven semaphore shall be provided for signaling close/open-position.
- c) A crank handle shall be provided for manual operation in case of emergency. The contractor may propose any other type of operative mechanism as per standard practice shall be of proved design, operation and shall be successful and trouble free operation atleast 2 years in a power plant.

~~III. INSTRUMENT TRANSFORMERS~~ DELETED

~~i. Current transformers~~ DELETED



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- a) The current transformers shall be of single phase cast resin ring core type. The current transformers shall be accessible through the removed top cover of the GCB-system enclosures. The design parameters such as VA burden, accuracy class, etc. will be furnished during detailed engineering.
- b) The secondary windings shall be permanently wired to terminal blocks into the GCB-system control cubicle.
- c) The design shall be permit removal or replacement of CTs.

~~ii. Voltage transformers~~ DELETED

The voltage transformers shall be of single phase cast resin type with two secondary windings. The design parameter's such as VA burden, accuracy, class, etc. will be furnished during detailed engineering. The voltage transformers shall be accessible through the removed top cover of the GCB-system enclosures. The voltage transformers shall have a basic impulse withstand level as specified for the system. The secondary windings shall be permanently wired to terminal blocks into the GCB-system control cubicle.

The V.T. cubicles, one for each phase, shall be metal-clad, dust and vermin proof, free standing dead front assemblies. Voltage transformer & surge protection equipment shall be housed in phase separated sheet steel/ aluminium cubicle with grounded barriers having degree of protection of IP 54.

Each phase cubicle shall house one (1) voltage transformer, one (1) in separate compartment.

Voltage transformer shall be of cast resin, draw out type with accuracy class 0.2 for metering and synchronizing and class 3.0 for protection. One non-linear surge arrester with discharge counter and one surge capacitor with built-in discharge resistor shall be furnished per phase.

VT shall be provided in between generator circuit breaker and generator transformer for synchronizing as well as earth fault protection (with broken delta tertiary winding). One number neutral displacement relay also shall be provided in the VT cubicle.

IV. SURGE PROTECTION EQUIPMENT

~~i. Surge arresters~~ DELETED

Metal-oxide surge arresters with polymer housings and sheds of silicone shall be fitted at the transformer side in each phase of the GCB-system to provide protection against over voltages for the equipment connected to the generator busbar.



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ii. Surge capacitors

Surge capacitors shall be of a metal-housed-type and use synthetic aromatic oil as dielectric. The surge capacitors shall be mounted on the generator- and transformer-side in each phase of the generator circuit-breaker to provide additional protection for the equipment connected to the generator busbar against over voltages and to limit the rate-of-rise of the transient recovery voltage.

V. SHORT-CIRCUITING SWITCH FOR RELAY SETTING

i. General

- a) The short-circuiting connection with switch shall facilitate an unearthed three phase short-circuit on generator side of the GCB-system unit.
- b) A short-circuit bar shall be installed manually between the interrupter and line disconnect switch. By closing the breaker a three-phase short-circuit can be established.

ii. Adjustment of protection

- a) The short-circuiting connection with switch shall help to expedite the testing and adjustment of the power plant protection system.
- b) Complete and detailed information required for preventive maintenance shall be furnished, including recommended maintenance intervals, required tests and inspections. A step-by-step description of the disassembly and re-assembly of the equipment shall be included, listing any precaution or critical adjustments or settings that are to be performed. A list of tools, test equipment or other equipment required for the proper repair and maintenance of the supplied equipment shall be included.
- c) A complete parts list identifying all parts which are expected to need replacement on a periodic basis and the quantities of each part shall be included. The information of part no., part designation, quantity, etc., required by the manufacturer to supply spare parts shall be listed accordingly.

VI. General Technical Particulars For Generator Circuit Breaker

(*) to be decided by ~~contractor~~ bidder based on generator and system parameters based on calculations during detailed engineering.

I. GENERAL		
i.	Quantity	ONE (1) No. (Part of BOQ-Cum-Price Schedule)
ii.	Location	INDOOR Installation



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iii.	Degree Of Protection. Of GCB Enclosure	IP 65
iv.	Degree Of Protection Of Local Control Panel	IP 54
v.	Auxiliary Voltage	220 V DC, 415 V AC 3 Ph 50 Hz
vi.	Power Connection - Type - Interphase With IPBD	Isolated Phase Busduct (IPBD) Enclosure Through flanges and Busbar Through Flexible Connections
vii.	Max. Ambient Temp	50°C
	Max. Temp. Of Busbar Connections considering silver plated joints	105°C
viii.	Max. Temp. Of Enclosure Connections	80°C
ix.	Noise Level	As Per Relevant IEEE Standard
x.	Electro-magnetic Compatibility	As Per Relevant IEEE Standard
II. GENERATOR CIRCUIT BREAKER		
i.	Rated Voltage	To Suit Generator Terminal Voltage
ii.	Rated Maximum Voltage	1.05 x Generator operating voltage
iii.	Rated Frequency	50 Hz
iv.	Rated Continuous Current	As per Data sheet-A
v.	Rated Insulation Level	As per Data sheet-A
vi.	One Minute Power Frequency Withstand Voltage To Earth & Across Circuit Breaker/Switch Contacts	As per Data sheet-A
vii.	Lightning impulse withstand voltage to earth & across circuit breaker/switch contacts	As per Data sheet-A
viii.	One Minute Power Frequency Withstand Voltage For Auxiliary And Control Circuits	2 Kv (Rms)



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ix.	Number Of Stored Close/Open Operations	2CO FOR HYDRAULIC OPERATED /OCO FOR SPRING OPERATED
x.	Short Circuit Capability	*
xi.	Symmetrical Interrupting Capability	*
xii.	Dc Component Of Fault Current	*
xiii.	Short Circuit Making Current	*
xiv.	Rated Peak Withstand Current (Kv Peak)	*
xv.	Rated Short Time Withstand Current (KA Rms, For 1 Sec)	160
xvi.	Interrupting Time (Tripping Command Till Arc Extinction)	AS PER RELEVANT STANDARDS
xvii.	Opening Time (Tripping Command Till Contact Separation)	AS PER RELEVANT STANDARDS
xviii.	Closing Time (Closing Command Till Contact Touch)	AS PER RELEVANT STANDARDS
xix.	Simultaneity Of Poles (Closing Or opening)	within 2 ms
xx.	Transient Recovery Voltage (For enerator Source Faults)	2.2 kV/Micro Sec
xxi.	Transient Recovery Voltage (For System Source Faults)	5.5 KV/Micro Sec
xxii.	Short circuit duty Cycle	CO-30Min-CO
xxiii.	Rated duty cycle	0-3 Min-CO-3 Min-CO
xxiv.	SF6 Gas - Normal Pressure - Leakage Rate	* *
xxv.	Operating Mechanism	Hydraulic/Spring Operated
xxvi.	Opening & Closing Coil Voltage	220 V DC
III. DISCONNECTING SWITCH DATA		
i.	Rated Voltage	To suit the generator terminal Voltage



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ii.	Rated Maximum Voltage	1.05 x Generator Operating Voltage
iii.	Rated Frequency	50 Hz
iv.	Rated Continuous Current	22244 A
v.	Rated Insulation Level - One Minute Power Frequency Withstand Voltage across isolating distance of disconnector - Lightning Impulse Withstand Voltage Across isolating distance of disconnector	* *
vi.	Rated Short Time Withstand Current (kA For 1 Sec)	160
vii.	Rated Peak Withstand Current (kA Peak)	*
viii.	Operating Time (Sec)	*
ix.	Operating Mechanism	Electrical Motor Operated/Manual
IV. EARTHING SWITCH		
i.	Rated Voltage	To suit the generator terminal Voltage
ii.	Rated Maximum Voltage	1.05 x Generator Operating Voltage
iii.	Rated Frequency	50 Hz
iv.	Rated Insulation Level - Power Frequency Withstand Voltage to earth and across switch contacts - Lightning Impulse Withstand Voltage to earth and across switch contacts	* *
v.	Rated Short Time Withstand Current (Ka For 1 Sec)	160
vi.	Rated Peak Withstand Current (Ka Peak)	*



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vii.	Operating Mechanism	Electrical Motor Operated common for the 3 poles
viii.	Operating Time (Sec)	*
V. SHORT CIRCUIT LINK DATA		
i.	Rated Voltage	To suit the generator terminal Voltage
ii.	Rated Maximum Voltage	1.05 x Generator Operating Voltage
iii.	Rated Frequency	50 Hz
iv.	Rated Continuous Current	*
v.	Rated Insulation Level - Power Frequency Withstand Voltage to earth and across switch contacts - Lightning Impulse Withstand Voltage to earth and across switch contacts	* *
vi.	Insulation Level to Enclosure	*
VI. VOLTAGE TRANSFORMER DELETED		
i.	Quantity	*
ii.	Rated Voltage Ratio	*
iii.	Accuracy	Protection - PS Metering - 5P20
iv.	Rated Burden	*
v.	Secondary Protection	By MCBS
VII. SURGE ARRESTORS DELETED		
i.	Location	Refer Enclosed SLD
ii.	Voltage Class	*



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iii.	Type	Metal Oxide Gapless
iv.	Rating	*
VIII. SURGE CAPACITORS		
i.	Location	one each on generator and Transformer side
ii.	Rating	*

2.2.4.4 OPERATING CONDITIONS/REQUIREMENTS

With the ambient of 50 deg C the temperature rise limits for enclosure shall be 30 deg C. Other components of the Generator Circuit breaker shall be within the limits specified in IEC 600694

2.2.4.5 INSPECTION AND TESTING

General

The equipments shall be tested as per the QAP submitted by the bidder at the manufacturers works in presence of owner's representative.

Only type tested equipments are acceptable. For type tests BIDDER shall furnish test reports (conducted not earlier than 5 years from the date 29/01/2016) for the test carries out on identical machine.

If any of the type tests listed in this specification is not already conducted by the bidder the same shall be conducted at free of cost to the owner. All tests shall be conducted as per latest IEC/IEEE-62271-37-013.

Shop Tests

1. Generator Circuit Breaker

a. ROUTINE TESTS

- Gas receiver tests
- Pressure Tests
- Leakage tests
- Resister, heater and coil tests
- Control & Secondary wiring tests
- Clearance & mechanical adjustment check tests
- Mechanical operation tests.
- Timing tests
- Stored Energy tests
- Electrical resistance of current path tests
- Power frequency withstand voltage tests on major insulation components
- Power frequency withstand voltage tests on control and secondary wiring.



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b. TYPE TESTS

- a. Rated continuous Current carrying tests & Temperature rise tests.
- b. Dielectric tests on main, auxiliary and control circuits.
- c. Short Circuit Current tests
- d. Rated transient Recovery Voltage tests
- e. Rated Standard operating duty tests
- f. Rated interrupting time tests
- g. Tests on Short-circuit current with delayed current zero
- h. Load Current Switching tests
- i. Out of phase current switching tests
- j. Tests on Mechanical life endurance tests
- k. Excitation current switching tests
- l. Sound Level tests
- m. EMC Tests

~~2. Voltage Transformer~~ DELETED

~~a. ROUTINE TESTS~~ DELETED

During manufacture and on completion, all equipment shall be subjected to the Routine Tests as laid down in Indian Standard. List of major Routine tests are furnished below.

Bidder to note that the list is not exhaustive. All Routine tests shall be carried out as stipulated in latest Indian standard(s) though not specifically listed.

- i. Verification of terminal marking & polarity.
- ii. Power frequency dry withstand test on primary winding.
- iii. Power frequency dry withstand test on secondary winding.
- iv. Partial discharge measurement in accordance with IS: 11322:1985
- v. Determination of errors or other characteristics according to the requirements of the appropriate designation or accuracy class.
- vi. Accuracy test
- vii. Power frequency test.

~~b. TYPE TESTS~~ DELETED

Type test certificates as stipulated in Indian Standard, shall be furnished. List of major Type tests are furnished below. Bidder to note that the list is not exhaustive. All Type test certificates carried out as stipulated in latest Indian standard(s) shall be furnished though not specifically listed



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- i. Temperature rise test.
- ii. Lightning impulse voltage test for voltage transformers for service in electrically exposed installation.
- iii. High voltage power frequency withstand voltage test on outdoor voltage transformers upto and including 245kV.
- iv. Accuracy limit test.
- v. Impulse voltage test
- vi. Transient response test

~~3. Current Transformer~~ DELETED

~~a. ROUTINE TESTS~~ DELETED

During manufacture and on completion, all equipment shall be subjected to the Routine Tests as laid down in Indian Standard. List of major Routine tests are furnished below. Bidder to note that the list is not exhaustive. All Routine test shall be carried out as stipulated in latest Indian standard(s) though not specifically listed.

1. Verification of terminal marking & polarity.
2. Power frequency dry withstand test on primary winding.
3. Power frequency dry withstand test on secondary winding.
4. Over voltage inter-turn test.
5. Partial discharge measurement in accordance with IS: 11322:1985.
6. Determination of errors or other characteristics according to the requirements of the appropriate designation or accuracy class.
7. Current error, phase displacement and Composite error (for protection CTs)
8. Accuracy test (for measuring CTs)
9. Knee point voltage and excitation current(for special class CTs)
10. Measurement of secondary winding resistance (for special class CTs)
11. Turns ratio (for special class CTs)



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~~b. TYPE TESTS~~ DELETED

Type test certificates as stipulated in Indian Standard, shall be furnished. List of major Type tests are furnished below. Bidder to note that the list is not exhaustive. All type test certificates carried out as stipulated in latest Indian standard(s) shall be furnished though not specifically listed.

1. Short time current tests.
2. Temperature rise test.
3. Lightning impulse voltage test for current transformers for service in electrically exposed installation.
4. High voltage power frequency wet withstand voltage test on outdoor current transformers up to and including 245kV.
5. Determination of errors or other characteristics according to the requirements of the appropriate designation or accuracy class.
6. Current error and phase displacement.(for protection CTs)
7. Composite error (for protection CTs)
8. Accuracy test & Instrument security current test (for measuring CTs)

4. Test Witness

Tests shall be performed in presence of Owner's representative if so desired by the Owner.

5. Site Tests

The GCB shall be erected as per good engineering practice and all checks/tests necessary to ensure receipt of correct material component, proper storage of material/component, correctness of erection as per drawing/specification and the following tests shall also be carried out in addition to the routine tests cited above except (a)

i. Generator Circuit Breaker:

- i. Gauge tests
- ii. Stored energy system tests
- iii. Electrical resistance of current path tests
- ii. Clearance and mechanical adjustment check tests



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- iii. Timing tests
 - iv. Power frequency voltage withstand tests
 - v. Checking of all interlocks, annunciations and auxiliary contacts.
 - vi. Operational checks.
-



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VOLUME NO. : **II**

SECTION : **II**

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SECTION – 'II'

GENERAL TECHNICAL REQUIREMENTS



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1.00.00 SCOPE

1.01.00 The scope includes:

1.01.01 Design, engineering, manufacturing, assembly, testing, inspection, packing & delivery of:

- Generator circuit breaker
- Start-up and commissioning spares.
- Mandatory spares, as specified.
- Recommended spares for three (3) years of plant Operation & Maintenance.
- Special tools and tackles.
- Cable glands, cable lugs and foundation bolts.

1.01.02 Supervision of erection, testing & commissioning.

1.01.03 Training of engineers.

1.02.00 Terminal points:

- Bus bar of GCB.
- Enclosure of GCB.
- Cable glands and lugs in Local Control Panel.
- Earthing terminals of GCB Local Control Panel.

2.00.00 CODES AND STANDARDS.

S.NO.	STANDARD NUMBER	STANDARD TITLE
1	IEC/IEEE 62271-37-013	High-voltage switchgear and control gear – Part 37-013: Alternating-current generator circuit-breakers
2	IEEE Std. C37.013-1997 (R2008)	IEEE Standard for AC High-Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis
3	IEEE Std. C37.013a-2007	IEEE Standard for AC High Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis Amendment 1: Supplement for Use with Generators Rated 10–100 MVA
4	IEC 62271-102	High-voltage switchgear and control gear - Part 102: Alternating current disconnectors and earthing switches



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3.00.00 GENERATOR CIRCUIT BREAKER

3.01.00 The Generator Circuit Breaker (GCB) shall be of the metal enclosed type suitable for direct connection to phase isolated generator bus duct in a manner designed to preserve the phase isolated principle. The breaker shall have continuous and short time current ratings as those indicated in the datasheet-A of Section-I, Volume-II.

3.02.00 The design and testing of the generator circuit breaker shall be in line with IEC/ IEEE 62271-37-013.

3.03.00 Each phase of the circuit breaker shall be enclosed in a non-magnetic (Aluminium alloy) enclosure. The degree of protection of the enclosure shall be such that the air leakage rate shall not exceed 5% of the total enclosure volume per hour. The enclosure shall be minimum flux type so as to prevent heating of nearby metallic structures.

3.04.00 Support insulators shall be interchangeable and of high creepage distance, high mechanical and dielectric strength as required by the circuit breaker. Insulators shall be so mounted as to provide easy access for cleaning and removal.

3.05.00 The interrupters of the circuit breaker shall be SF6 type. The rated short circuit duty cycle shall be CO - 30 minutes – CO and continuous current duty cycle shall be CO - 3 minutes – CO.

3.06.00 GCB, isolator and earthing switch shall have separate operating mechanism. The operating mechanism for isolator and earth switch shall be motor operated.

Hand operation of the operating mechanism shall also be possible for GCB, isolator and earthing switch. Interlock shall be provided to prevent motor operation when the switch is being manually operated.

3.07.00 The circuit breaker shall be operated with a hydraulic/spring charged operating mechanism. All the three poles of the circuit breaker shall be gang operated. The circuit breaker shall have antipumping feature.

3.08.00 Hydraulic Operating Mechanism:

Each three-phase circuit breaker shall have a hydraulic system complete with all associated pipework etc. The total stored energy in the operating system offered shall be sufficient for 2 CO operations

Protection shall be provided to take care of possible failure of the hydraulic system that drives the breaker. Upon failure of the hydraulic system in the open position, the breaker shall remain locked in open position and shall not tend to close. Similarly, upon failure of the hydraulic system in the closed position, the breaker shall remain locked in closed position.

3.09.00 Spring Operating Mechanism:

Spring charged mechanism shall be complete with all its accessories. The total stored energy in the operating system offered shall be sufficient for O-C-O operations.

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



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- mechanism to prevent discharging of closing springs when the breaker is already in the closed position.
- 3.10.00 The visual check of the position of the Breaker, Disconnecting switch, starting switch & earthing switch shall be possible from outside the phase enclosure by means of inspection windows.
- 3.11.00 Each circuit breaker shall be provided with a shunt opening release. Such release shall have duplicate actuating coils. These coils shall be capable of opening the circuit breaker at any load or short circuit.
 Rated auxiliary voltage and the minimum operating voltage of the trip coils shall be as per the values specified in the datasheet-A of Section-I, Volume-II. GCB shall have closing coil and tripping coil supervision relays & both the trip coils shall be monitored.
- 3.12.00 SF6 gas monitor(s) shall be provided for each circuit breaker by bidder as per bidder's standard and proven practice, ensuring utmost reliability of the equipment and failsafe monitoring of SF6 gas, covering all phases and associated pipework. Bidder in the bid shall declare the number of SF6 gas monitor(s) included.
 Interlock shall be provided to prevent breaker from opening when the SF6 gas density falls to a level, which is inadequate to complete a successful opening operation of the breaker at its rated capacity.
- 3.13.00 Following interlocks and locking facilities shall be provided:
- a) It shall be possible to key-lock the series isolator in 'open' position blocking both electrical and hand closing of the isolator.
 - b) Key interlock shall be provided to prevent unauthorized operation of GCB.
 - c) Interlock shall also be provided between GCB and isolator.
 - d) Interlock shall also be provided between earth-switch and isolator.
 - e) Mechanical Interlock shall also be provided in addition to electrical interlock for circuit breaker, isolators and earth switches.
- 3.14.00 **Disconnecting switch, starting switch and Earthing switch**
- 3.14.01 The arrangement shall include disconnecting switch, starting switch & earthing switch as per the Annexure-I of Section-I, Volume-II.
- 3.14.02 The hinged point of Starting switch shall be connected with external cable from Gas turbine generator static starter. (Applicable for gas turbine generator set)
- 3.14.03 The design and testing of disconnecting switch, starting switch & earthing switch shall be in line with IEC 62271-102.



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3.15.00 Local Control Panel (LCP)

3.15.01 Each three-phase circuit breaker shall have a local control panel, for control of the auxiliaries. It shall have all the necessary indication for gas (SF6) pressure/ density, temperature etc. as per the standard practice of the manufacturer.

3.15.02 Mimic diagram shall be provided on local control panel (LCP). LCP shall contain stay put type local/remote selector switch, spring return to neutral control switch/ Push Button for GCB, isolator & earth switch, electrically operated semaphore/ LED indicators for indicating status of GCB, isolator and earth switch.

3.15.04 Two nos. incoming DC supply feeders will be made available by purchaser for GCB. Necessary arrangement shall be provided in GCB LCP for receiving these two feeders. Independent MCBs and voltage supervision relays shall be provided in GCB LCP for each DC supply. Auto contactor controlled 220V DC changeover scheme shall be provided.

3.15.05 a) It shall be possible to know abnormal or fault or lockout conditions from GCB local control panel. Visual annunciation shall be provided for this purpose alongwith 'lamp reset' and 'lamp test' push buttons on GCB LCP.

b) Separate sets of contacts for annunciation of various abnormal conditions of GCB in Central control room (CCR) shall be provided.

c) Two sets of contacts of GCB lockout conditions (when GCB is 'closed') shall be provided for interlocking in generator protection scheme. This is in addition to the requirements of GCB abnormal condition contacts given in b) above.

d) Potential-free contacts shall be provided on GCB LCP for indication in CCR for following conditions:

- i) GCB selected for remote control
- ii) GCB ready for 'close'
- iii) DC failure at GCB

e) Bidder to provide potential free auxiliary contacts for purchaser's use, in addition to requirement in d) above, as indicated in Data sheet-A of Section-I, Volume-II. These contacts shall be wired to the terminal blocks of LCP for external use.

f) Operation counter for GCB shall be provided in Local Control Panel.

3.15.06 Gland plate of local control panel shall be of adequate size for terminating external cables using glands (Glands and lugs in bidder's scope). No. of external cables, glands and lugs shall be finalized after the award of LOI and there shall not be any price implication on this account.

3.15.07 Spare terminals shall be provided in local control panel. Number of spare terminals shall not be less than 10%.

3.16.00 All interconnecting cables between various equipment in the scope of the bidder shall be included by bidder in their scope.



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3.17.00 Bidder must also establish that the model quoted is suitable for asymmetrical and symmetrical short circuit current contribution from generator side and system side to a 3-phase fault. Bidder to refer Annexure-II of Section-I, Volume-II to compute generator side and system side fault current and establish GCB suitability as per IEC/ IEEE 62271-37-013. Bidder must take a negative tolerance on generator reactances and an over-voltage factor of 1.05 for calculating the fault currents.

Bidder must also include the computations/ verification checks for the above in the bid. In the absence of this, the bid will be treated as incomplete and liable to be rejected.

4.00.00 COLOUR OF PAINT

The colour of paint shall be intimated to the vendor after the award of LOI and there shall be no commercial implication on this account.

5.00.00 TESTS

5.01.00 ROUTINE TESTS

The equipment shall be completely assembled, wired, adjusted and routine tested at manufacturer's works as per IEC/ IEEE 62271-37-013. Series isolator and earth switch shall be tested as per IEC 62271-102.

5.02.00 TYPE TESTS

All equipment offered should be of type-tested design. Offered model of GCB should have been type tested as per latest version of standard IEC/ IEEE 62271-37-013. Series isolator and earth switch should have been type tested as per IEC 62271-102.

5.03.00 SITE TESTS

Each generator circuit breaker shall be subjected to the following tests after it is totally assembled at site in its final location.

- i/ Leakage tests alongwith generator busduct
- ii/ Gauge tests
- iii/ Stored energy system tests
- iv/ Electrical resistance of current path tests
- v/ Clearance and mechanical adjustment check tests
- vi/ Timing tests
- vii/ Low frequency withstand voltage tests

5.04.00 WITNESSING OF TESTS

All tests shall be performed in presence of purchaser's representatives. The vendor shall give at least 45 days advance notice for routine tests and type tests (if required as per cl. 4.02.00).



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6.00.00 QUALITY PLAN

- a. The manufacturer shall furnish a detailed Quality Plan for approval covering testing on all major components like, enclosures, castings, forgings, insulators, springs, contacts, nozzles, cylinders (SF6), manometers, pressure switches, density meters, valves, pipes and fittings, pumps, coils (for tripping and closing), heaters, relays, filters, base frame, support structures, SF6 gas, terminals, etc. The tests shall include all applicable tests like, material, chemical and other tests as per relevant material and international standard. The critical casting and forgings and weld joints shall also be subject to UT/RT and dye penetration examination to ensure freedom from defects. All pressurized vessels/enclosures shall be pressure and leak tested at 1.5 times the design pressure or twice the operating pressure.
- b. The assembled generator circuit breaker shall be tested in accordance with IEC/ IEEE 62271-37-013. The manufacturer shall furnish a detailed test procedure for routine and type test for BHEL/ultimate customer review and approval.
- c. Routine tests on isolator and earth-switch shall be conducted as per IEC 62271-102.

7.00.00 SPARES

- 7.01.00 Bidder to furnish list of start-up and commissioning spares which may be required during the start-up and commissioning of the equipment.
- 7.02.00 Mandatory spares shall be quoted (if applicable) as per BOQ-cum-price schedule as part of NIT.
- 7.03.00 The bidder shall furnish a list of "Recommended spares for 3 years of normal operation of the plant".
- 7.04.00 Various schedules of spares to be submitted alongwith the bid shall indicate description of spare parts alongwith type designation, quantity, unit price, total price etc.

8.00.00 SPECIAL TOOLS & TACKLES

- 8.01.00 Bidder shall offer one set of unused special tools and tackles which are required for erection, assembly, adjustment, maintenance and dismantling of GCB.
- 8.02.00 These tools and tackles shall be separately packed and sent to site prior to erection of GCB.
- 8.03.00 List of special tools and tackles, alongwith quantity shall be furnished as a part of offer.

9.00.00 SUPERVISION OF ERECTION, TESTING AND COMMISSIONING

Bidder shall quote for "Supervision of Erection, Testing and Commissioning" of each GCB. Required instruments for site testing of GCB shall be arranged by the vendor, in case the same are not available at site. These instruments shall be brought by the vendor and shall be taken back after completion of commissioning.



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10.00.00 TRAINING OF ENGINEERS

Bidder shall provide training for a maximum of six (6) engineers from BHEL/ultimate customer at works, training centre etc. The training shall also include application, layout, design, construction, operating principle, operating mechanism, local control panel, operation, maintenance, site inspection, erection, site testing, spares etc. of GCB.

10.01.00 The language of instructions shall be English. All training material to be supplied to engineers shall be in English.

10.02.00 The training programme shall be finalised after the award of LOI.

11.00.00 O & M MANUAL

11.01.00 The vendor shall submit after the award of LOI, draft "O & M Manual" for approval. Final "O & M Manual" shall be properly bound.

11.02.00 The O & M Manual shall contain:

11.02.01 Complete set of approved drawings together with performance/ rating curves of the equipment and test certificate wherever applicable.

11.02.02 Storage and handling instructions.

11.02.03 Step by step procedure for erection, testing & commissioning of equipment.

11.02.04 The operating and maintenance instructions of the equipment shall be in sufficient details to enable the owner to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step-by-step procedure for all operations likely to be carried out during the life of the plant/ equipment.

11.02.05 Spare part catalogue for all the equipment.

11.02.06 A separate section of the manual shall be for each size/ type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets, drawings and list of parts with procedure for ordering spares. Maintenance instructions shall include charts showing lubrication, checking, testing and replacement procedures to be carried out daily, weekly, monthly and at longer intervals to ensure trouble free operation. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or break down. A collection of manufacturer's standard leaflets will not be accepted as a compliance of this clause. The manual shall be specifically compiled for the concerned project.