KARNATAKA POWER CORPORATION LIMITED

"1X370 MW YELAHANKA COMBINED CYCLE POWER PLANT"

VOLUME – II

TECHNICAL SPECIFICATION FOR

GENERATOR CIRCUIT BREAKER (GCB)

SPECIFICATION NO : PE-TS-409-510-E001
REV-0

BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UTTAR PRADESH, INDIA – 201301

CONTENTS

TOTAL NUMBER OF SHEETS: 37

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same

2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'

3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

BIDDER'S STAMP & SIGNATURE

SECTION – 'I'

SPECIFIC TECHNICAL REQUIREMENTS

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

S.No.	***Reference Clause No. of Section- II***	***Specific Requirement/ Change***
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 of Local Control Panel shall be IP52

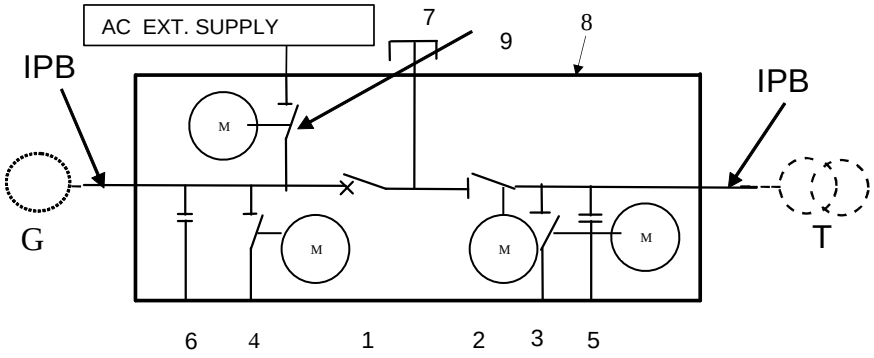
4.0 DOCUMENTATION

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.

ATTACHMENT – I

Sketch – I



1	Circuit-breaker	7	Short-circuiting/Breaking switch
2	Disconnector	5, 6	Surge capacitors
3, 4	Earthing switches	8	System enclosure
9	Starting Switch(only for GTG)		

SINGLE LINE CONFIGURATION OF GENERATOR CIRCUIT BREAKER

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

SL. NO.	DESCRIPTION	UNIT	VALUE	
A	GENERATOR PARAMETERS			
1	RATED POWER		GTG	STG
	9.9°C		317.88 270.2	162.12 137.80
	15°C		310.94 264.30	163.53 139.00
	28°C	MVA MW	278.62 236.83	156.74 133.23
	39°C		245.88 209.00	143.76 122.20
	40°C		241.76 205.50	142 120.70
	50°C		208.71 177.40	125.29 106.50
	POWER UNDER VWO CONDITION	MVA MW	Not Applicable	
2	RATED FREQUENCY	Hz	50 Hz	
3	RATED VOLTAGE	KV	15.75	
4	VOLTAGE VARIATION	%	±5	
5	RATED POWER FACTOR		0.85	
6	REACTANCE VALUE (SATURATED):		GTG	STG
6 a	SYNCHRONOUS REACTANCE, DIRECT AXIS, Xd	pu	1.715	1.918
6 b	TRANSIENT REACTANCE, DIRECT AXIS, Xd'	pu	0.237	2.04
6 c	SUB TRANSIENT REACTANCE, DIRECT AXIS, Xd"	pu	0.162	0.126

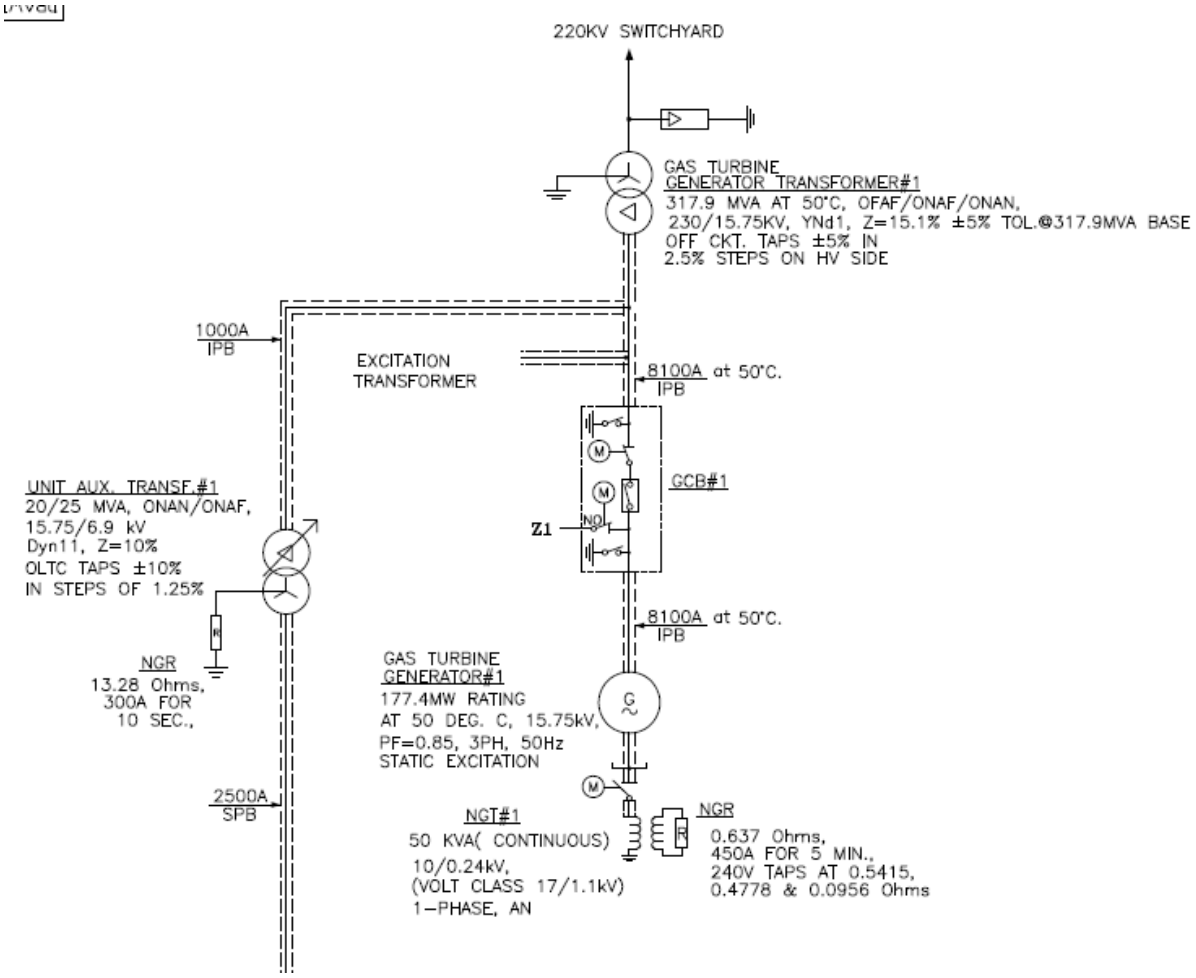
6 d	SYNCHRONOUS REACTANCE, QUADRATURE AXIS, Xq	pu	1.54	1.66
6 e	TRANSIENT REACTANCE, QUADRATURE AXIS, Xq'	pu	0.49	0.41
6 f	SUB TRANSIENT REACTANCE, QUADRATURE AXIS, Xq"	pu	0.172	0.139
7	ZERO SEQUENCE REACTANCE	pu	0.104	0.081
8	NEGATIVE SEQUENCE REACTANCE	pu	0.164	0.132
9	TOLERANCE IN GENERATOR REACTANCES	%	±15	
10	STATOR RESISTANCE (Ra)	OHMS	GTG	STG
			0.000858 @ 25°C	0.001639 @ 25°C
			0.00102 @ 75°C	0.001954 @ 75°C
11	FIELD CURRENT AT GENERATOR RATED VOLATGE AND POWER FACTOR	AMPS	GTG 2314.2	STG 932.4
12	TIME CONSTANTS (SHORT CIRCUIT TIME CONSTANTS):		GTG	STG
12 a	TRANSIENT TIME CONSTANT, DIRECT AXIS, Td'	s	1.13	1.081
12 b	SUB TRANSIENT TIME CONSTANT, DIRECT AXIS, Td"	s	0.0304	0.028
12 c	TRANSIENT TIME CONSTANT, QUADRATURE AXIS, Tq'	s	0.646	0.457
12 d	SUB TRANSIENT TIME CONSTANT, QUADRATURE AXIS, Tq"	s	0.0680	0.0679
12 e	ARMATURE TIME CONSTANT	s	0.473	0.318
13	SPEED	rpm	3000	
14	GENERATOR NEUTRAL EARTHING		High Resistance (Through Transformer loaded with Resistance on secondary)	
15	NGT PARAMETERS			
	PRIMARY VOLTAGE	KV	10	
	SECONDARY VOLTAGE	KV	0.24	
	NGR (AT SECONDARY OF NGT)	OHMS	0.637	
B	**GENERATOR ISOLATED PHASE BUS DUCT (IPBD) DETAILS [GCB to comply to these requirements]**			
1	Type		Isolated phase bus duct	
2	Overall diameter of enclosure (Inside)	mm	GTG 863.3	STG 770.44

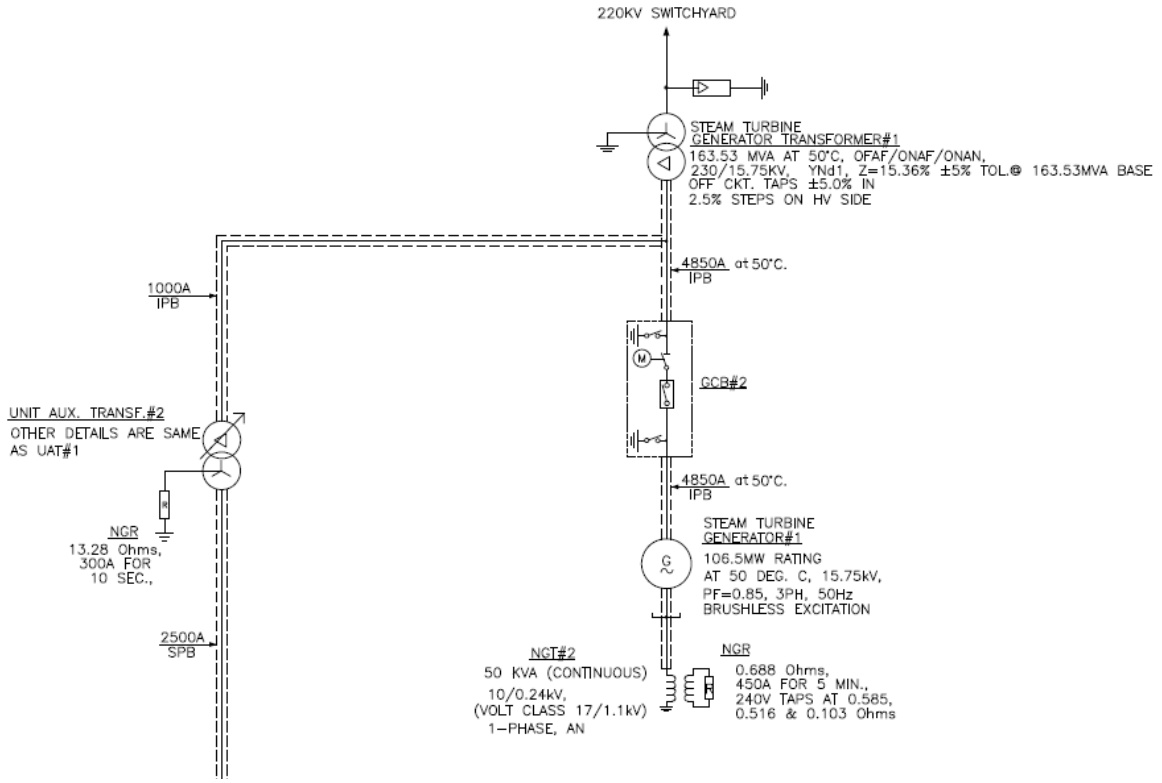
3	Thickness of enclosure	mm	GTG 6.35	STG 4.78
4	Phase-phase spacing	mm	GTG 1250	STG 1250
5	Enclosure material		Al. alloy	
6	Conductor material		Al. alloy	
7	Conductor profile		Round	
8	Cooling of IPBD		Natural	
9	Pressurization System provided		Yes	
10	Pressure of air inside the enclosure	mm of water col.mn	100 mm water column	
11	Maximum temperature of enclosure at 50°C	°C	70	
12	Maximum temperature of silver plated conductor joints at 50°C	°C	105	
C	**GENERATOR TRANSFORMER PARAMETERS**			
1	RATED MVA	MVA	GTG 317.9	STG 163.53
2	HV SIDE VOLTAGE	KV	230	
3	MAXIMUM HV VOLTAGE	KV	242	
4	MINIMUM HV VOLTAGE	KV	198	
5	LV VOLTAGE	KV	15.75	
6	FREQUENCY	HZ	50	
7	X/R RATIO		80	65
8	SHORT CIRCUIT IMPEDANCE	P.U.	15.1	15.36
9	TOLERANCE IN SHORT CIRCUIT IMPEDANCE	%	±5	
D	**UNIT TRANSFORMER PARAMETERS (UT#1)**			
1	RATED MVA	MVA	25	
2	NUMBER OF WINDINGS (2 / 3)		2	
3	HV SIDE VOLTAGE	KV	15.75	
4	MAXIMUM HV VOLTAGE	KV	16.54	
5	MINIMUM HV VOLTAGE	KV	14.96	
6	LV VOLTAGE	KV	6.9	
7	FREQUENCY	HZ	50	
8	X/R RATIO		20	

9	SHORT CIRCUIT IMPEDANCE	P.U.	10
10	TOLERANCE IN SHORT CIRCUIT IMPEDANCE	%	±10
11	MOTOR LOADS CONNECTED TO UNIT TRANSFORMER	MVA	6.0
12	MOTOR RATED VOLTAGE	KV	6.6
13	MOTOR STARTING CURRENT (TIMES FULL LOAD CURRENT)	TIMES	7.2
E	**UNIT TRANSFORMER PARAMETERS (UT#2)**		
1	RATED MVA	MVA	25
2	NUMBER OF WINDINGS (2 / 3)		2
3	HV SIDE VOLTAGE	KV	15.75
4	MAXIMUM HV VOLTAGE	KV	16.54
5	MINIMUM HV VOLTAGE	KV	14.96
6	LV VOLTAGE	KV	6.9
7	FREQUENCY	HZ	50
8	X/R RATIO		20
9	SHORT CIRCUIT IMPEDANCE	P.U.	10
10	TOLERANCE IN SHORT CIRCUIT IMPEDANCE	%	±10
11	MOTOR LOADS CONNECTED TO UNIT TRANSFORMER	MVA	6.0
12	MOTOR RATED VOLTAGE	KV	6.6
13	MOTOR STARTING CURRENT (TIMES FULL LOAD CURRENT)	TIMES	7.2
F	**STATION TRANSFORMER PARAMETERS (IF APPLICABLE)**		Not Applicable
1	RATED MVA	MVA	
2	NUMBER OF WINDINGS (2 / 3)		
3	HV SIDE VOLTAGE	KV	
4	MAXIMUM HV VOLTAGE	KV	
5	MINIMUM HV VOLTAGE	KV	
6	LV VOLTAGE	KV	
7	FREQUENCY	HZ	
8	X/R RATIO		
9	SHORT CIRCUIT IMPEDANCE	P.U.	
10	TOLERANCE IN SHORT CIRCUIT IMPEDANCE	%	
11	MOTOR LOADS CONNECTED TO UNIT TRANSFORMNER	MVA	
12	MOTOR RATED VOLTAGE	KV	

13	MOTOR STARTING CURRENT (TIMES FULL LOAD CURRENT)	TIMES	
G	**SYSTEM PARAMETERS**		
1	RATED VOLTAGE	KV	220
2	MAXIMUM VOLTAGE	KV	242
3	MINIMUM VOLTAGE	KV	198
4	RATED FREQUENCY	HZ	50
5	MAXIMUM THREE PHASE SHORT CIRCUIT CURRENT	KA	40
6	X/R RATIO		14

NOTE: PLEASE REFER ATTACHED SINGLE LINE DIAGRAM FOR CONFIGURATION




220KV SWITCHYARD
STEAM TURBINE GENERATOR TRANSFORMER#1
163.53 MVA AT 50°C, OFAF/ONAF/ONAN,
230/15.75KV, YNd1, Z=15.36% ±5% TOL.@ 163.53MVA BASE
OFF CKT. TAPS ±5.0% IN
2.5% STEPS ON HV SIDE
4850A at 50°C.
IPB
1000A
IPB
GCB#2
UNIT AUX. TRANSF.#2
OTHER DETAILS ARE SAME
AS UAT#1
4850A at 50°C.
IPB
NGR
13.28 Ohms,
300A FOR
10 SEC.,
STEAM TURBINE GENERATOR#1
106.5MW RATING
AT 50 DEG. C, 15.75kV,
PF=0.85, 3PH, 50Hz
BRUSHLESS EXCITATION
2500A
SPB
NGT#2
50 KVA (CONTINUOUS)
10/0.24kV,
(VOLT CLASS 17/1.1kV)
1-PHASE, AN
NGR
0.688 Ohms,
450A FOR 5 MIN.,
240V TAPS AT 0.585,
0.516 & 0.103 Ohms

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 (if applicable). (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.

ATTACHMENT – IV

DOCUMENTS REQUIRED AFTER AWARD OF LOI.

SL. No.	DOCUMENT TITLE	DWG. / DOCUMENT No.
1	TECHNICAL DATASHEET FOR GENERATOR CIRCUIT BREAKER	PE-V0-409-510-E001
2	GA AND FOUNDATION PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-409-510-E002
3	CONTROL & SCHEME DRAWING FOR GENERATOR CIRCUIT BREAKER	PE-V0-409-510-E004
4	NAME PLATE FOR GENERATOR CIRCUIT BREAKER	PE-V0-409-510-E005
5	SIZING CALCULATIONS INCLUDING SHORT CIRCUIT CALCULATIONS AS PER IEEE	PE-V0-409-510-E007
6	SF6 PRESSURE SCHEME GENERATOR CIRCUIT BREAKER	PE-V0-409-510-E009
7	FIELD QUALITY PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-409-510-E010
8	TYPE TEST CERTIFICATES OF GENERATOR CIRCUIT BREAKER	PE-V0-409-510-E011
9	O/M MANUALS FOR GENERATOR CIRCUIT BREAKER	PE-V0-409-510-E012
10	EQUIPMENT LIST OF GENERATOR CIRCUIT BREAKER	PE-V0-409-510-E110
11	MANUFACTURING QUALITY PLAN FOR GENERATOR CIRCUIT BREAKER	PE-V0-409-510-E901

Note:

1. The above list of drawings and documents is indicative.

DATA SHEET –A

SL.NO	PARAMETER	UNIT	VALUE	
1.00	**Generator Circuit Breaker details**			
1.01	Minimum continuous current rating at following ambient temp:	A	GTG	STG
	9.9°C		12265.96	6255.55
	15°C		11998.13	6310.03
	28°C		10750.88	6047.86
	39°C		9487.74	5547.37
	40°C		9328.85	5479.28
	50°C		8053.23	4834.66
1.02	Rated voltage	kV	15.75	
1.03	No. of poles	Nos.	3	
1.04 (a)	Rated short time withstand current	kA	84 for GTG & 48 for STG	
1.04 (b)	Duration	sec	1	
1.05 (a)	Rated symmetrical breaking capability (i)System Source fault (ii)Generator Source fault	kA	(i) As per IEEE/IEC 62271-37-013:2015 (ii) As per IEEE/IEC 62271-37-013:2015	
1.05 (b)	Rated making current capability (i)System Source fault (ii)Generator Source fault	kApeak	(i) As per IEEE/IEC 62271-37-013:2015 ((ii) As per IEEE/IEC 62271-37-013:2015	
1.06	One minute power frequency withstand voltage	kV(RMS)	As per IEEE/IEC 62271-37-013:2015	
1.07	Impulse withstand voltage	kV(Peak)	As per IEEE/IEC 62271-37-013:2015	
1.08	Location of GCB	Indoor / Outdoor	Indoor	
1.09	Quantity of GCB	Nos.	02 NOS (01NO. for GTG & 01 NO. for STG)	
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	YES (Only for GTG)
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 or Forced air cooled as per manufacturer standard
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	**Auxiliary supplies**		
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 effectively earthed (240V, 1 phase, 2 wire, 50 Hz).
3.00	**Requirement of potential free Auxiliary Contacts for Purchaser's use:** (In addition to those required for own operation and indications)		
3.01	Total number of contacts for **GCB**		
	a. Normally Open (NO) numbers	Nos.	12 Minimum
	b. Normally Close (NC) numbers	Nos.	12 Minimum
3.02	Total number of contacts 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 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	IEC/IEEE 62271-37-013

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**	Yes/No	No
7.00	**Current Transformer**	Yes/No	No
8.00	Type Tests		
8.01	Validity period of type test reports		Type Test Report as per IEEE C37.013 shall be furnished
8.02	Type tests to be conducted for this contract, despite availability of valid & acceptable test certificates	Yes/ No	No.Type Test Report as per IEEE C37.013 shall be furnished
8.03	If yes, list of type tests to be conducted		
9.00	**Mandatory Spares**		
9.01	Mandatory Spares to be quoted for this contract	Yes/ No	No
9.02	If yes, list of mandatory spares		
10.00	**SF6 Gas leakage Detector**, if applicable	Quantity	NA

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 at ambient temperature of: 40°C 50°C	A		
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		

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	Motor driven pumps in hydraulic mechanism			
1.16 a)	Voltage rating	V		
1.16 b)	Power rating	kW		
1.16 c)	No. of motor driven pump	Nos.		
1.17	Fans in forced cooling system			
1.17 a)	Voltage rating	V		
1.17 b)	Power rating	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?		Yes/ No	
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:			
a	Normal current :	A		
b	Normal voltage :	kV		
c	System source Fault current :	kA		
d	Generator source Fault current :	kA		
e	Making current :	kApeak		
f	Dielectric withstand voltage :	kVrms,		
g	Dielectric withstand voltage :	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?		Yes/ No	
1.25	Type of operating mechanism provided			
1.26	Whether three poles of the circuit breaker are gang operated?		Yes/ No	
1.27	Whether circuit breaker has anti pumping feature?		Yes/ No	
1.28	Whether circuit breaker has trip free mechanism?		Yes/ No	
1.29	Whether separate SF6 gas monitors provided for each of the three phases of the circuit breaker?		Yes/ No	
1.30	No. of SF6 gas monitors provided for each GCB			
1.31	Trip Coil			
1.31 a 1.31 b 1.31 c	No. of coils provided Voltage rating Minimum operating voltage	No V V		
1.32	Emergency current rating during loss of coolant at 50^{o}C ambient (if applicable)	A		
1.33	Time available at rated current before load reduction	min		
1.34	Rate at which load current should be reduced	A/sec		
1.35	Reduced continuous operating current	A		
1.36	Rated permissible tripping time	msec		
1.37 a b c	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		
1.38	Minimum creepage distance	mm		
1.39	Clearance in air of live parts - phase to earth	mm		
1.40	a) Control circuit suitable for aux. supply voltage of b) Mechanism motor suitable for aux. supply voltage of	V V		
1.41	Value of capacitor included in GCB on	nF/phase		

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

j	Rated power frequency withstand voltage	kV		
k	Rated impulse withstand voltage	kV		
l	No. of poles per switch	No.		
m	No. of control mechanism per switch	No.		
n	Ambient air temp. limits	Deg C		
o	Control circuit suitable for aux. supply voltage of?	V		
p	Mechanism motor suitable for aux. supply voltage of?	V		
1.51	Series isolator			
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	Is series isolator fully compatible with GCB in respect of normal current ratings at various ambient temperatures?		Yes/ No	
i	Rated short time withstand current	kArms		
j	Rated peak withstand current	kApeak		
k	Rated power frequency withstand voltage	kV		
l	Rated impulse withstand voltage	kV		
m	No. of poles per switch	No.		
n	No. of control mechanism per switch	No.		
o	Ambient air temp. limits	Deg C		

p	Control circuit suitable for aux. supply voltage of?	V		
q	Mechanism motor suitable for aux. supply voltage of?	V		
1.52	a) Whether all type tests have been conducted on GCB b) Have all the type tests been carried out at independent test laboratories? c) Summary of Type test reports for GCB enclosed as Annex. No.		Yes/ No Yes/ No	
1.53	Whether the offer includes performance of all site tests as per specification?		Yes/ No	
1.54	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.		Yes/ No Yes/ No	
1.55	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.		Yes/ No Yes/ No	
1.56	**<u>Requirement of potential free Auxiliary Contacts for Purchaser's use:</u>** (In addition to those required for own operation and indications)			
1.56.01	Total number of contacts furnished for **GCB**			
	a. Normally Open (NO) numbers	Nos.		
	b. Normally Close (NC) numbers	Nos.		
1.56.02	Total number of contacts furnished for **Disconnecting** switch			
	a. Normally Open (NO) numbers	Nos.		
	b. Normally Close (NC) numbers	Nos.		
1.56.03	Total number of contacts furnished for **Earth** switch			
	a. Normally Open (NO) numbers	Nos.		
	b. Normally Close (NC) numbers	Nos.		
1.57	**Wiring (copper wiring)**			
1.57.01	Internal Wiring	Sq.mm.		
1.57.02	Motor Circuit	Sq.mm.		

1.57.03	CT & VT circuit	Sq.mm.		
1.58	**Voltage Transformer**		Yes/ No	
1.59	**Current Transformer**		Yes/ No	
1.60	**SF6 Gas leakage Detector**	Nos.		

VT location	**VT No.**	**Ratio**	**Burden**	**Accuracy Class**	**Connection Type**	**Primary protection/ Secondary protection**

CT Location	**CT No.**	**Core No.**	**Ratio (A)**	**Burden (VA)**	**Accuracy Class**	**ALF/ ISF**	**Knee Point Voltage, Vk ≥ (Volts)**	**Ie≤ (mA)**	**Rct at 75°C (Ohms)**

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 at ambient temperature of: 40°C 50°C	A		
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		

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	Motor driven pumps in hydraulic mechanism			
1.16 a)	Voltage rating	V		
1.16 b)	Power rating	kW		
1.16 c)	No. of motor driven pump	Nos.		
1.17	Fans in forced cooling system			
1.17 a)	Voltage rating	V		
1.17 b)	Power rating	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?		Yes/ No	
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:			
a	Normal current :	A		
b	Normal voltage :	kV		
c	System source Fault current :	kA		
d	Generator source Fault current :	kA		
e	Making current :	kApeak		
f	Dielectric withstand voltage :	kVrms,		
g	Dielectric withstand voltage :	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?		Yes/ No	
1.25	Type of operating mechanism provided			
1.26	Whether three poles of the circuit breaker are gang operated?		Yes/ No	
1.27	Whether circuit breaker has anti pumping feature?		Yes/ No	
1.28	Whether circuit breaker has trip free mechanism?		Yes/ No	
1.29	Whether separate SF6 gas monitors provided for each of the three phases of the circuit breaker?		Yes/ No	
1.30	No. of SF6 gas monitors provided for each GCB			
1.31	Trip Coil			
1.31 a 1.31 b 1.31 c	No. of coils provided Voltage rating Minimum operating voltage	No V V		
1.32	Emergency current rating during loss of coolant at 50^{o}C ambient (if applicable)	A		
1.33	Time available at rated current before load reduction	min		
1.34	Rate at which load current should be reduced	A/sec		
1.35	Reduced continuous operating current	A		
1.36	Rated permissible tripping time	msec		
1.37 a b c	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		
1.38	Minimum creepage distance	mm		
1.39	Clearance in air of live parts - phase to earth	mm		
1.40	a) Control circuit suitable for aux. supply voltage of b) Mechanism motor suitable for aux. supply voltage of	V V		
1.41	Value of capacitor included in GCB on	nF/phase		

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

j	Rated power frequency withstand voltage	kV		
k	Rated impulse withstand voltage	kV		
l	No. of poles per switch	No.		
m	No. of control mechanism per switch	No.		
n	Ambient air temp. limits	Deg C		
o	Control circuit suitable for aux. supply voltage of?	V		
p	Mechanism motor suitable for aux. supply voltage of?	V		
1.51	Series isolator			
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	Is series isolator fully compatible with GCB in respect of normal current ratings at various ambient temperatures?		Yes/ No	
i	Rated short time withstand current	kArms		
j	Rated peak withstand current	kApeak		
k	Rated power frequency withstand voltage	kV		
l	Rated impulse withstand voltage	kV		
m	No. of poles per switch	No.		
n	No. of control mechanism per switch	No.		
o	Ambient air temp. limits	Deg C		

p	Control circuit suitable for aux. supply voltage of?	V		
q	Mechanism motor suitable for aux. supply voltage of?	V		
1.52	a) Whether all type tests have been conducted on GCB b) Have all the type tests been carried out at independent test laboratories? c) Summary of Type test reports for GCB enclosed as Annex. No.		Yes/ No Yes/ No	
1.53	Whether the offer includes performance of all site tests as per specification?		Yes/ No	
1.54	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.		Yes/ No Yes/ No	
1.55	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.		Yes/ No Yes/ No	
1.56	**<u>Requirement of potential free Auxiliary Contacts for Purchaser's use:</u>** (In addition to those required for own operation and indications)			
1.56.01	Total number of contacts furnished for **GCB**			
	c. Normally Open (NO) numbers	Nos.		
	d. Normally Close (NC) numbers	Nos.		
1.56.02	Total number of contacts furnished for **Disconnecting** switch			
	c. Normally Open (NO) numbers	Nos.		
	d. Normally Close (NC) numbers	Nos.		
1.56.03	Total number of contacts furnished for **Earth** switch			
	c. Normally Open (NO) numbers	Nos.		
	d. Normally Close (NC) numbers	Nos.		
1.57	**Wiring (copper wiring)**			
1.57.01	Internal Wiring	Sq.mm.		
1.57.02	Motor Circuit	Sq.mm.		

1.57.03	CT & VT circuit	Sq.mm.		
1.58	**Voltage Transformer**		Yes/ No	
1.59	**Current Transformer**		Yes/ No	
1.60	**SF6 Gas leakage Detector**	Nos.		

VT location	**VT No.**	**Ratio**	**Burden**	**Accuracy Class**	**Connection Type**	**Primary protection / Secondary protection**

CT Location	**CT No.**	**Core No.**	**Ratio (A)**	**Burden (VA)**	**Accuracy Class**	**ALF / ISF**	**Knee Point Voltage, Vk ≥ (Volts)**	**Ie≤ (mA)**	**Rct at 75°C (Ohms)**

SECTION – 'II'

STANDARD TECHNICAL REQUIRMENTS

CONTENTS

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

3.00.00 GENERATOR CIRCUIT BREAKER

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

3.02.00 The breaker shall have continuous and short time current ratings as those indicated in the datasheet-A of section-I, Volume-II.

3.03.00 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. 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 **Operating Mechanism**

3.06.01 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.

3.06.02 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.

3.06.03 **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.

3.06.04 **Spring Operating Mechanism:**

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

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

3.07.00 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.

3.08.00 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.

3.09.00 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.
Bidder to provide SF6 gas leakage detector, if specified in Data Sheet-A of section-I, volume-II.

3.10.00 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.

3.11.00 **Disconnecting switch, starting switch and Earthing switch**

3.11.01 The arrangement shall include disconnecting switch, starting switch & earthing switch as per the Attachment-I of Section-I, Volume-II.

3.11.02 The hinged point of Starting switch shall be connected with external cable from Gas turbine generator static starter. (Applicable for gas turbine generator set)

3.11.03 The design and testing of disconnecting switch, starting switch & earthing switch shall be in line with IEC 62271-102.

3.12.00 Bidder to provide CTs and VTs, if specified in Data Sheet-A of section-I, volume-II.

3.13.00 **Local Control Panel (LCP)**

3.13.01 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.

3.13.02 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.

3.13.04 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.

3.13.05 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.

3.13.06 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.

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

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

3.15.00 Foundation bolts shall be supplied along with GCB.

3.16.00 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. Series isolator and earth switch shall be tested as per IEC 62271-102.

5.02.00 TYPE TESTS

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

5.03.00 SITE TESTS

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

i/ Leakage tests alongwith generator busduct

ii/ Gauge tests

iii/ Stored energy system tests

iv/ Electrical resistance of current path tests

v/ Clearance and mechanical adjustment check tests

vi/ Timing tests

vii/ Low frequency withstand voltage tests

5.04.00 WITNESSING OF TESTS

All tests shall be performed in presence of purchaser's representatives. The vendor shall give at least 45 days advance notice for routine tests and type tests.

6.00.00 QUALITY PLAN

a. The manufacturer shall furnish a detailed Quality Plan for approval covering testing on all major components like, enclosures, castings, forgings, insulators, springs, contacts, nozzles, cylinders (SF6), manometers, pressure switches, density meters, valves, pipes and fittings, pumps, coils (for tripping and closing), heaters, relays, filters, base frame, support structures, SF6 gas, terminals, etc. The tests shall include all applicable tests like, material, chemical and other tests as per relevant material and international standard. The critical casting and forgings and weld joints shall also be subject to UT/RT and dye penetration examination to ensure freedom from defects. All pressurized vessels/enclosures shall be pressure and leak tested at 1.5 times the design pressure or twice the operating pressure.

b. The assembled generator circuit breaker shall be tested in accordance with IEC/ IEEE 62271-37-013. The manufacturer shall furnish a detailed test procedure for routine and type test for BHEL/ultimate customer review and approval.

c. Routine tests on isolator and earth-switch shall be conducted as per IEC 62271-102.

7.00.00 SPARES

7.01.00 Bidder to furnish list of start-up and commissioning spares which may be required during the start-up and commissioning of the equipment.

7.02.00 Mandatory spares shall be quoted (if applicable) as per BOQ-cum-price schedule as part of NIT.

7.03.00 The bidder shall furnish a list of “Recommended spares for 3 years of normal operation of the plant”.

7.04.00 Various schedules of spares to be submitted alongwith the bid shall indicate description of spare parts alongwith type designation, quantity, unit price, total price etc.

8.00.00 SPECIAL TOOLS & TACKLES

8.01.00 Bidder shall offer one set of unused special tools and tackles which are required for erection, assembly, adjustment, maintenance and dismantling of GCB.

8.02.00 These tools and tackles shall be separately packed and sent to site prior to erection of GCB.

8.03.00 List of special tools and tackles, alongwith quantity shall be furnished as a part of offer.

9.00.00 SUPERVISION OF ERECTION, TESTING AND COMMISSIONING

Bidder shall quote for “Supervision of Erection, Testing and Commissioning” of each GCB. Required instruments for site testing of GCB shall be arranged by the vendor, in case the

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

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. if mentioned in BOQ cum price schedule as part of NIT. 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.

12.00.00 PACKING

12.01.00 Proper seaworthy packing of international standard shall be provided.