

**ANDHRA PRADESH POWER DEVELOPMENT
COMPANY LIMITED (APPDCL)**

1X800 MW SDTPS, STAGE-II, UNIT-3, KRISHNAPATTANAM

VOLUME – II

TECHNICAL SPECIFICATION FOR
GENERATOR CIRCUIT BREAKER (GCB)

SPECIFICATION NO : PE-TS-420-510-E001
REV-0



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



**TECHNICAL SPECIFICATION FOR
GENERATOR CIRCUIT BREAKER**

SPECIFICATION NO. PE-TS-420-510-E001

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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</u>	<u>Specific Requirement/ Change</u>
1.0	5.02.00	Clause shall be read as "All equipment offered should be of type tested design. Offered model of GCB should have been type tested as per standard IEEE C37.013. Series isolator and earth switch should have been type tested as per IEC 62271-102."
2.0	-	The Degree of Protection shall be as below:- Phase Enclosure : IP65 Local Control Cabinet : IP55
3.0	General	One number Spare pole assembly completely identical to the main pole assembly along with enclosure suitable for complete replacement of any of the main poles. This spare pole should be complete with the interrupting chamber, VTs, surge capacitors, disconnecter, earthing switches etc. as in the main pole along with its lifting beam.

4.0 DOCUMENTATION

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



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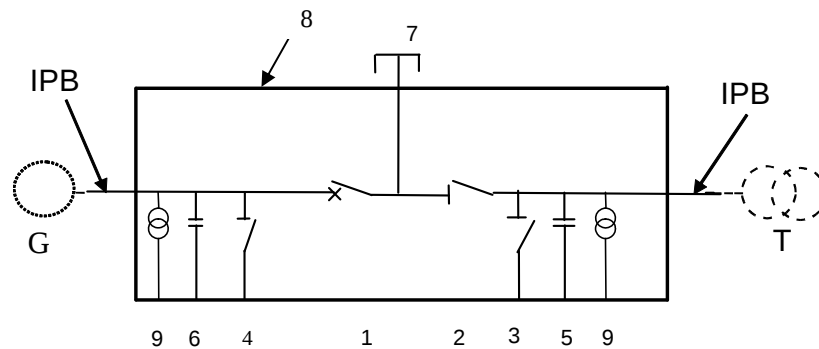
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ATTACHMENT – I



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

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

SINGLE LINE CONFIGURATION OF GENERATOR CIRCUIT BREAKER



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ATTACHMENT – 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 VOLATGE AND POWER FACTOR	AMPS	5549
18	GENERATOR NEUTRAL EARTHING		High Resistance (Through Transformer loaded with Resistance on secondary)



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19	NGT PARAMETERS PRIMARY VOLTAGE SECONDARY VOLTAGE NGR (AT SECONDARY OF NGT)	KV KV OHMS	21000 0.5 DDE
20	TIME CONSTANTS (SHORT CIRCUIT TIME CONSTANTS):		
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	0.08
25	ARMATURE TIME CONSTANT	s	0.285
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	DDE
3	Thickness of enclosure	mm	DDE
4	Phase-phase spacing	mm	2000mm (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



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2	HV SIDE VOLTAGE	KV	400/ $\sqrt{3}$
3	MAXIMUM HV VOLTAGE	KV	+10%
4	MINIMUM HV VOLTAGE	KV	-10%
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
D	UNIT TRANSFORMER PARAMETERS (UT#1)		
1	RATED MVA	MVA	70
2	NUMBER OF WINDINGS (2 / 3)		TWO
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.	0.125
10	TOLERANCE IN SHORT CIRCUIT IMPEDANCE	%	10
11	MOTOR LOADS CONNECTED TO UNIT TRANSFORMER	MVA	40
12	MOTOR RATED VOLTAGE	KV	11
13	MOTOR STARTING CURRENT (TIMES FULL LOAD CURRENT)	TIMES	450% FOR MDBFP, 720% FOR OTHER 11kV motors
E	UNIT TRANSFORMER PARAMETERS (UT#2)		
1	RATED MVA	MVA	70
2	NUMBER OF WINDINGS (2 / 3)		TWO
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.	0.125
10	TOLERANCE IN SHORT CIRCUIT IMPEDANCE	%	10



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11	MOTOR LOADS CONNECTED TO UNIT TRANSFORMNER	MVA	21.4
12	MOTOR RATED VOLTAGE	KV	11
13	MOTOR STARTING CURRENT (TIMES FULL LOAD CURRENT)	TIMES	450% FOR MDBFP, 720% FOR OTHER 11kV motors
F	STATION TRANSFORMER PARAMETERS		
1	RATED MVA	MVA	140/70/70
2	NUMBER OF WINDINGS (2 / 3)		3
3	HV SIDE VOLTAGE	KV	400/11.5/11.5
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-LV1-0.265 HV-LV2-0.265 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	400
2	MAXIMUM VOLTAGE	KV	420
3	MINIMUM VOLTAGE	KV	380
4	RATED FREQUENCY	HZ	50
5	MAXIMUM THREE PHASE SHORT CIRCUIT CURRENT	KA	40
6	X/R RATIO		14

NOTES: PLEASE REFER ATTACHED SINGLE LINE DIAGRAM FOR CONFIGURATION



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ATTACHMENT – III

DOCUMENTS REQUIRED ALONG WITH TECHNICAL OFFER.

- 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-V0-420-510-E001	APPROVAL
2	GA AND FOUNDATION PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-420-510-E002	APPROVAL
3	CONTROL & SCHEME DRAWING FOR GENERATOR CIRCUIT BREAKER	PE-V0-420-510-E004	APPROVAL
4	NAME PLATE FOR GENERATOR CIRCUIT BREAKER	PE-V0-420-510-E005	APPROVAL
5	SIZING CALCULATIONS INCLUDING SHORT CIRCUIT CALCULATIONS AS PER IEEE	PE-V0-420-510-E007	APPROVAL
6	SF6 PRESSURE SCHEME GENERATOR CIRCUIT BREAKER	PE-V0-420-510-E009	APPROVAL
7	FIELD QUALITY PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-420-510-E010	INFORMATION
8	TYPE TEST CERTIFICATES OF GENERATOR CIRCUIT BREAKER	PE-V0-420-510-E011	INFORMATION
9	O/M MANUALS FOR GENERATOR CIRCUIT BREAKER	PE-V0-420-510-E012	INFORMATION
10	EQUIPMENT LIST OF GENERATOR CIRCUIT BREAKER	PE-V0-420-510-E110	INFORMATION
11	LIST OF MANDATORY SPARES	PE-V0-420-510-E112	APPROVAL
12	MANUFACTURING QUALITY PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-420-510-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
1.03	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 IEC/IEEE 62271-37-013 (ii) As per IEC/IEEE 62271-37-013
1.05 (b)	Rated making current capability (i)System Source fault (ii)Generator Source fault	kApeak	(i) As per IEC/IEEE 62271-37-013 (ii) As per IEC/IEEE 62271-37-013
1.06	One minute power frequency withstand voltage	kV(RMS)	As per IEC/IEEE 62271-37-013
1.07	Impulse with	kV(Peak)	As per 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 Attachment – I of Section-I
1.14	Interrupting Medium		SF6
1.15	Type of cooling		Natural / Forced



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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		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, 3 wire effectively earthed (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	56%
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
5.03	CT & VT circuit	Sq.mm.	2.5 sq.mm.
6.00	Voltage Transformer		

1.19

Maximum Allowable Temperature of Parts handled By operator in normal course of work duties

°C

As per IEC/IEEE 62271-37-013

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VT location	VT No.	Ratio	Burden	Accuracy Class	Connection Type	Primary protection / Secondary protection
Generator Side	VT-1	$(27000/\sqrt{3})/(110\sqrt{3})$	60 VA	0.2s/3P	Star/Star	Fuse/MCB
Generator Transformer Side	VT-2	$(27000/\sqrt{3})/(110\sqrt{3})$	60 VA	0.2s/3P	Star/Star	Fuse/MCB

Above VT details are tentative and shall be confirmed during detail engineering. VTs shall be provided separately as single phase unit.

7.00	Current Transformer		Not Applicable
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8.00	<u>Type Tests</u>		
8.01	Validity period of type test reports		Valid type test report for Offered model.
8.02	Type tests to be conducted for this contract, despite availability of valid & acceptable test certificates	Yes/ No	No
8.03	If yes, list of type tests to be conducted		NA
9.00	<u>Mandatory Spares</u>		
9.01	Mandatory Spares to be quoted for this contract	Yes/ No	Yes
9.02	If yes, list of mandatory spares		AS PER BOQ-CUM-PRICE SCHEDULE
10.00	AUXILIARY EQUIPMENT		
10.01	SF6 Gas leakage Detector	Quantity	2 Nos.
10.02	Circuit Breaker Operation Analyzer	Quantity	1 Nos.
10.03	Gas Density Monitoring Device	Quantity	1 Nos.
10.04	Gas Density Meter	Quantity	1 Nos.
10.05	SF6 Evacuation & refilling Unit	Quantity	1 Nos.



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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		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			



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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?	kArms kApeak 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	kV Hz A kArms kApeak kV		



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	l) Rated impulse withstand voltage 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 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.		



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	d. Normally Close (NC) numbers	Nos.		
1.59.03	Total number of contacts furnished for Earth switch			
	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.		
1.61.03	CT & VT circuit	Sq.mm.		
1.62	Voltage Transformer			
1.62.01	Voltage Tranformer-1(Generator side)			
(a)	Primary Voltage	kV		
(b)	Secondary Voltage	kV		
(c)	Rated Output (VA)	VA		
(d)	Accuracy Class			
1.62.02	Voltage Tranformer-2(Generator Transformer side)			
(a)	Primary Voltage	kV		
(b)	Secondary Voltage	kV		
(c)	Rated Output (VA)	VA		
(d)	Accuracy Class			
1.63	Current Transformer			
1.63.01	Current Transformer-1 (Generator Side)			
(a)	CT ratio	A		
(b)	Accuracy Class			
(c)	Burden	VA		
(d)	Knee Point Voltage (Applicable for PS class CT)	V		
(e)	Excitation Current (Applicable for PS class CT)	mA		
1.64	SF6 Gas leakage Detector	Nos.		



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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 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.		



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1.59.03	Total number of contacts furnished for Earth switch			
	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.		
1.61.03	CT & VT circuit	Sq.mm.		
1.62	Voltage Transformer			
1.62.01	Voltage Tranformer-1(Generator side)			
(a)	Primary Voltage	kV		
(b)	Secondary Voltage	kV		
(c)	Rated Output (VA)	VA		
(d)	Accuracy Class			
1.62.02	Voltage Tranformer-2(Generator Transformer side)			
(a)	Primary Voltage	kV		
(b)	Secondary Voltage	kV		
(c)	Rated Output (VA)	VA		
(d)	Accuracy Class			
1.63	Current Transformer			
1.63.01	Current Transformer-1 (Generator Side)			
(a)	CT ratio	A		
(b)	Accuracy Class			
(c)	Burden	VA		
(d)	Knee Point Voltage (Applicable for PS class CT)	V		
(e)	Excitation Current (Applicable for PS class CT)	mA		
1.64	SF6 Gas leakage Detector	Nos.		



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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	

VOLUME : V-A**SECTION-XIV****TECHNICAL SPECIFICATION
FOR
GENERATOR CIRCUIT BREAKER****1.00.00 SCOPE OF WORK****1.01.00 Scope of supply**

Type and rating of the equipment listed below are detailed in the attached annexure and associated single line diagram. The equipment shall be offered in strict compliance with the same.

1.01.01 Generator Circuit Breaker Assembly * : One (1) set

(* GCB ratings to be decided by Bidder)

1.01.02 Following Auxiliary equipment shall be supplied

- a. One (1) set of Portable SF6 gas evacuating & filling equipment
- b. Two (2) sets of SF6 gas leakage detectors
- c. One (1) set of Circuit Breaker operation analyzer.

1.01.03 One set of special tools and tackles.

1.01.04 Mandatory spare parts.

1.01.05 Recommended spare parts for three (3) years continuous operation.

1.01.06 All relevant drawings, data and instruction manuals.

2.00.00 GENERAL REQUIREMENTS**2.01.00 Codes and Standards**

2.01.01 Generator Circuit Breaker shall be designed manufactured and tested in accordance with ~~IEEE Standard C37.013-1997~~ All other equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.01.02 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.01.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

3.01.00 The Generator Circuit Breaker assembly shall be designed, manufactured, and tested in accordance with ~~IEEE Standard C37.013-1997~~ and its latest interpretations and amendment.

3.02.00 The Generator Circuit Breaker shall be installed in between the Generator and Generator Transformer and shall be connected to both the equipment with isolated phase bus duct.

3.03.00 The generator circuit-breaker shall be capable of continuous operation under the following condition :

- Voltage variation : $\pm 10\%$
- Frequency variation : $+3\%$ to -5%
- Combined voltage and : 10%
(frequency variation absolute sum)

3.04.00 Generator Circuit Breaker shall be suitable for synchronizing duty. Main functions of the Generator Circuit Breaker system shall be the following :

- Start up of the turbo-generator auxiliaries via its unit transformer with the Generator circuit breaker is open
- Carry the full load current of the generator continuously
- Paralleling of the generator with external network
- Disconnection of the generator from the system under various loading conditions ranging from no load to full load
- Make and break generator-source feed short-circuit currents
- Make and break system-source feed short-circuit currents

3.05.00 The Generator Circuit Breaker shall be located indoor or outdoor as indicated in the annexure, hot, humid and tropical atmosphere.

3.06.00 For continuous operation at specified ratings, temperature rise of the various Circuit Breaker components such as insulating materials, main contacts, conducting joints and parts subject to contact by operating personnel shall be limited to the permissible values stipulated in the relevant standards and/or this specification.

3.07.00 Circuit Breaker shall be either naturally cooled or forced cooled as defined in the annexure. For forced cooled Generator Circuit Breaker, emergency current rating during loss of cooling shall be established according to the IEEE Standard and incorporated in the design.

3.08.00 The Circuit Breaker and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current listed in the annexure without any damage or deterioration of material.

3.09.00 Each pole of the Circuit Breaker, series disconnectors, earth switch and additional components, if any specified in Annexure-B, shall be mounted in single phase non-magnetic aluminum alloy enclosures. The three single phase enclosures along with the Control box housing the operating mechanism, supervisory and control equipment shall be factory assembled on a common frame.

- 3.10.00 The enclosure shall be able to carry the induced reverse current flowing through the isolated phase bus duct. All enclosure connection to isolated phase bus duct shall be welded or via a bellow to provides a physically and electrically continuous ducting connection to the generator and the transformer.
- 3.11.00 The distance among the centre line of the phase enclosures shall be such that it matches with the bus duct spacing.
- 3.12.00 The Circuit Breaker movement during short circuit shall be restricted so as to limit the stresses on Circuit Breaker support insulators within their capabilities.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 Type and Duty

- 4.01.01 The Generator Circuit Breaker shall consist of three nos. single-pole interrupter housed in sulphur hexafluoride (SF₆) breaking chambers.
- 4.01.02 The duty of the Circuit Breaker shall involve satisfactory interruption of short circuit currents as listed in the annexure.
- 4.01.03 The breaker shall be suitable for operation under out of phase condition arising out of faulty synchronization.
- 4.01.04 Breakers with multi-break interruptions shall be so designed that the voltage developed across a pole is uniformly distributed over the power breaks.

4.02.00 Constructional Feature

- 4.02.01 Each Generator circuit-breaker shall comprise of three (3) identical poles complete with auxiliary components housed in single phase enclosures, all fully assembled on a common frame with mechanical gang operated mechanism.
- 4.02.02 All poles of the circuit breaker shall be maintained at the same SF₆ density by a suitable balancing connection via the refilling pipe. The SF₆ gas density shall be monitored and regulated by temperature compensated gas density monitoring devices, which shall be mounted at a convenient and easily approachable location. The device shall signal loss of SF₆ gas in several steps for refilling, alarm and blocking annunciation. The system shall also be provided with a Gas density meter.
- 4.02.03 The Circuit Breaker shall have proper sealing so that leakage of gas outside is not more than 1% per annum under all conditions of operation.
- The operating rod connecting the operating mechanism to the arc chamber (SF₆ media) shall have adequate seals. All gasketed surfaces shall be smooth, straight and reinforced, if necessary, to minimize distortion and make a tight seal
- 4.02.04 SF₆ breakers shall be furnished with first charge of SF₆ gas, plus 15% additional quantities of SF₆ gas required for complete lot.
- 4.02.05 The SF₆ gas shall be supplied in properly treated steel cylinder of adequate strength. Chemical analysis of gas supplied shall be furnished for Owner/Purchaser's reference.

- 4.02.06 The Circuit Breaker units shall be complete with associated valves, piping, gauges, seals, lubricants and other accessories/materials to ensure their proper assembly and functioning.
- 4.02.07 Suitable provisions shall be made for connection with Isolated Phase Bus-ducts (IPB) through flexible connection.
- 4.03.00 **Power Contacts**
- 4.03.01 The Circuit Breaker shall have two separate power contact systems, one for carrying the normal load current and one for arc interruption.
- 4.03.02 The main contacts shall have adequate area and contact pressure for carrying rated continuous and short time current without excessive heating liable to cause pitting and welding.
- 4.03.03 The contacts shall be easily replaceable and shall have minimum movable parts and adjustments.
- 4.04.00 **Auxiliary Contacts** Number of contacts shall be as per Datasheet-A of Section-I
- 4.04.01 Each breaker shall be provided with minimum ~~six (6)~~ normally open and ~~six (6)~~ normally closed electrically separate spare auxiliary contacts, in addition to those required for its own operation and indication.
- 4.04.02 The auxiliary contacts shall be convertible type so that normally open contacts can be converted into normally close contact and vice versa at site.
- 4.04.03 The auxiliary contacts shall be rated 10A at 240 V A.C. and 2A at 220 V D.C.
- 4.05.00 **Interlock**
- 4.05.01 All electrical and mechanical interlocks, which are necessary for safe and satisfactory operation of the Circuit Breaker, shall be furnished.
- 4.05.02 Breaker operation shall be locked in case of low SF₆ gas density and/or low control fluid pressure at preset values. Alarms shall be provided for low gas density and low control fluid pressure at values higher than lockout density of SF₆ gas and/or fluid pressure.
- 4.05.03 Gas density monitoring contacts, pressure switch contacts, etc. shall be suitable for direct use as permissive in closing, tripping, annunciation and control circuits.
- DC supplies for all auxiliary circuits shall be monitored and provision shall be made for remote annunciations.
- 4.06.00 **Operating Mechanism**
- 4.06.01 Circuit Breaker operating mechanism shall be pneumatically or hydraulically controlled spring energy storage type. Anti-pumping and trip free features complete with 2x100% shunt trip coils shall be provided. The mechanism of the breaker shall be such that the position of the breaker is maintained even after leakage of operating media and/or gas.

- 4.06.02 All three breaker poles shall close simultaneously. Pole discrepancy feature shall be provided to trip the breaker out if all the poles do not close simultaneously within the stipulated time.
- 4.06.03 The mechanism shall be designed for electrical control from remote as well as local position. In addition local manual trip button shall be provided.
- 4.06.04 Operation counters and mechanical ON-OFF indicator shall be provided for the breaker.
- 4.06.05 The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.
- 4.06.06 Circuit Breaker shall be provided with two (2) independent tripping circuits, and trip coils. The trip coils shall be suitable for trip circuit supervision during both open and close positions of the breaker. Interlock shall be provided with OCTC tap changing operation to prevent the operation of circuit breaker.

4.06.07 Hydraulic Operated mechanism

Hydraulically operated mechanism shall comprise of operating unit with power cylinder, control valves, high and low pressure reservoir, motor etc. one number hand pump set shall also be provided for emergency operation of the Circuit Breaker.

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

The mechanism shall be suitable for at least two close open operations after failure of AC supply to the motor starting at pressure equal to the lowest pressure of auto recluse duty.

The oil pressure switch controlling the pump and pressure in the high pressure reservoir shall have adequate number of spare contacts to be used for continuous monitoring of low pressure, high pressure etc. Trip lockout shall be provided to prevent operations of the Circuit Breaker below the minimum specified hydraulic pressure. Alarm contacts for loss of Nitrogen shall be provided.

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

4.06.08 Pneumatically Operated Mechanism

Each Circuit Breaker shall be provided with its own compressor, air receiver, necessary piping and valves, control equipment etc. to maintain the air pressure at the air receiver between operating limits.

Each air receiver shall be of sufficient capacity to allow one complete duty cycle of the breaker without running of compressor.

Each compressor shall have sufficient capacity to charge air receiver to the following service schedule:

- i) From minimum operating pressure to maximum operating pressure within 5 minutes of operation.
- ii) From atmospheric pressure to maximum operating pressure within 15 minutes of operation.
- iii) Normal running air-charging time for the compressor shall not exceed 15 minutes considering 10% leakage/day

The compressor shall be furnished complete with suction filter, after-cooler, drive motor, starter, controls and other accessories. All starters, switches, fuses and other accessories shall be housed in a pedestal mounted sheet steel control panel. The compressor motor shall be suitable for direct on line starting, both manually and automatically through pressure switch contacts. The pressure switch contacts shall be easily adjustable within reasonable limit. The compressor motor shall be capable of starting against any backpressure in receiver or pipelines.

Each receiver shall be provided with safety valve to protect the pneumatic system against abnormally high pressure and drain valve to drain any water or oil in the receiver.

The flow capacity of the safety valve connected to the air receiver shall be 20% higher than the total compressor capacity. The safety valve connected after the reducing valve shall have sufficient flow capacity so that the pressure on the secondary side can never exceed the highest permissible pressure even when the reducing valve becomes locked in fully open position for any reason. The reducing valves shall preferably be diaphragm type. Reducing valves, non-return valves, etc. must be of such type that more sensitive parts would not be exposed to accumulation of water or dust.

4.07.00 Control Cubicle

- 4.07.01 A common control cubicle shall be furnished to house electrical, controls, monitoring devices. The Control cubicle shall be mounted on the C.B system supporting frame work.
- 4.07.02 The cubicle shall be wired up to suitable terminal block for cable connection..
- 4.07.03 The cubicle shall have front access door with lock and removable gland plate at the bottom for cable entry.
- 4.07.04 An active Mimic with the actual position indications and the integrated local controls of the Circuit Breaker, disconnect switches and earth switches shall be provided at the front.
- 4.07.05 LOCAL/REMOTE selector switches for Circuit Breaker, disconnect switches and earthing switches, Operation counters and local alarms for faults/ troubles shall be provided in the Control Cubicle.
- 4.07.06 Potential free contacts shall be provided in the cubicle for the following remote annunciations and indications as a minimum.

ALARMS

- a. SF6 density low (for refilling)
- b. SF6 density very low (alarm)
- c. SF6 density very low (blocking)
- d. Circuit Breaker Trip circuit unhealthy
- e. Pole discrepancy
- f. Loss of control voltage
- g. Oil/ Air pressure low
- h. Operating system failure

INDICATIONS

- a. Breaker positions
- b. Disconnect switch positions
- c. Earth switch positions
- d. Local/ Remote selector switch positions

4.07.07 Thermostat controlled space heater, internal illumination lamp and 3 pin 5A socket with individual ON-OFF switches shall be provided in the cubicle.

4.08.00 **Disconnecting switch, starting switch and earthing switch**

4.08.01 The off load disconnecting switch shall be installed at generator transformer side of the circuit breaker. It shall be air insulated, telescopic type, with sliding tubular contacts and hinged point on the line side.

4.08.02 ~~Starting switch, if provided, shall be installed in the Generator side. The switch shall be blade type with the fixed contact at the current path. The hinged point shall be connected with external cable from Gas turbine generator static starter.(applicable for gas turbine generator set)~~

4.08.03 Earthing switches shall be installed one on the generator side terminal of the circuit breaker and the other on the generator transformer side after the terminals of the disconnecting switch.

Earth switches shall be blade type with the fixed contact at the current path and with hinged point connected to earth.

4.08.04 Operating mechanism of the above switches shall be motorized. Electrical motors shall be suitable for 3 phase, 50Hz, 415 V $\pm$ 10% A.C.

A manual (mechanical) operating mechanism shall also be provided for maintenance and emergency purpose. Interlock shall be provided to prevent motor operation when the switch is being manually operated.

4.08.05 Electrical and mechanical interlocks shall be provided to avoid wrong operation on the disconnecting switches, earthing switches and Circuit Breaker.

4.08.06 The visual check of the position of the above switches shall be possible from outside the phase enclosure by means of inspection windows.

4.08.07 Each switch shall be provided with minimum 6 N.O. + 6 N.C spare auxiliary contacts.

4.09.00 **Short circuit devices**

- 4.09.01 The Circuit Breaker system shall be equipped with short circuit link (for relay testing).
- 4.09.02 The short circuit link shall be installed between the Circuit Breaker and the disconnecting switch in order to actuate the 3 phase unearthed short circuit on the generator terminals by closing the Circuit Breaker.
- 4.09.03 The short circuit link shall be manually mounted by removing the specific doors on the Circuit Breaker system phase enclosures.

4.10.00 **Instrument Transformers**

- 4.10.01 ~~The current transformers shall be cast resin, ring type, mounted within the Circuit Breaker phase enclosures and suitable for operation at an ambient temperature equal to rated bus-bar temperature.~~
- 4.10.02 ~~The C.T.s shall have polarity markings indelibly marked on them. C.T. secondary leads will be brought out to separate terminal block mounted on the Control cubicle.~~
- 4.10.03 The voltage transformer shall be three single phase cast-resin type, suitable for nominal operation connected from line to ground, and for 1.73 times rated line to ground voltage under sustained emergency condition.
- 4.10.04 The high voltage winding of the voltage transformer shall be protected by current limiting fuse mounted on top of the primary bushing.
- 4.10.05 The secondary leads from the voltage transformer shall be extended to a fuse / Miniature circuit breaker (MCB) and then to separate terminal block mounted on the Control cubicle. Facility for making the star points shall be kept at the Control cubicle.

4.11.00 **Surge Protection devices**

- 4.11.01 ~~Lightning arrester shall be station class, hermetically sealed type, fitted on the transformer side and shall be specifically suitable for generator protection.~~
- ~~The characteristic of the lightning arrester shall be carefully chosen to provide a low protective ratio for generator BIL.~~
- 4.11.02 ~~A discharge counter shall be provided for each lightning arrester. The discharge counter register shall be provided in readily visible position.~~
- 4.11.03 The surge capacitor shall be non-inflammable and non-toxic type, single pole, fitted on both side of the breaker system.

4.12.00 **Wiring**

Please refer SIZES mentioned in DATASHEET-A of section-I

- 4.12.01 Wiring shall be complete in all respects to ensure proper functioning of the control, protection, and monitoring and interlocking schemes.
- 4.12.02 DC circuit for trip coil 1 & 2 shall be wired separately so as to connect with duplicate DC supply.
- 4.12.03 Wiring shall be done with flexible 1100V grade, PVC insulated, switchboard wires with 2.5 mm² stranded copper conductor. Wiring between individual poles and control cubicle shall be routed through G.I. / PVC rigid conduits.

- 4.12.04 Each wire shall identified at both ends with permanent markers bearing wire numbers as per Contractor's wiring diagram.
- 4.12.05 Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.
- 4.12.06 All spare contacts of relays, push buttons, auxiliary switches etc. shall be wired upto terminal blocks in the control cubicle.
- 4.13.00 **Terminal blocks**
- 4.13.01 Terminal blocks shall be 650V grade, enclosed clamp type with engraved numbers suitable for termination of at least two numbers of 2.5 mm² stranded copper conductor.
- 4.13.02 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.
- 4.13.03 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.
- 4.14.00 **Sulphur Hexafluoride (SF6) Gas**
- 4.14.01 The SF6 gas shall be new and comply with relevant IEC/IS and shall be suitable in all respects for use in the Circuit Breakers under the various operating conditions.
- 4.14.02 SF6 gas shall be tested for quality, dew point, air, hydrolysable fluorides and water content as per IEC quoted above and test certificates shall be furnished covering all tests for each lot of SF6 gas.
- 4.14.03 The use, handling & storage of SF6 gas shall comply with requirements of relevant IEC/IS.
- 4.15.00 **Auxiliary Equipment**
- 4.15.01 A Portable SF6 gas filling and evacuating system shall be supplied with necessary gas valves, safety devices, gas purity monitoring devices, regulators, vacuum pump, pressure gauges/switches, hose pipes etc.
- 4.15.02 The sensing probe of SF6 gas leaked detector shall be able to reach all the points on the breaker where leakage is to be sensed. The accuracy of the equipment shall be at least 10 ppm. It shall be free from induced voltage effect.
- 4.15.03 An Operational Analyzer shall be supplied to record contact travel, speed and for making measurement of operating timings, synchronization of contacts in one pole or all poles.
- 4.16.00 **Name Plate**
- 4.16.01 Each Circuit Breaker and its operating devices and accessories shall be provided with name plate clearly marked the particulars in accordance with ~~IEEE Std. C37.013-1997~~.
- 4.16.02 Instruction and Warning signs shall be provided in accordance with ~~IEEE Std. C37.013-1997~~.

4.16.03 The name plate shall be provided in visible portion of normal service and installation.

5.00.00 TESTS

5.01.00 Routine Test

During manufacture and on completion, Generator Circuit Breaker shall be subjected to the routine tests (Production tests) as laid down in IEEE Standard C37.013-1997. The disconnecting switches, earthing switches, surge arrester and surge capacitors shall be subjected to routine tests as laid down in relevant IS/IEC standard.

5.02.00 Type Tests

The Generator Circuit Breaker shall be type tested (design tests) as per IEEE Standard C37.013-1997. Further associated components such as disconnecting switches, earthing switches, surge arrester and surge capacitors shall be type tested as per relevant IS/ IEC standards..

6.00.00 SPECIAL TOOLS & TACKLES

6.01.00 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

6.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

7.00.00 SPARES

7.01.00 The Bidder shall submit a list of **recommended spare parts** for three (3) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.

7.02.00 The Bidder shall quote and supply **mandatory spare parts** as per the list. The final quantity shall be decided during placement of order.

7.03.00 Each list shall be complete with specification, make, identification number, unit rate, quantity etc.

8.00.00 DRAWINGS, DATA & MANUALS

8.01.00 Drawings, Data and Manuals shall be submitted with the bid and in quantities and procedures as specified in General Conditions on Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.

8.02.00 To be submitted with the Bid

8.02.01 Typical general arrangement drawings of the equipment.

8.02.02 Proposal Technical Particulars, leaflets on equipment and special tools explaining construction features, principle of operation, special features etc.

8.02.03 Type test certificate of the offered model of the Circuit Breaker for the specified type tests.

8.03.00 **To be submitted for Owner/Purchaser's Approval and Distribution**
(A) : 'Approval Category' (R) : 'Reference Category'

8.03.01 Guaranteed Technical Particulars(A) & Quality assurance plan.(A)

8.03.02 Dimensional general arrangement drawing showing disposition of various fittings, (A)

8.03.03 Foundation plan and loading.(R)

8.03.04 Assembly drawing for erection at site with part numbers and schedule of materials Transport/shipping dimensions with weights.(R)

8.03.05 Control schematic (A) and wiring diagrams (A).

8.03.06 Symmetrical and asymmetrical short circuit current calculation for three phase fault at generator terminals, according to IEEE Std. C37.013, on the basis of the generator and system data provided in annexure (A).

8.03.07 Out of phase current calculation for 90° out of phase condition, according to IEEE Std. C37.013, on the basis of the generator and system data provided in annexure (A)

8.03.08 Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance.

8.03.09 Instruction manuals on Circuit Breakers and its accessories.(R)

The manual shall clearly indicate method of installation, check ups and tests to be carried out before commissioning of the equipment.

8.04.00 The drawings and documents marked with (A) above are of 'Approval' category and are subject to review by Owner/Purchaser. Those marked (R) are for 'reference' category.

The Owner/Purchaser may review the documents marked (R) if thought necessary. The contractor shall note that the approval of drawings & documents by the Owner/Purchaser does not relieve him of his contractual obligation.

8.05.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, curves, etc require to fully describe the equipment are to be submitted with the bid.

8.06.00 All drawings shall be prepared by using AutoCAD and documents shall be generated using Electronic version. The paper copy of the drawings & document shall be submitted for approval & reference. All final drawings and documents shall be submitted in CD in AutoCAD 2000 and MS office format as applicable for Owner/Purchaser's future reference.

RATINGS & REQUIREMENTS

GENERATOR CIRCUIT BREAKER ASSEMBLY

1.0	Type	:	Enclosed
2.0	Service	:	Indoor / Outdoor
3.0	P o l e	:	3
4.0	Mounting	:	Horizontal
5.0	Location	:	In between Generator & Generator Transformer, connected to isolated phase bus duct system at both ends.
6.0	Enclosure :		
6.1	Construction	:	3 single phase enclosures assembled on common frame with control cubicle
6.2	Material	:	Aluminum alloy
6.3	Degree of Protection	:	IP-52/IP-55
6.4	Phase spacing		
	▪ Minimum	:	
	▪ Maximum	:	
7.0	Design ambient temperature °C	:	50
8.0	Additional components		
8.1	Line Disconnect Switch	:	Yes
8.2	Earthing switch – GT side	:	Yes
8.3	Earthing switch – Generator side	:	Yes
8.4	Starting Switch	:	No
8.5	Voltage Transformer – GT side	:	Yes
8.6	Voltage Transformer – Generator side	:	No/Yes (Optional, project specific)
8.7	Current Transformer – GT side	:	No/Yes (Optional, project specific)
8.8	Current Transformer – Generator side	:	No
8.9	Surge Capacitor – GT side	:	Yes (For limiting TRV)
8.10	Surge Capacitor – Generator side	:	Yes (For limiting TRV)

As mentioned in section-I, pt. no. 3.0, Sl. No. 2 Specific technical Requirements

ANNEXURE-A

- 8.12 Manual short circuiting connection : Yes
- 8.13 Motorized short circuiting switch : No
- 9.0 Cooling Natural / Forced : Natural / **Forced**
- 10.0 Rated Voltage kV rms : to be decided by Bidder
- 11.0 Rated Frequency Hz : $50 \pm 5\%$
- 12.0 Rated continuous current Amp :
- 13.0 Reference Standard : IEEE Std.C37.013--IEC-60529, 61166

GENERATOR CIRCUIT BREAKER

- 1.0 Type : SF6
- 2.0 Operating Mechanism : Hydraulic / Pneumatic, Stored energy, Gang operated
- 3.0 No. of poles : Three
- 4.0 Rated Maximum Voltage KV rms : to be decided by Bidder
- 5.0 Rated Frequency Hz : $50 \pm 5\%$
- 6.0 Rated continuous current at site condition Amps : to be decided by Bidder
- 7.0 Reference Standard : IEEE Std.C37.013--IEC-60694
- 8.0 Rated Insulation Level
- 8.1 Full wave Impulse withstand voltage (1.2 x 50 μ s wave) KV peak : to be decided by Bidder
- 8.2 Rated one minute power frequency withstand voltage : to be decided by Bidder
- 9.0 Rated short circuit duty cycle : CO – 30 min - CO
- 10.0 Rated interrupting time ms : 60 - 90
- 11.0 Rated Making & Breaking Capacity :
- 11.1 Rated Short-circuit breaking current (Symmetrical) KA rms : to be decided by Bidder
- 11.2 Rated short-circuit making current KA peak : As per IEEE Std. C37.013
- 11.3 Rated peak withstand current KA peak : As per IEEE Std. C37.013

ANNEXURE-A

11.4	Rated short time withstand current for rated duration of 1sec.	KA rms	: As per IEEE Std. C37.013
11.5	Transient Recovery Voltage (TRV) rating		: As per IEEE Std. C37.013
11.6	Rated load current switching capability & Operation endurance capabilities		: As per IEEE Std. C37.013
11.7	Rated Out of phase breaking current In % of rated Short Ckt. Breaking current		: As per IEEE Std. C37.013
11.8	Rated Out of phase making current In % of rated Short Ckt. Breaking current		: As per IEEE Std. C37.013
12.0	First pole to clear factor		: 1.5
13.0	Amplitude factor		: 1.5
14.0	Temperature rise		
14.1	Design ambient temperature °c		: 50 deg. C
14.2	Allowable temperature limits		: As per IEEE Std. C37.013
15.0	Number of trip coils		: Two
16.0	Rated auxiliary Supply Voltage and frequency for		
16.1	Closing		: 220 V D.C
16.2	Tripping		: 220 V D.C.
16.3	Compressor / Pump Motor		: 415V, 3 Ph,3W,50Hz
16.4	Heater/Lamp/Socket		: 240V, 1 Ph, 2W
17.0	Seismic Acceleration		: 0.5 g (horizontal)
18.0	SF6 Gas		: As Per IEC60376 & 61634

Note : Bidder shall determine the Generator Circuit Breaker ratings according to IEEE Std.C37.013, based on the Generator and System parameters. The ratings and requirements of the generator circuit breaker indicated above represent the minimum requirement only.

ANNEXURE-A

DISCONNECTING SWITCH & EARTH SWITCH

- 1.0 Type : Air break
- 2.0 Operating Mechanism : A.C. Motor Operated as well as Manual
- 3.0 No. of poles : Three
- 4.0 Rated Maximum Voltage KV rms : to be decided by Bidder
- 5.0 Rated Frequency Hz : 50 +3% to -5%
- 6.0 Rated continuous current at site condition for DS Amps : to be decided by Bidder
- 7.0 Short time current for 1secs KA rms :
- 8.0 Peak Withstand current KA peak :
- 9.0 Reference Standard : IEC-62271-102
- 10.0 Rated Insulation Level
- 10.1 Rated Lightning Impulse Withstand Voltage (KV peak) : as per IEC
 - a. Across isolating distance :
 - b. To Earth & Between Poles :
- 10.2 One Minute Power Frequency Withstand Voltage (KV rms) : as per IEC
 - a. Across isolating distance :
 - b. To Earth & Between Poles

~~**CURRENT TRANSFORMER**~~

- ~~1.0 Type : Cast resin, ring type.~~
- ~~2.0 Service : Indoor / Outdoor.~~
- ~~3.0 Mounting : Inside phase enclosure.~~
- ~~4.0 Insulation class : to be decided by Bidder~~

C.T. Type	Description	Current Ratio A/A	Output VA	Class	ISF	Knee-Point Voltage Vk Volt *	Excitation Current mA **	Secondary Resistance Ohm +
Generator Side (to be decided by Bidder)								
A.	Core-1							
B.	Core-2							
C.	Core-3							
Generator Transformer Side (to be decided by Bidder)								
A.	Core-1							
B.	Core-2							
C.	Core-3							

NOTE : The ratings indicated are tentative. The exact requirement will have to be co-ordinated on finalization of protection scheme.

* Not less than
** Nor more than
+ At maximum operating temperature.

ANNEXURE-A

~~LIGHTNING ARRESTOR~~

1.0	Type	:	Station class.
2.0	Service	:	Indoor/ Outdoor
3.0	Rated Voltage	:	to be decided by Bidder
4.0	Nominal Discharge Current	:	to be decided by Bidder
5.0	Reference Standard	:	IEC 60099-4

SURGE CAPACITOR

1.0	Type	:	Non-inflammable, single pole.
2.0	Service	:	Indoor/ Outdoor.
3.0	Voltage class	:	to be decided by Bidder
4.0	Capacitance	:	... micro-farad. (By Vendor) (*)
5.0	Reference Standard	:	IEC 60358

(*) Total capacitance of surge capacitors shall not be less than 0.25 micro-farad

VOLTAGE TRANSFORMER

1.0	Type	:	Cast-resin,
2.0	Service	:	Indoor/ Outdoor.
3.0	Rated Voltage		
	a. Primary	:	to be decided by Bidder
	b. Secondary	:	110/√3 volt
4.0	Winding Connection		
	a. Primary	:	Grounded Wye
	b. Secondary	:	Grounded Wye
5.0	Insulation Class	:	to be decided by Bidder
6.0	Over Voltage Factor		
	a. Continuous	:	1.2
	b. 30 seconds	:	1.9

ANNEXURE-A

7.0	Other Ratings	:	Accuracy Class	Rated VA
a.	Metering/relaying and EHG system	:	Pls refer values mentioned in DATASHEET- A	
b.	AVR and EHG System	:		
c.	Performance test and EHG System	:		

FITTINGS & ACCESSORIES

The following fittings and accessories shall be provided.

1.0 Generator Circuit Breaker

- a) Mechanical position indicator marked 'ON' and 'OFF' visible externally to the operating mechanism.
- b) Manual mechanical trip, three-pole.
- c) Operations counter, one per pole
- d) Device for manual slow closing and opening during maintenance
- e) Anti-pumping and trip-free mechanism
- f) SF6 gas density monitoring system (for SF6 interrupter)
- g) Hydraulic/ Pneumatic operating mechanism
- h) Control cabinet

2.0 Disconnecting Switch

- a) Motorized drive
- b) Mechanical position indicator marked 'ON' and 'OFF' visible externally to the operating mechanism.
- c) Emergency manual operation-hand crank
- d) Key interlocking in closed and open position
- e) Operating mechanism & Control

3.0 Earthing Switch

- a) Motorized drive
- b) Mechanical position indicator marked 'ON' and 'OFF' visible externally to the operating mechanism.
- c) Key interlocking in closed and open positions
- d) Operating mechanism & Control .

4.0 ~~Current & Voltage~~ Transformers

~~5.0 Lightning arresters~~

6.0 Surge capacitors



TITLE :
**STANDARD TECHNICAL SPECIFICATION
FOR
GENERATOR CIRCUIT BREAKER**

SPECIFICATION NO.
PE-SS-999-510-E001

VOLUME NO. : **II**

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REV NO. : **00** DATE : 10.05.2016

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SECTION – 'II'

GENERAL TECHNICAL REQUIREMENTS



TITLE :
**STANDARD TECHNICAL SPECIFICATION
FOR
GENERATOR CIRCUIT BREAKER**

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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



TITLE :
**STANDARD TECHNICAL SPECIFICATION
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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.



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

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 Attachment-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 Attachment-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



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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).

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



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same are not available at site. These instruments shall be brought by the vendor and shall be taken back after completion of commissioning.

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.