

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

2X800 MW UPPUR TPS

VOLUME – II

TECHNICAL SPECIFICATION FOR
GENERATOR CIRCUIT BREAKER (GCB)

SPECIFICATION NO: PE-TS-425-510-E001
REV-00



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



TECHNICAL SPECIFICATION FOR GENERATOR CIRCUIT BREAKER

2 X 800 MW UPPUR TPS

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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	GENERAL	<i>GCB make & Model of suitable rating complying specification without any deviation shall be type tested and having proven track record on performance for reliability in operation. Also GCB make and model shall possess high reliability and proven performance in the past.</i>
2.0	1.01.00 & 9.00.00	<i>Training of Engineers not required and hence not to be quoted.</i>
3.0	2.06.00	<i>The hydraulic pump shall have 2 x 100% capacity. However, if bidder design is with 1x100% pump & Motor, bidder to supply 1x100% extra additional pump & motor without any price implication</i>

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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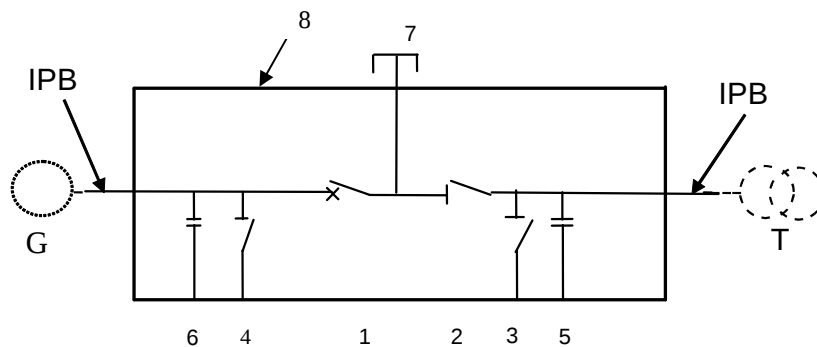
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ANNEXURE – I



- 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 VOLATGE 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	1600
3	Thickness of enclosure	mm	8
4	Phase-phase spacing	mm	2000
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 IEEE C.37-013-1997
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	80
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.	0.15
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	80
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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- 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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ANNEXURE – IV

DOCUMENTS REQUIRED AFTER AWARD OF LOI.

SL. No.	DOCUMENT TITLE	DWG. / DOCUMENT No.	CATEGORY
1	TECHNICAL DATASHEET FOR GENERATOR CIRCUIT BREAKER	PE-V0-425-510-E001	APPROVAL
2	GA AND FOUNDATION PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-425-510-E002	APPROVAL
3	CONTROL & SCHEME DRAWING FOR GENERATOR CIRCUIT BREAKER	PE-V0-425-510-E004	APPROVAL
4	NAME PLATE FOR GENERATOR CIRCUIT BREAKER	PE-V0-425-510-E005	APPROVAL
5	SIZING CALCULATIONS INCLUDING SHORT CIRCUIT CALCULATIONS AS PER IEEE	PE-V0-425-510-E007	APPROVAL
6	SF6 PRESSURE SCHEME GENERATOR CIRCUIT BREAKER	PE-V0-425-510-E009	APPROVAL
7	FIELD QUALITY PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-425-510-E010	INFORMATION
8	TYPE TEST CERTIFICATES OF GENERATOR CIRCUIT BREAKER	PE-V0-425-510-E011	INFORMATION
9	O/M MANUALS FOR GENERATOR CIRCUIT BREAKER	PE-V0-425-510-E012	INFORMATION
10	EQUIPMENT LIST OF GENERATOR CIRCUIT BREAKER	PE-V0-425-510-E110	INFORMATION
11	LIST OF MANDATORY SPARES	PE-V0-425-510-E112	APPROVAL
12	MANUFACTURING QUALITY PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-425-510-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	3 sec for Breaker & Disconnecter and 1 sec for earth switch
1.05 (a)	Rated symmetrical breaking capability (i)System Source fault (ii)Generator Source fault	kA	As per IEEE C.37-013-1997
1.05 (b)	Rated making current capability (i)System Source fault (ii)Generator Source fault	kA _{peak}	As per IEEE C.37-013-1997
1.06	One-minute power frequency withstands voltage	kV(RMS)	As per IEEE C.37-013-1997
1.07	Impulse withstand voltage	kV(Peak)	As per IEEE C.37-013-1997
1.08	Location of GCB	Indoor / Outdoor	Indoor
1.09	Quantity of GCB	Nos.	2
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 and Insulating Medium		SF6(Both main & interrupting Contact in SF6 gas)



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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 IEEE C.37-013-1997, which may be more than five years old from the date 20/05/2016.



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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	No
7.02	If yes, list of mandatory spares		



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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		IEEE C.37-013-1997	
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) Suitablity 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) Suitablity 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 IEEE C.37-013-1997? 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		IEEE C.37-013-1997	
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 IEEE C.37-013-1997? 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) FOR EACH GCB

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) FOR EACH GCB

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) FOR EACH GCB

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	

SECTION 29: GENERATOR CIRCUIT BREAKER (GCB)**29.01.00 CODES AND STANDARDS**

All equipment and materials furnished under this specification shall conform to the **IEEE C37.013-1997 and other applicable IEC/IEEE Standards**. In particular the following Standards shall apply:

1. General	
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
2. Generator Circuit-Breaker	
IEEE Std. C37.013	IEEE Standard for AC High-Voltage Generator Circuit-Breakers Rated on a Symmetrical Current Basis.
3. Disconnectors	
IEC 62271-102	Alternating Current Disconnectors (Isolators) and Earthing Switches Earthing Switch
4. Instrument Transformers, Surge arresters & surge capacitors.	
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.
IEC 61869	Voltage Transformers
IEC 62271-102	Earthing Switch

29.02.00 SCOPE OF SUPPLY AND SERVICES**2.01.00 EQUIPMENT AND COMPONENTS TO BE SUPPLIED**

- i) The basic supply of the GCB to be provided by the **bidder** shall include, but not necessarily be limited to, the following items and components:-
- One (1) triple pole circuit breaker, comprising three(3) single phase enclosures, all fully assembled on a common frame with operating mechanism.
 - 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



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- disconnecter position. The disconnecter shall be operable only with open position of the GCB.
- b) ~~Three (3) Heavy duty station class surge arresters with operation counter and with surge capacitors, suitable for (18-27) kV rated generator. DELETED~~
 - c) Surge capacitors on either side of circuit breaker.
 - 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 disconnecter , 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 dis-connectors/ 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. (if required for bidder specific products).
 - m) Continuous online monitoring device for GCB. (Part of BOQ-Cum-Price Schedule)
 - n) ~~Temporary elements, if required, for field erection and testing. DELETED~~
 - o) Spare parts for start-up and testing, until Provisional Acceptance. (Part of BOQ-Cum-Price Schedule)
 - p) Special tools for erection and maintenance. (Part of BOQ-Cum-Price Schedule)



- q) One(1) set of spare parts recommended for 3 years normal operation. (Part of BOQ-Cum-Price Schedule)

29.03.00 GCB DESIGN AND CONSTRUCTIONAL FEATURE

29.03.01 General

- i) 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.
Both Main and Interrupting(arcing) contacts shall be in SF6 gas.
- ii) 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 90 degrees.
- iii) 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.
- iv) The time between the first and last pole to open or close shall not exceed 2 ms. The circuit-breaker shall be electrical trip-free and prevent pumping.
- v) GCB shall be provided for each generator in the turbine building. GCB shall be installed between the generator and generator transformer located in a hot, humid and tropical climate.

The voltage class of the Generator circuit breaker shall be same as that of the generator.

Ambient temperature prevailing inside the equipment while carrying rated current, when the outside air ambient temperature is 50 degree C shall be considered as design ambient temperature for sizing the equipment/device/bus rating. Temperature rise shall be as per applicable IEC/IEEE standards.

The **bidder** shall ensure that GCB satisfies all requirements of IEEE C37.013.

GCB shall be used for the following:

- a. Synchronising the generator to the system



-
- b. Connecting and disconnecting the generator from the system under out-of phase conditions.
 - c. Connecting the generator to the system under fault conditions i.e. switch on to fault
 - d. Interrupting load and fault current from network and generator source within the interrupting capability specified.
 - e. House load operation while isolated from grid i.e. with the generator transformer HV breaker in open position.
 - f. Transferred surges from HV side of generator transformer
 - vi) The short time current rating of the GCB shall be decided considering higher of the short circuit current contribution from generator or the short circuit current contribution from EHV system through generator transformer and contribution of HV auxiliary system through Unit transformers.
 - vii) The connections and GCB shall be designed to withstand full $\frac{1}{2}$ cycle instantaneous and asymmetrical peak maximum currents under short circuit fault conditions. The connections & GCB shall be rated to carry the full unrestricted fault current for 3 seconds
 - viii) Momentary current rating shall be calculated based on X/R ratio of EHV system, HV system and generator.
 - a. The breaker shall meet the transient recovery voltage (TRV) requirements specified in IEEE C37.013 for system source faults and generator source faults. The applicable values shall be adjusted for 50 Hz operation.
 - b. The breaker shall also be capable of withstanding and interrupting the out-of-phase switching currents and inherent TRV conditions required in accordance with IEEE C37.013 (adjusted for 50 Hz operation).
 - c. The breaker shall be capable of interrupting its rated interrupting current after trip coil has been energised within the specified time.
 - d. The following factors shall be taken into account while selecting the ratings and interlock schemes for the GCB:
 - Synchronizing requirements of the generator
 - Transferred surges from HV side of generator transformer.
 - Load rejection from full load and rated power factor and house load operation while isolated from grid i.e. with the generator transformer EHV breaker in open position.
 - Connecting and disconnecting the generator from the system under out-of phase conditions.
 - Interrupting load and fault currents from network / auxiliary system and generator sources
 - Connecting the generator to the system under fault conditions i.e. switching on to fault.
 - Design ambient temperature.



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- e. During normal condition, when grid power is available, the generator shall be started with GCB in open position and synchronizing shall be done at the GCB. However, during grid disturbance, generator shall be running with GCB in closed position on house load (generator transformer EHV breaker in open position) and subsequently, generator shall be synchronized with grid through EHV breaker. Necessary scheme and interlocks shall be provided in GCB.
- f. The **bidder** shall submit calculations indicating continuous current rating, short circuit breaking current, DC component of breaking current, making current etc. of GCB for approval. The calculations shall be based on IEEE C37.013.
- g. The GCB shall be based on IEEE C37.013 which shall be tested with a test circuit time constant of 133 milli-second based on which the peak and asymmetrical break short circuit multiplying factors shall apply:-
- $\frac{1}{2}$ cycle (10 milli-second at 50 Hz) peak making short circuit current duty shall be 2.7 times the GCB symmetrical ac short circuit rms current rating
 - 50 milli-second break short circuit current duty shall be 1.39 times the GCB symmetrical ac short circuit rms current rating
- h. The GCB with its main contacts open and insulating gas at atmospheric pressure must be capable of withstanding an out-of-phase voltage across the terminals with the phase angle between two voltages varying continuously. This shall be in line with the requirements given in the IEEE standard C37.013
- i. SF6 circuit-breakers shall not incorporate components which are liable to deterioration or likely to create undesirable chemical action when in contact with the by-products of arcing or other substances likely to be encountered under service conditions. Precautions to minimise the presence of moisture and SF6 decomposition products shall be incorporated.
- j. Static and moving gas seals shall be designed to prevent the leakage of gas or ingress of moisture throughout the service life of the interrupting module.
- k. The enclosure of the module shall be strong enough to withstand the internal pressures generated when switching and shall incorporate an over pressure relief device for safe discharge of any excess pressure that may arise in service.
- l. Interrupters incorporating separate main and arcing contacts shall be arranged such that any re-ignitions or restrikes always occur in the arcing zone between the arcing contacts.



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- m. Where the design is such that leakage could cause gas pressure to fall below that at which the specified insulating and interrupting capacities can be maintained, gas pressure monitoring devices shall be incorporated to provide an alarm and block operation.
 - n. GCB movement during short circuit shall be restricted so as to limit the stresses on GCB support insulators within their capabilities.
 - o. Support structure shall be designed to withstand the dynamic as well as static load of the GCB.
 - p. The circuit breakers shall be designed for natural air cooling in general. Where forced cooling is adopted, it shall be subject to Owner's approval. For forced cooling arrangement, 2X100% rated cooling fans shall be provided.

29.03.02 Operating mechanism

- i) A motor or hydraulically charged spring operated 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 three poles.
- ii) The capacity of energy facilities shall be of sufficient size to store at least 2 complete close-open operations. The design of the operating mechanism shall be co-ordinated with the circuit-breaker 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 positions. For Hydraulic spring charged mechanism, 2Close Open(2CO) operations will be permitted. However, with motorised spring charge mechanism, Open Close Open (OCO) operations shall be permitted as per standard design
- iii) 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.

29.03.03 SF6 supervision

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 density switch. One contact of the density 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 the critical level.

29.03.04 Circuit-breaker control

For each circuit-breaker two trip coils shall be provided. Upon loss of drive energy, control power supply or SF6-gas, the breaker shall remain in the fully closed or open position.

29.03.05 Accessories

Each circuit-breaker shall be equipped with

- a) an operation counter
- b) a SF6 density monitor
- c) a reliable, mechanical position indicator to indicate the open or closed position of the circuit-breaker
- d) a manual operation device for maintenance purpose

29.03.06 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.

29.03.07 Control cubicle

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).

29.03.08 Conventional (wired) control equipment

- i) 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, disconnecter, earthing switch (es).
- ii) 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.~~

29.03.09 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.

29.03.10 Painting

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. The circuit breaker shall be executed and must fulfil the following corrosion requirements. For indoor installation DIN EN ISO 12944 C4 long or for indoor installation DIN EN ISO 12944 C5-I long/C5-M long.

Paint Shade will be RAL-7032 subject to owner's approval.

29.03.11 Conductors of active parts

- i) 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.
- ii) 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.

29.03.12 Generator circuit-breaker system enclosure

- i) The GCB system enclosure shall be designed for welded connections to the isolated 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.
- ii) 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.

29.03.13 Earthing pads

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.

29.04.00 DISCONNECTOR

29.04.01 General

- i) 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.
- ii) 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.

29.04.02 Operating mechanism

- i) 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.
- ii) 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.

29.05.00 EARTHING SWITCHES

29.05.01 General

- i) 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 disconnector 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 disconnector.
- ii) 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.

29.05.02 Operating mechanism

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.

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. The bidder may propose any other type of operative mechanism.

~~29.06.00 INSTRUMENT TRANSFORMERS~~ DELETED

~~29.06.01 Current transformers~~ DELETED

- i) The current transformers shall be of single phase 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.
- ii) The secondary windings shall be permanently wired to terminal blocks into the GCB-system control cubicle.
- iii) The current transformers shall be rated for 120%
- iv) Facilities shall be provided which allow primary injection testing of the current transformers with the minimum disturbance to the GCB.

~~29.06.02 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.

29.07.00 SURGE PROTECTION EQUIPMENT

~~29.07.01 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.

29.07.02 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.

29.08.00 SHORT-CIRCUITING SWITCH FOR RELAY SETTING

29.08.01 General

- i) The short-circuiting connection with switch shall facilitate an unearthed three phase short-circuit on generator side of the GCB-system unit.
- ii) 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.

29.08.02 Adjustment of protection

- i) The short-circuiting connection with switch shall help to expedite the testing and adjustment of the power plant protection system.
- ii) 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.
- iii) 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

29.08.03 GCB Control Cubicle features

- a) The GCB control cubicle shall be of sheet enclosed dust and vermin proof simplex type. The enclosure shall be made out of aluminium alloy / cold rolled sheet steel of 2 mm thick. The panel enclosure shall provide a degree of protection not less than IP54 . All doors and openings shall be provided with neoprene gaskets.



- b) The cubicle shall be suitable to be installed on base frame supplied in one piece along with foundation bolts. Adequate holes shall be provided at the bottom of all the panels for their installation on base frame. Anti-vibration pad of 25 mm thick shall be provided between base frame and panel through its entire width on the front/rear side.
- a) All control and supervisory apparatuses shall be mounted in the control cubicle. The following control and indicating facilities shall be provided as a minimum:
- A local mimic with the electrical single line GCB diagram of the system.
 - Local - Off - Remote key operated selector switch.
 - Local electrical opening and closing facilities.
 - Remote electrical opening and closing facilities via interposing relays.
 - Mechanical open and closed indication facilities.
 - DC close and trip coils and an additional D.C. trip coil per pole.
 - Gas pressure meter for each SF6 filled compartment
 - Operations counter.
 - Alarm table with first up facility.
 - Lamp test push-button.
 - Indications
 - Alarms

29.08.04 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	Two (2) Nos. (Part of BOQ-Cum-Price Schedule)
ii.	Location	INDOOR Installation
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



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	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)
ix.	Number Of Stored Close/Open Operations	2CO FOR HYDRAULIC OPERATED /OCO FOR SPRING OPERATED
x.	Short Circuit Capability	160 KA FOR 3 SEC
xi.	Symmetrical Interrupting Capability	As per IEEE C 037.013-1997.
xii.	Dc Component Of Fault Current	As per IEEE C 037.013-1997.
xiii.	Short Circuit Making Current	*
xiv.	Rated Peak Withstand Current (Kv Peak)	*
xv.	Rated Short Time Withstand Current (KA Rms, For 3 Sec)	160 KA FOR 3 SEC
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 Generator 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
xxvii.	Mounting Details for surge arrester, Voltage transformer etc.,	Inside GCB Enclosure
xxviii.	Material of enclosure for GCB	Aluminum Alloy
III. DISCONNECTING SWITCH 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	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 3 Sec)	160 KA FOR 3 SEC
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 KA FOR 1 SEC
vi.	Rated Peak Withstand Current (Ka Peak)	*
vii.	Operating Mechanism	Electrical Motor Gang 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	*
ii.	Voltage Class	*



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

29.09.00 LIST OF TESTS TO BE CONDUCTED

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

29.09.01 TYPE TESTS

All the equipment supplied shall be of type tested quality. The performance of the generator circuit-breaker system should have been fully tested in accordance to the standard IEEE C37.013 with regard to the interrupting capability.

Further type tests should have been carried out with all of the related components within the system to prove continuous current capability, dielectric strength, long term endurance, noise level etc. and verify the liability and compliance with the requirements of the relevant IEC-standards. Type test reports for the following shall be submitted for review by the Owner.

- a. Rated dielectric strength tests
 - (i) Rated low frequency withstand voltage dry test.
 - (ii) Rated full wave impulse withstand voltage test.
- b. Short circuit rating and transient recovery voltage tests
 - (i) Test for rated symmetrical short circuit current interrupting capability, duty cycle and rated transient recovery voltage parameters.
 - (ii) Test for rated closing, latching and short time current carrying capability.
 - (iii) Test for rated Generator source asymmetrical short circuit interrupting capability.
- c. Load current switching test
- d. Out of phase switching current tests
- ~~e. Rated excitation current switching tests.~~
- f. Type tests and oscillographic test records for closing and tripping timings for generator circuit breaker of the rating offered.
- g. Rated continuous current carrying tests
- h. Mechanical endurance life tests.
- i. Noise level tests.

29.09.02 Routine Tests

- i) Gas receiver tests;
- ii) Pressure tests;
- iii) Nameplate check;
- iv) Leakage tests;



-
- v) Resistor, heater, and coil check tests;
 - vi) Control and secondary wiring check tests;
 - vii) Clearance and mechanical adjustment check tests;
 - viii) Dielectric tests on the main circuit
 - ix) Dielectric tests on auxiliary and control circuit
 - x) Mechanical operation tests;
 - xi) Timing tests;
 - xii) Stored energy system tests;
 - xiii) Electrical resistance of current path tests;
 - xiv) Power frequency withstand voltage tests on major insulation components;
 - xv) Power frequency withstand voltage tests on control and secondary wiring;

29.09.03 Tests after Delivery / Site Tests

Site tests shall be performed on the GCB-system to confirm that the equipment was not damaged during shipping and to check the operation of the GCB-system under actual conditions at site. The manufacturer shall furnish technical support to review the commissioning procedures and a list of tests to be performed at site:-

- i) Leakage tests;
- ii) Gauge tests;
- iii) Stored energy system test;
- iv) Electrical resistance of current path tests;
- v) Clearance and mechanical adjustment check tests;
- vi) Timing tests;
- vii) Power frequencies withstand voltage tests.
- ~~viii) Ratio and polarity checks for VTs~~
- ix) Functional tests of circuit breaker and isolator / earth switch including checks of interlocks, indications etc.





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1.00.00 SCOPE

1.01.00 The scope shall include planning, design, engineering, manufacturing, assembly, testing, inspection, packing, supply, transportation of equipment related to Generator Circuit Breaker and associated equipment and services:

- Generator circuit breaker [as per quantity indicated in Data Sheet –A/BOQ-Cum-Price Schedule].
- Start-up and commissioning spares.
- Mandatory spares, as specified.
- Recommended spares for three (3) years of plant operation and maintenance, as specified.
- Special tools and tackles.
- Supervision of erection, testing & commissioning.
- 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.



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2.00.00 GENERATOR CIRCUIT BREAKER

- 2.01.00 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 for Generator Bus Duct in the Data Sheet - A.
- 2.02.00 The interrupters of the circuit breaker shall be SF6 type. The rated short circuit duty cycle shall be CO - 30 minutes - CO.
- 2.03.00 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.
- 2.04.00 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.
- 2.05.00 Each three-phase circuit breaker shall have a hydraulic system complete with all associated pipework etc. or spring charged mechanism system complete with all accessories. The total stored energy in the operating system offered shall be sufficient for 2 CO operations for hydraulic and O-C-O operations for spring charged mechanism.
- 2.06.00 The number of motor driven hydraulic pumps shall be included by bidder as per bidder's standard and proven practice, ensuring utmost reliability of the operating system. Bidder in the bid shall declare the number of motor driven hydraulic pumps included.
- 2.07.00 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 with the voltage at coil terminals reduced to 56 % of the rated operating voltage of the coil.
- The trip coils are to be rated for DC auxiliary voltage specified in Data-Sheet-A and the minimum operating voltage of the trip coils shall be 56% of rated DC voltage. Both the trip coils shall be monitored.
- 2.08.00 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.
- 2.09.00 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.



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- 2.10.00 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.
- 2.11.00 The design and testing of the generator circuit breaker shall be in line with ANSI/IEEE C37.013 latest versions.
- 2.12.00 The arrangement shall include earth switch as per Data Sheet - A. The design and testing of the earth switch shall be in line with IEC62271-102/IEC-129.
- 2.13.00 The arrangement shall include a series isolator as per Data Sheet - A. The design and testing of the isolator shall be in line with IEC62271-102/IEC-129.
- 2.14.00 ~~Single phase Voltage Transformers (VT) and Lightning Arresters (LA) shall be included on each phase of GCB assembly as per the technical particulars & quantities specified in Data Sheet - A of this specification. VT primary leads shall be provided with suitable HT fuses and the neutral formation of VT primary windings shall be grounded as stipulated in Data Sheet - A. VT secondary leads shall be brought to terminal blocks & in GCB LCP after providing suitable fuses/ MCBs and the neutral formation of secondary leads shall be grounded.~~
- 2.15.00 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.
- 2.16.00 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.
- 2.17.00 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, temperature etc. as per the standard practice of the manufacturer.
- Local control panel shall also contain, stay put type local/remote selector switch, spring return to neutral control switch for GCB, isolator & earth switch, electrically operated position indicator for GCB, isolator & earth switch etc.
- 2.18.00 Mimic diagram shall be provided on local control panel (LCP). Electrically operated semaphore indicators shall be used for indicating status of GCB, isolator and earth switch. Semaphore indicators shall form part of the mimic diagram. In case of failure of auxiliary DC supply, indicating bar of semaphore indicators shall take 45° position.
- 2.19.00 Requirement of potential free auxiliary contacts for purchaser's use is indicated below:



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GCB : 12NO + 12NC
Each Isolator : 8NO + 8NC
Each Earth Switch : 8NO + 8NC

These contacts shall be wired to the terminal blocks of LCP for external use.

- 2.20.00 Two nos. incoming DC supply feeders and 2 Nos. AC supply feeders will be made available by purchaser for GCB. Necessary arrangement shall be provided in GCB LCP for receiving these four feeders. Independent MCBs and voltage supervision relays shall be provided in GCB LCP for each DC and AC supply.
- 2.21.00
- 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 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'
 - e) Potential-free contacts shall also be provided on GCB LCP for 'DC failure at GCB'.
- 2.22.00 Operation counter for GCB shall be provided in Local Control Panel.
- 2.23.00 Gland plate of local control panel shall be of adequate size for terminating external cables using glands. No. of external cables shall be finalized after the award of LOI.
- 2.24.00 Spare terminals shall be provided in local control panel. Number of spare terminals shall not be less than 20%.
- 2.25.00 All interconnecting cables between various equipment in the scope of the bidder shall be included by bidder in his scope.
- 2.26.00 GCB normal current rating, short time withstand current rating, peak withstand current rating, insulation levels, etc. shall not be less than those given for generator busduct given in Data Sheet-A.
- 2.27.00 Generator Circuit Breaker shall be suitable for busduct fault levels given in Data Sheet - A. Bidder must also establish that the model quoted is suitable for asymmetrical and symmetrical short circuit current contribution from generator side to a 3-phase and 2-phase fault. Generator reactances and time constants are given in Data Sheet -A to enable bidder to compute generator side fault current and establish GCB suitability. Bidder must take a negative tolerance of 15% on generator reactances and an over-



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voltage factor of 1.05 for calculating the fault currents. Also, both no-load and full-load conditions of generator shall be considered.

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.

2.28.00 **Cable glands, cable lugs and foundation nuts & bolts shall be supplied along with GCB.**

The required quantity of glands and lugs for terminating purchaser's external cables shall be finalized during contract engineering and there shall be no price implication on this account.

3.00.00 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.

4.00.00 TESTS

4.01.00 ROUTINE TESTS

The equipment shall be completely assembled, wired, adjusted and routine tested at manufacturer's works as per applicable standards.

4.02.00 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 ANSI/IEEE C37.013. Series isolator and earth switch should have been type tested as per latest version of standard IEC62271-102/IEC-129.

4.03.00 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

4.04.00 WITNESSING OF TESTS

All tests shall be performed in presence of purchaser's representatives.



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The vendor shall give at least 45 days' advance notice for routine tests and type tests (if required as per cl. 4.02.00).

5.00.00 QUALITY PLAN

- a. The manufacturer shall draw a detailed Quality Plan for approval covering testing on all major component 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 relevant IEC/Test procedure, etc. The manufacturer shall draw up a detailed test procedure for routine and type test for BHEL/ultimate customer review and approval. The tests to be carried out shall include following but not limited to same:

1. ROUTINE TESTS ON GCB

- a. Check completeness of breaker and associated control system.
- b. Millivolt drop test
- c. Mechanical operation test as per IEC
- d. Determination of leak rate of SF6 & moisture condensation determination (dampness rate)
- e. Determination of breaker operating times including speed (under various conditions of driving mechanism and various pressure and voltage conditions).
- f. PF high voltage tests on breakers as per IEC56 Clause 20 Part-IV (with poles closed and open conditions).
- g. Functional and performance test of all control circuits, trip and alarms circuits with breaker connected.
- h. Drive mechanism
- i/ Performance tests
- ii/ Functional tests
- iii/ Resistance of trip coils
- iv/ Check performance of safety valves
- v/ Operation of pressure switches and setting ranges.
- vi/ Check motor current consumption and also the ratings.



TITLE :

TECHNICAL SPECIFICATION FOR
GENERATOR CIRCUIT BREAKER
(GENERAL TECHNICAL REQUIREMENT)

SPECIFICATION NO.

PE-SS-999-510-E001VOLUME NO. : **II-B**SECTION : **D**REV NO. : **00** DATE : 15.02.2006

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- i/ Check performance of gang operated switches and the auxiliary contact terminals as per schematic arrangement.

2. ROUTINE TESTS ON ISOLATOR AND EARTH-SWITCH

Routine tests on isolator and earth-switch shall be conducted as per IEC62271-102/IEC-129.

6.00.00 SPARES

- 6.01.00 Start-up and commissioning spares are those which may be required during the start-up and commissioning of the equipment.
- 6.02.00 Mandatory spares shall be quoted as applicable as per Data Sheet-A.
- 6.03.00 The bidder shall include and provide a list of recommended spares for 3 years of normal operation of the plant.
- 6.04.00 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.

7.00.00 SPECIAL TOOLS & TACKLES

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

8.00.00 SUPERVISION OF ERECTION, TESTING AND COMMISSIONING

Bidder shall quote for supervision of erection, testing and commissioning of each GCB. Details shall be furnished in the technical offer.

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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9.00.00 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.

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

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

10.00.00 O & M MANUAL

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

10.01.00 The instruction manual shall contain full details and drawings of all the equipment furnished, the storage procedures, erection and testing procedures, operation and maintenance procedure of the equipment.

10.02.00 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 including erection, testing, commissioning, operation, maintenance, dismantling, repair and assembly. Each manual shall also include a complete set of approved drawings together with performance/ rating curves of the equipment and test certificate wherever applicable.

10.03.00 The instruction manuals shall also include the spare part catalogue for all the equipment.

10.04.00 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.

11.00.00 TECHNICAL DEVIATIONS

Bidder shall clearly indicate deviations in the offer. Only the deviations which are specifically mentioned in the offer in the prescribed Deviation Schedule shall be considered, otherwise it shall be presumed that offer is fully in conformance to the specification.