TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)

2x660MW (UNIT #1 &2)
ENNORE SUPER-CRITICAL TPP
(AT ASH DYKE OF NORTH CHENNAI TPS, KATTUPALLI)

VOLUME – II

TECHNICAL SPECIFICATION FOR

GENERATOR CIRCUIT BREAKER (GCB)

BHEL DOCUMENT NO. : PE-TS-412-510-E001
REV-0

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

CONTENTS

TOTAL NO. OF SHEETS = 66 (INCLUDING COVER/ SEPARATOR SHEETS)

IT IS CONFIRMED THAT OUR TECHNICAL OFFER COMPLIES WITH THE SPECIFICATION IN TOTO, & THAT THERE ARE NO TECHNICAL DEVIATIONS.

BIDDER'S STAMP & SIGNATURE
(REFER INSTRUCTION NO. 1 OF 'INSTRUCTIONS TO BIDDERS)

INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFERS

1. In line with clause no. 6.0 of Section-C, Volume-II-B of the specification, two signed and stamped copies of the following shall be furnished by all bidders as technical offer:

    a. Unpriced BOQ-Cum-Price Schedule with 'QUOTED' word against each item with bidder's signature and company stamp.
    b. A copy of this sheet ("Instructions to Bidders for Preparing Technical Offer"), with bidder's signature and company stamp.
    c. A copy of previous sheet ("List of Contents"), with bidder's signature and company stamp.
    d. Other document as listed in clause no. 6.0 of Section-C, Volume-IIB.

2. Confirmations/ comments (if any) regarding delivery schedules shall be furnished as part of the commercial offer. Any reference elsewhere/ covering letter of technical offer shall not be considered by BHEL.

3. 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.

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

BIDDER'S STAMP & SIGNATURE

PREAMBLE

1.0 The Tender document contains three Volumes. The Bidder shall meet the requirements of all three Volumes.

1.1 VOLUME: I CONDITIONS OF CONTRACT

This consists of four parts as below:

Volume-IA: This Part contains instructions to Bidders for making Bids to BHEL.

Volume-IB: This Part contains General Commercial Conditions of the Tender & includes provision that Vendor shall be responsible for the Quality of item supplied by their Sub-Vendors.

Volume-IC: This Part contains Special Conditions of Contract.

Volume-ID: This Part contains Commercial Conditions for Erection & Commissioning Site Work as applicable**.**

1.2 VOLUME: II TECHNICAL SPECIFICATIONS

Technical requirements are stipulated in Volume-II, which comprises of:

Volume-IIA: General Technical Conditions.

Volume-IIB: Technical Specification.

Volume –IIB is sub-divided in to following Sections.

Section-A: This Section outlines the Scope of enquiry.

Section-B: This Section provides Project information.

Section-C: This Section indicates Specific Requirements.

Data Sheet A (Specified Data)

Attachment-I

Attachment-II

Attachment-III

Section-D: This Section comprises the following:

Technical Specification/Requirements

Data Sheet C (Data / Documents to be furnished after the award of Contract).

1.3 VOLUME: III TECHNICAL SCHEDULES

This Volume contains the following:

Data Sheet – B (To be duly filled by Bidder and furnished with the Technical Bid.)

Note: The requirements mentioned in Section-C / Data Sheet A of Volume-IIB shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-D

SECTION-A

SCOPE OF ENQUIRY

1.0 This specification covers design, manufacture, assembly, inspection & testing at manufacturer's works, proper packing, delivery to site 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 of **2x660 MW ENNORE STPS AT ASH DYKE OF NORTH CHENNAI PLANT .**

2.0 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.

3.0 The general terms and conditions, instruction to bidders and other attachment referred to elsewhere are hereby made part of the Technical Specification.

4.0 The bidder shall be responsible for and governed by all requirements stipulated hereinafter.

5.0 The bidder shall confirm total compliance to the specification without any deviations from the technical/ quality assurance requirements stipulated.

6.0 All the documents submitted by the bidder shall be in English language and MKS system of units.

SECTION – B
(PROJECT INFORMATION)

1. INTRODUCTION

Tamilnadu Generation and Distribution Corporation owns the proposed green-field 1320 MW (2 units of 660 MW each) Coal Based Thermal Power Station at Katupalli. This is an expansion of North Chennai Thermal Power Station (NCTPS) and located on some portion of the ashdyke of NCTPS.

2. OWNER

Tamilnadu Generation and Distribution Corporation

~~3. CONTRACT SPECICATIONS~~

~~TNEB specification No. SE/E/T&H(P)/OT.No.175/2007-08~~

4. LOCATION

The proposed site for main power plant is located near Ennore port (approx 5 kms).
The nearest Railway station is at Athipattu Pudunagar (approx 5 kms)
All weather road from Pattamandri on the Thiruvottiyur-Ponneri district highway is the nearest road access.
The nearest airport is at Chennai at a distance of 60 km.

5. SITE CONDITION

The site is located near Vayalur Village, Ennore
Latitude : 13°17' N to 13°18' N
Longitude : 80°18' E to 80°19' E
Distance from Chennai City : 35 km
Nearest Airport is at Chennai at a
Distance of : 60 km

6. AVAILABILITY OF LAND

About 500 acres of land has been earmarked to locate all the facilities of the proposed plant and the land is in possession of TANGEDCO.

7. SITE DEVELOPMENT

Generally, level and rough graded land will be made available by the owner.

8. SOIL CONDITION

As indicated by soil consultants, the present site is located in a coastal region with sub-surface consisting of sedimentary deposits. Soil investigation has been carried out at the proposed site. From bore logs it is observed that sub soil in this strata is generally comprising of medium coarse sand up to 5 m followed by silty clay, and compacted clay layers below.

9. PLANT FOUNDATIONS

All major buildings like Turbine Building, Mill Building, Chimney, Boiler, etc. will be on piles. Major equipment foundations like TG foundations, Boiler Feed Pumps, ID Fan, FD Fan, PA Fan, Coal Mills will be on pile foundations. Other buildings can be supported on spread or raft foundations.

10. MAJOR DISTANCES TO PROJECT SITE

Plant located in Athipattu, Ponneri Taluk of Thiruvallur district, Tamil Nadu.

Distance from Chennai	-	35 km North of Chennai
Distance from Manali	-	20 km
Nearest road	-	All weather road from Pattamandiri, 5 km from Site on Chennai – Ponneri district highway
Nearest Railway Station	-	Athipattu Pudunagar on Chennai Howrah mainline, 3 km from Site
Nearest Sea Port	-	Ennore Port – 3 km and Chennai Port – 20 km from Site
Nearest Air Port	-	Chennai

11. ACTUAL DESTINATION FOR MATERIALS

ENNORE Thermal Power Station

12. MODE OF DESPATCH

Road / Rail / Sea / Air (as per project requirement)

Ambient temperature for Design of electrical equipment in non-air conditioned area	:	50^0C
Relative humidity for design of electrical equipment	:	85%
AC Voltage Level For Aux Power Distribution :		11 KV, 3 phase, 3 wire 3.3 KV, 3 phase, 3 wire 415 V, 3 phase, 4 wire
Rated frequency	:	50 Hz.
Voltage & Frequency variation	:	All equipment shall be suitable for Voltage variation of ± 10 %, frequency variation of (+) 3% to (-) 5% and 10% combined variation (sum of absolute values) of voltage and frequency.

The voltage level for motor shall be as follows:

- Above 1500 KW : 11 KV
- Above 160 KW & upto 1500 KW : 3.3 KV

• Upto 160 KW	:	415 V
AC control voltage	:	240 V, 1ph, 50 HZ
UPS Voltage	:	240 V, 1ph, 50 Hz
DC Voltage for motor, protection, control and emergency lighting	:	220 V
DC Voltage for control & instrumentation	:	24 V
AC Voltage for lighting, Space heating	:	240 V, 1ph, 50 Hz
AC emergency supply	:	415V; 3 Ph; 3 wire
DC Voltage variation	:	187 V - 242 V for 220 V DC

Fault levels:

400KV System	:	63kA for 1 sec
33kV System	:	25 kA for 3 sec
11KV System	:	50 kA for 3 sec
3.3KV System	:	40 kA for 3 sec
415V System	:	50 kA for 1 sec
220V DC System	:	25 kA

Grounding:

a).	400KV System	:	Solidly grounded
b).	Generator	:	High resistance grounded through distribution Transformer, transformer secondary loaded with resistor.
c).	11KV System	:	Low Resistance Grounded with Earth-Fault Current limited to 300A
d).	3.3KV System	:	Low Resistance Grounded with Earth-Fault Current limited to 300A
e).	415V System	:	Solidly grounded
f).	220V DC System	:	Ungrounded
g).	Diesel Generator	:	Ungrounded

SECTION – C

SPECIFIC TECHNICAL REQUIREMENTS

CHAPTER – 3

GENERATOR CIRCUIT BREAKER (GCB)

1.00.00 CODES AND STANDARDS

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

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. Disconnector	
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.

2.00.00 SCOPE OF SUPPLY AND SERVICES (REFER BOQ cum PRICE SCHEDULE OF GCB)

2.01.00 EQUIPMENT AND COMPONENTS TO BE SUPPLIED

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

For each GCB, the following shall be provided:

- ~~One (1)~~ Two (2) triple pole circuit breaker, comprising three(3) single phase enclosures, all fully assembled on a common frame with operating mechanism
- ~~Two (2)~~ One (1) triple pole mechanically-ganged motorized disconnectors for series isolation, ~~one~~ on ~~each~~ GT side of the GCB ~~and each provided~~ with a triple pole earth switch, mechanically and electrically interlocked with the disconnector position. The disconnector shall be operable only with open position of the GCB (on each side)
- Three(3) Heavy duty station class surge arresters with operation counter and with surge capacitors, suitable for (18-27) kV rated generator
- ~~Three (3) sets of three (3) single phase voltage transformers on transformer side, each with one primary and two secondary windings~~.
- ~~Set of three (3) single phase voltage transformers on generator side, each with one primary and two secondary windings.~~
- ~~Three(3) Current transformers on transformer side having 3 cores~~
- ~~Three(3) Current transformers on generator side having 3 cores~~
- One(1) three phase short-circuiting and grounding device between the GCB and series disconnector , for performing pre-commissioning tests on generator and protection system
- One (1) Local control panel/cabinet, common to all three phases, for control of GCB and associated disconnectors/earth switches, suitable for receiving commands from and transmitting status information to remote control panel/DCS
- Miscellaneous bolting and gasket material required for all equipment and panels
- Primer painting of external surfaces and corrosion protection of internal surfaces
- Miscellaneous items for field erection, testing, pre-commissioning and performance testing
- Continuous online monitoring device for GCB.
- Temporary elements, if required, for field erection and testing

One set of following shall be provided:

- Spare parts for start-up and testing, until Provisional Acceptance
- Special tools for erection and maintenance
- One(1) set of spare parts recommended for 3 years normal operation

3.00.00 GCB DESIGN AND CONSTRUCTIONAL FEATURE

3.00.01 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.

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 180 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.

3.00.02 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.

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.

3.00.03 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.

3.00.04 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.

3.00.05 Accessories

Each circuit-breaker shall be equipped with

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

3.00.06 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.

3.00.07 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).

3.00.08 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 1.5mm^2 for internal wiring, 2.5mm^2 for motor circuits, internal wiring of instrumentation transformers and 6mm2 for instrument transformers, conventional apparatuses. Terminal marking with connection designation of maximum 3 digits. An active mimic diagram with position indicators integrated in the lighted (LED's) push-button switches for the circuit-breaker, disconnector, earthing switch (es).

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.

3.00.09 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.

3.00.10 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.

3.00.11 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.

3.00.12 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.

3.00.13 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.

3.01.00 DISCONNECTOR

3.01.01 General

i. A disconnector shall be provided on GT side ~~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.

3.01.02 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.

3.02.00 EARTHING SWITCHES

3.02.01 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.

3.02.02 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 contractor may propose any other type of operative mechanism.

3.03.00 INSTRUMENT TRANSFORMERS

3.03.01 Current transformers

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.

3.03.02 Voltage transformers

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.

3.04.00 SURGE PROTECTION EQUIPMENT

3.04.01 Surge arresters

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.

3.04.02 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.

3.05.00 SHORT-CIRCUITING SWITCH FOR RELAY SETTING

3.05.01 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.

3.05.02 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

3.06.00 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.
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 welding and Busbar Through Flexible Connections
vii.	Max. Ambient Temp	50˚C
	Max. Temp. Of Busbar Connections considering silver plated joints	105˚C
viii.	Max. Temp. Of Enclosure Connections	80˚C
ix.	Noise Level	As Per Relevant IEEE Standard
x.	Electro-magnetic Compatibility	As Per Relevant IEEE Standard
II. GENERATOR CIRCUIT BREAKER		
i.	Rated Voltage	21 kV
ii.	Rated Maximum Voltage	1.05 x Generator operating voltage
iii.	Rated Frequency	50 Hz
iv.	Rated Continuous Current	23595A (min.)
v.	Rated Insulation Level	As per IEEE Std. C37.013

vi.	One Minute Power Frequency Withstand Voltage To Earth & Across Circuit Breaker/ Switch Contacts	As per IEEE Std. C37.013
vii.	Lightning i mpulse withstand v oltage t o e arth & across circuit breaker / switch contacts	As per IEEE Std. C37.013
viii.	One Minute Power Frequency Withstand Voltage For Auxiliary And Control Circuits	2 Kv (Rms)
ix.	Number Of Stored Close/Open Operations	2
x.	Short Circuit Capability	160 kA
xi.	Symmetrical Interrupting Capability	160 kA
xii.	Dc Component Of Fault Current	later
xiii.	Short Circuit Making Current	As per IEEE Std. C37.013
xiv.	Rated Peak Withstand Current (Kv Peak)	As per IEEE Std. C37.013
xv.	Rated Short Time Withstand Current (KV Rms, For 3 Sec)	160 kA
xvi.	Interrupting Time (Tripping Command Till Arc Extinction)	As per IEEE Std. C37.013
xvii.	Opening Time (Tripping Command Till Contact Separation)	As per IEEE Std. C37.013
xviii.	Closing T ime (Closing C ommand Till C ontact Touch	As per IEEE Std. C37.013
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	As Per IEC60376 & 61634

xxv.	Operating Mechanism	Hydraulic / Spring Operated
xxvi.	Opening & Closing Coil Voltage	220 V DC
III. DISCONNECTING SWITCH DATA		
i.	Rated Voltage	same as GCB
ii.	Rated Maximum Voltage	as per relevant standard
iii.	Rated Frequency	50 Hz
iv.	Rated Continuous Current	23595A (min.)
v.	Rated Insulation Level - One Minute Power Frequency Withstand Voltage across isolating distance of disconnector - Lightning I mpulse Withstand V oltage Across isolating distance of disconnector	as per relevant IEC
vi.	Rated S hort T ime Withstand C urrent (kA F or 3 Sec)	160kA
vii.	Rated Peak Withstand Current (kA Peak)	as per relevant standard
viii.	Operating Time (Sec)	as per relevant standard
ix.	Operating Mechanism	Electrical Motor Operated/ ~~Manual~~
IV. EARTHING SWITCH		
i.	Rated Voltage	same as GCB
ii.	Rated Maximum Voltage	as per relevant standard
iii.	Rated Frequency	50 Hz
iv.	Rated Insulation Level - Power F requency Withstand V oltage t o earth and across switch contacts - Lightning Impulse W ithstand Voltage t o earth and across switch contacts	as per relevant IEC

v.	Rated Short Time Withstand Current (Ka For 3 Sec)	160kA
vi.	Rated Peak Withstand Current (Ka Peak)	as per relevant standard
vii.	Operating Mechanism	Electrical Motor Operated common for the 3 poles
viii.	Operating Time (Sec)	as per relevant standard
V. SHORT CIRCUIT LINK DATA		
i.	Rated Voltage	to be furnished by the vendor
ii.	Rated Maximum Voltage	
iii.	Rated Frequency	
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		
i.	Quantity	*
ii.	Rated Voltage Ratio	*
iii.	Accuracy	Protection – PS Metering – 5P20
iv.	Rated Burden	*
v.	Secondary Protection	By MCBS
VII. SURGE ARRESTORS		
i.	Location	as per SLD (Annexure-1)
ii.	Voltage Class	later

iii.	Type	Metal Oxide Gapless
iv.	Rating	later
VIII. SURGE CAPACITORS		
i.	Location	as per SLD (Annexure-1)
ii.	Rating	later

4.00.00 LIST OF TESTS TO BE CONDUCTED

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

4.01.00 TYPE TESTS

The type tests shall be in accordance with the relevant standard.

4.02.00 ROUTINE TESTS

1. Gas receiver tests;
2. Pressure tests;
3. Nameplate check;
4. Leakage tests;
5. Resistor, heater, and coil check tests;
6. Control and secondary wiring check tests;
7. Clearance and mechanical adjustment check tests;
8. Mechanical operation tests;
9. Timing tests;
10. Stored energy system tests;
11. Electrical resistance of current path tests;
12. Power frequency withstand voltage tests on major insulation components;
13. Power frequency withstand voltage tests on control and secondary wiring;

4.03.00 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.

1. Leakage tests;

2. Gauge tests;
3. Stored energy system test;
4. Electrical resistance of current path tests;
5. Clearance and mechanical adjustment check tests;
6. Timing tests;
7. Power frequencies withstand voltage tests.

5.00.00 DRAWINGS, DATA & INSTRUCTION MANUALS

The instruction manuals shall provide complete information necessary for the installation, operation and maintenance throughout the life of the equipment.

5.01.00 Drawings & Data to be submitted in quadruplicate with tender:

Refer section-C clause 6.0

i. Typical General Arrangement drawings of the equipment
ii. Dimensional general arrangement drawing showing disposition of various fittings/ terminal connections, etc
iii. Technical leaflets on equipment explaining construction features, principles of operation, special features, etc
iv. Type test on similar equipment
v. Calculation of generator circuit breaker short circuit breaking current.

5.02.00 Documents/ drawings to be submitted after award of contract:

Refer section-C clause 7.0

i. Dimensional general arrangement drawing showing disposition of various fittings, terminal connections, etc
ii. Transport/ Shipping dimensions with weight
iii. Foundation plan & loading
iv. Assembly drawing for erection at site with part numbers & schedule of materials
v. Control schematic & wiring diagram
vi. CT parameters calculations in line with the approved relay schemes.
vii. Any other relevant drawing or data necessary for satisfactory installation.

6.0 DOCUMENTS REQUIRED ALONG WITH TECHNICAL OFFER

Bidder shall submit following documents 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] General Arrangement drawing of GCB showing various dimensions, space required for operation and maintenance, weight etc.

e] Summary of Type tests certificates indicating key test results, clause & standard reference, date and place of testing (As per IEEE)

f] Write up on operating mechanism of GCB.

g] Schedule of deviations

h] Schedule of BOQ-Cum-Price Schedule (**Unpriced**)

i] Schedule of start-up and commissioning spares (**Unpriced**)

~~j] Schedule of Mandatory spares as per Annexure-1 **(Unpriced)**~~

j] Schedule of special tools and tackles **(Unpriced)**

k] Reference list.

7.0 DOCUMENTS REQUIRED AFTER THE AWARD OF LOI

7.1 Bidder shall submit following documents after the award of LOI for approval and distribution:

a] Filled in data sheet – C(Combination of Datasheet-A and Datasheet-B) .

b] Detailed general arrangement drawing of GCB showing various dimensions, space required for operation and maintenance, weights etc. (GA drawing to be complete for GCB and auxiliaries.)

c] Foundation arrangement drawing showing loading, forces at various points etc.

d] General arrangement drawing of local control panel.

e] Logic for closing/tripping of GCB, isolator and earth-switch.

f] Electrical control scheme of local control panel.

g] Drawings for operating mechanism.

h] P & I Diagram.

i] Complete Type tests certificates (as per IEEE)

j] Manufacturing Quality Plan.

k] Field quality plan for equipment storage, handling, erection, testing and commissioning at site, recommended by vendor.

l] O & M Manual.

m] Routine test certificates.

n] Design calculations for support structure

o] Complete detailed calculations for short circuit capability for system side & generator side fault contribution.

7.2 All drawings, documents shall be in English.

7.3 The vendor after LOI shall submit drawings/documents in requisite number of copies as indicated in ATTACHMENT-III ("DOCUMENTS / DRAWINGS DISTRIBUTION SCHEDULE").

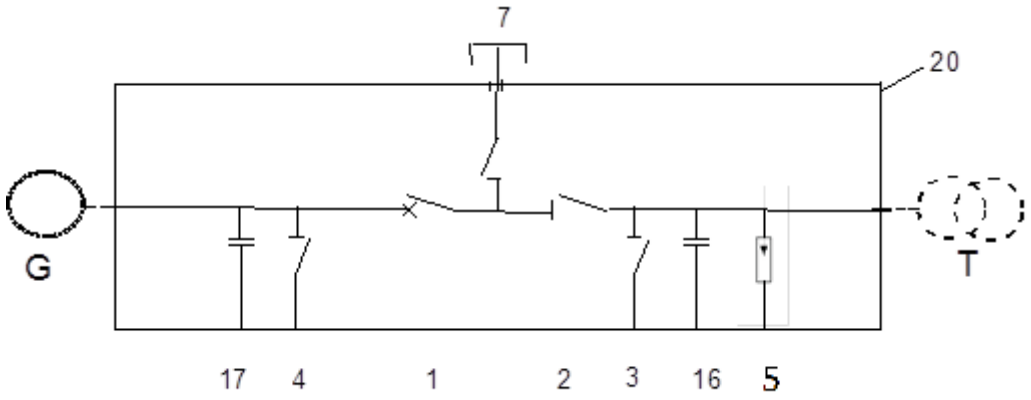
DATA SHEET –A

SL.NO.	PARAMETER	UNIT	VALUE
1.00	**Generator**		
1.01	Rated voltage	kV	21
1.02	Generator voltage variation	±%	5
1.03	Generator rated MW Rating at 50 deg C ambient	MW	660
1.04	Rated power factor		0.85
1.05	Frequency	Hz	50
1.06	Generator Reactances and Time Constants		As per Attachment - II
2.00	**Generator Bus Duct details** **[GCB to comply to these requirements]**		
2.01	Type		Isolated phase busduct
2.02	Maximum continuous current		
	at 50 °C	A	24000 A
2.03	One minute power frequency withstand voltage	kV(RMS)	As per IEEE.
2.04	Impulse withstand voltage	kV(Peak)	As per IEEE.
2.05	Overall diameter of enclosure (Inside)	mm	DDE
2.06	Thickness of enclosure	mm	DDE
2.07	Phase-phase spacing	mm	2000 (Tentative)
2.08	Enclosure material		Al. alloy
2.09	Conductor material		Al. alloy
2.10	Conductor profile		Round
2.11	Cooling of IPBD		Natural
2.12	Pressurization System provided	Yes/No	Yes
2.13	Pressure of air inside the enclosure	mm of water col.mn	100mm water column
2.14	Maximum temperature of enclosure at 50°C	°C	30
2.15	Maximum temperature of silver plated conductor joints at 50°C	°C	55

3.00	**Generator Circuit Breaker details**		
3.01	Minimum continuous current rating at 50 °C	A	23595 A (Minimum)
3.02	Rated voltage	kV	21
3.03	No. of poles	Nos.	3
3.04	Rated short time withstand current [3 sec.]	kA	160
3.05 (a)	Interrupting capacity (symmetrical) at rated voltage and operating duty	kA	160
3.05 (b)	Rated making current (kApeak)	kApeak	As per IEEE
3.06	One minute power frequency withstand voltage	kV(RMS)	As per IEEE
3.07	Impulse withstand voltage	kV(Peak)	As per IEEE
3.08	Location of GCB	Indoor / Outdoor	Indoor
3.09	Quantity of GCB	Nos.	2
3.10	Quantity of Earth Switch per GCB	Nos.	2
3.11	Quantity of Series Isolator per GCB	Nos.	1
3.12	Connection for Gas Turbine Starting circuit required	Yes/No	No
3.13	Configuration of Earth Switch, Series Isolator & Short circuiting connection with switch		As per Attachment - I
4.00	Generator Neutral Earthing		High Resistance (Through Transformer loaded with Resistance on secondary)
5.00	Basic impulse insulation withstand voltage of stato	KVpeak	89 KVp .
6.00	**Type Tests**		
6.01	Validity period of type test reports		Valid type test report for Offered model.
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	**Mandatory Spares**		
7.01	Mandatory Spares to be quoted for this contract	Yes/ No	No

7.02	If yes, list of mandatory spares		AS PER BOQ-CUM-PRICE SCHEDULE (Annexure-1)
8.00	**Auxiliary supplies**		
8.01	DC	V	220
8.02	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).

ATTACHMENT – I



1 Circuit-breaker
2 Disconnector
3, 4 Earthing switches
5 Surge Arrestor
7 Short-circuiting/braking switch
16, 17 Surge capacitors
20 System enclosure

REF. SINGLE LINE CONFIGURATION OF GENERATOR CIRCUIT BREAKER

ATTACHMENT – II
GENERATOR DATA

SL. NO.	DESCRIPTION	UNIT	VALUE
1	RATED POWER	MVA MW	776 660
2	RATED FREQUENCY	Hz	50
3	RATED VOLTAGE	KV	21
4	MINIMUM / MAXIMUM GENERATION VOLTAGE	%	+/-5
5	RATED POWER FACTOR		0.85
6	REACTANCE VALUE (SATURATED):		
	SYNCHRONOUS REACTANCE, DIRECT AXIS, Xd	pu	2.441(Unsaturated)
	TRANSIENT REACTANCE, DIRECT AXIS, Xd'	pu	0.302
	SUB TRANSIENT REACTANCE, DIRECT AXIS, Xd"	pu	0.202
	SYNCHRONOUS REACTANCE, QUADRATURE AXIS, Xq	pu	2.319(Unsaturated)
	TRANSIENT REACTANCE, QUADRATURE AXIS, Xq'	pu	0.701
	SUB TRANSIENT REACTANCE, QUADRATURE AXIS, Xq"	pu	0.222
	ZERO SEQUENCE REACTANCE	pu	0.1062
7	TIME CONSTANTS (SHORT CIRCUIT TIME CONSTANTS):		
	TRANSIENT TIME CONSTANT, DIRECT AXIS, Td'	s	0.855
	SUB TRANSIENT TIME CONSTANT, DIRECT AXIS, Td"	s	0.029
	TRANSIENT TIME CONSTANT, QUADRATURE AXIS, Tq'	s	0.836
	SUB TRANSIENT TIME CONSTANT, QUADRATURE AXIS, Tq"	s	0.07
	ARMATURE TIME CONSTANT	s	0.326
8	SPEED	rpm	3000

ATTACHMENT – III

No. of prints to be submitted by vendor after award of contract shall be as under:

S. NO.	DESCRIPTION	No. hard /soft copies	No. of CD-ROMs	REMARKS
1	Docs. /drgs. for approval (First submission)	PDF File + 5 Hard copies	NIL	
2	Drgs. / docs. for approval (Second & subsequent submission till approval)	PDF File + 5 Hard copies	NIL	
3	Final approval drgs. / docs. for Distribution after CAT-1.	PDF File + 10 Hard Copies	1 CD-ROM	
4	As Built drgs./doc.	10 Hard Copies	6 CD-ROMS	
5	Operation, Erection & Maintenance manual for approval	PDF File + 2 Hard Copies	NIL	
6	Approved Operation & Maintenance Manual for distribution	PDF File + 10 Hard Copies	6 CD-ROMS	
7	Type Test Certificates/ Reports for approval	PDF+ 2 hard Copies	NIL	
8	Type Test Certificates/ Reports for distribution	10 hard Copies	6 CD-ROMS	

2 X 660 MW ENNORE STPS

BOQ-CUM-PRICE SCHEDULE OF GENERATOR CIRCUIT BREAKER

SL. NO.	ITEM CODE	MAIN ITEM DESCRIPTION	UNIT	QTY.	UNIT PRICE	TOTAL PRICE	REMARKS
1.0	510-11003-A	GENERATOR CIRCUIT BREAKER INCLUDING ALL ASSOCIATED SERIES ISOLATOR, EARTH-SWITCHES, SHORT CIRCUITING CONNECTION LINK, SURGE CAPACITORS AND CONTROL PANEL ALONGWITH ITEM AT S.NO. 1.0(a)	SET	2			
1.0(a)	510-11042-A	CONTINUOUS ONLINE MONITORING SYSTEM FOR GCB	SET	2			BIDDER TO INDICATE UNIT PRICE
2.0	510-11006-A	O&M SPARES (FOR 3 YEARS OPERATION)	LOT	1			BIDDER TO FURNISH THE LIST
3.0	510-11007-A	START-UP AND COMMISSIONING SPARES *	LOT	1			BIDDER TO FURNISH THE LIST
4.0	510-11008-A	SUPERVISION OF ERECTION, TESTING AND COMMISSIONING					
4.0(a)		CHARGES PER VISIT	VISIT	1			REFER NOTE-1 & 2
4.0(b)		MANDAYS CHARGES	DAYS	4			REFER NOTE-1 & 2
5.0	510-11011-A	SPECIAL TOOLS AND TACKLES **	LOT	1			BIDDER TO FURNISH THE LIST
6.0	510-11012-A	TRAINING OF 6 NOS. ENGINEERS	SET	1			FOR OPERATION, TROUBLESHOOT AND MAINTENANCE AS PER CLAUSE 9.00.00 (SECTION-D) OF SPECIFICATION. REFER NOTE 4.

NOTES

1 FOR EACH GCB 1(ONE) VISIT AND 4(FOUR) MANDAYS TO BE CONSIDERED. THE PRICES SHALL BE INCLUSIVE OF CHARGES OF AIRFARE, BOARDING/LODGING, VISA, MEDICAL, INSURANCE ETC.

2 AMOUNT PAYABLE PER VISIT = VISIT CHARGES AS PER SL. NO. 4.0(a) ABOVE (+) MANDAYS CHARGES AS PER SL. NO. 4.0(b) ABOVE (x) NO. OF DAYS AT SITE(TO BE CERTIFIED BY BHEL SITE)

3 WHEREEVER SET IS INDICATED ABOVE, IT MEANS THE TOTAL PARTS/ACCESSORIES REQUIRED TO REPLACE THE PARTICULAR ITEM FOR A GIVEN EQUIPMENT.

4 * START-UP AND COMMISSIONING SPARES SHALL INCLUDE SPARES FOR TESTING AS MINIMUM REQUIREMENT

5 ** SPECIAL TOOLS & TACKLES SHALL ALSO INCLUDE THE FOLLOWING AS MINIMUM REQUIREMENT:-

a) MISCELLANEOUS ITEMS FOR FIELD ERECTION, TESTING, PRE-COMMISSIONING AND PERFORMANCE TESTING

b) SPECIAL TOOLS FOR ERECTION AND MAINTENANCE

6 FOR TRAINING, COST OF AIRFARE (TO & FRO), BOARDING, LODGING, VISA, MEDICAL, INSURANCE SHALL BE BORNE BY PURCHASER.

DEVIATION SCHEDULE

SL. NO.	PAGE NO.	CLAUSE NO.	DEVIATION	REASONS FOR DEVIATION

It is certified that the offer is fully in conformance to the specification requirements except for the deviations which are specifically brought out in the above prescribed Deviation Schedule.

Signature & seal of Bidder's authorized representative

SECTION – D
GENERAL TECHNICAL REQUIREMENTS

CONTENTS

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.
- 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.

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 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.

Necessary terminals shall be provided for connection of trip coil supervision relays provided in Generator Relay Panels.

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.

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 IEEE C37.013 latest version.

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 IEC129.

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 IEC129.

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:

GCB	:	12NO + 12NC
Each Isolator	:	6NO + 6NC
Each Earth Switch	:	6NO + 6NC

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

2.20.00 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.

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 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'

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 10%.

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-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 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.

2.29.00 Bidder to ensure that the equipment offered has been in successful operation after commissioning at two different power plants for at least two years as on date of this enquiry.

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 IEC-129.

Type tests should have been conducted within last five years as on date indicated in Data Sheet –A/Sec-C.

Any specific requirement of conducting type tests against this enquiry is included in Data Sheet – A/Sec-C.

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.

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.

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 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, disassembly, 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.

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 DOCUMENTS REQUIRED ALONG WITH TECHNICAL OFFER

Bidder shall submit following documents alongwith 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] Verification checks for short circuit capability for generator side fault contribution (refer clause 2.27.00 of this specification).

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 start-up and commissioning spares. (Unpriced)

j] Schedule of Mandatory spares. (Unpriced)

k] Schedule of O/M spares (Recommended) for 3 years of plant operation. (Unpriced)

l] Schedule of special tools and tackles. (Unpriced)

m] Reference list.

11.00.00 DOCUMENTS REQUIRED AFTER THE AWARD OF LOI

Bidder shall submit following documents after the award of LOI for approval and distribution:

a] Filled in data sheet.

b] Detailed general arrangement drawing of GCB showing various dimensions, space required for operation and maintenance, weights etc. (GA drawing to be complete for GCB and auxiliaries.)

c] Foundation arrangement drawing showing loading, forces at various points etc.

d] General arrangement drawing of local control panel.

e] Logic for closing/tripping of GCB, isolator and earth-switch.

f] Electrical control scheme of local control panel.

g] Drawings for operating mechanism.

h] P & I Diagram.

i] Type tests certificates.

j] Manufacturing Quality Plan.

k] Field quality plan for equipment storage, handling, erection, testing and commissioning at site, recommended by vendor.

l] O & M Manual.

m] Routine test certificates.

11.01.00 All drawings, documents shall be in English.

11.02.00 The vendor after LOI shall submit drawings/documents in requisite number of copies as indicated in ATTACHMENT-V ("DOCUMENTS / DRAWINGS DISTRIBUTION SCHEDULE").

12.00.00 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.

12.01.00 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.

12.02.00 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.

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

12.04.00 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.

13.00.00 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.

DATA SHEET –B

TECHNICAL PARTICULARS

[*TO BE SUBMITTED ALOGWITH TECHNICAL OFFER*]

SL.NO.		SPECIFIED	OFFERED
GENERATOR CIRCUIT BREAKER			
1.01	a. Manufacturer		
	b. Country of Manufacture		
	c. Type Designation		
1.02	Applicable Standard	ANSI/IEEE (C37.013)	
1.03	Rated voltage (kV)		
1.04	Rated frequency	50Hz	
1.05	Rated continuous current (A) at ambient temperature of: 40°C 50°C		
1.06	Interrupting medium	SF6	
1.07	Breaking capability		
i)	System source fault		
	a) Rated symmetrical breaking current (kA rms)		
	b) Rated asymmetrical breaking current (kA rms)		
	c) DC component		
ii)	Generator source fault		
	a) Rated symmetrical breaking current (kA rms)		
	b) Rated asymmetrical breaking current		

	(kA rms)		
	c) DC component		
	d) Suitablity of GCB checked with Generator data.	Yes/ No	
1.08	Rated making current (kApeak)		
1.09	Rated duty cycle	CO -30 - CO	
1.10	Rated impulse withstand voltage (kVpeak)		
1.11	Rated Power frequency `dry test' withstand voltage: Earth (kVrms): Across the pole (kVrms):		
1.12	Type of cooling		
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	Voltage rating of motor driven pumps (in hydraulic mechanism)		
1.17	No. and KW rating of motor driven pumps		
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 (A) under natural cooled conditions which can be carried by GCB at following ambient temperatures:		

	--°C --°C --°C --°C 50°C		
1.21	Nominal Ratings of the basic model quoted: Normal current (A): Normal voltage (kV): Fault current (kA): Making current (kApeak): Dielectric withstand voltage (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?		
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		
1.33	Emergency current rating during loss of coolant (if applicable)		
1.34	Time available at rated current before load reduction		
1.35	Rate at which load current should be reduced		
1.36	Reduced continuous operating current		
1.37	Rated voltage range factor K		
1.38	Rated short circuit duty cycle		
1.39	Rated permissible tripping time		
1.40	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:		
1.41	Minimum creepage distance		
1.42	Clearance in air of live parts - phase to earth		
1.43	a) Control circuit suitable for aux. supply voltage of b) Mechanism motor suitable for aux. supply voltage of		

1.44	Value of capacitor included in GCB on generator transformer 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: Generator 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 f) Rated frequency g) Rated normal current at 50 deg C h) Rated short time withstand current 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?		
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 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?		
1.54	a) Whether all type tests have been conducted on GCB as per ANSI/IEEE C37.013 latest version? 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 129? 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 129? b) Summary of Type test reports for earth-switch enclosed as Annex. No.		

1.59	a) Project sites and dates of commissioning of GCBs of same model and type (as quoted in 1.01 of this data sheet) - indicate for two earliest installations b) Does the equipment offered meet requirements of clause 2.29.00 of this specification		

	(Service)	
3.00.02	Tentative dimensions control panel/desk	mm
3.00.03	Detail of components	Make & Type
3.00.04	Contactors (Furnish details for AC & DC separately)	
3.00.05	Timers (Furnish details for AC & DC separately)	
3.00.06	Relay (Furnish details for AC & DC Relays separately)	
3.00.07	Control switch	
3.00.08	Push button	
3.00.09	Ammeter/voltmeter selector switches	
3.00.10	Indicating lamps	
3.00.11	Space heater	
3.00.12	Terminal blocks	
3.00.13	Indicating Instruments	
3.00.14	Wires	
3.00.15	Panel	
3.00.16	Annunciator	
3.00.17	Whether detail write-up of the scheme furnished	
3.00.18	Details of mimic diagram	
2.00.00	**Generator Circuit Breaker**	
1.00.00	**General**	
1.01.00	Rated maximum voltage :	KV,rms

DATASHEET - C

1.02.00	Rated frequency	Hz
1.03.00	Rated continuous current: natural cooled Limiting conditions*	A
	a. Installation	
	b. Ambient temperature	°C
	c. Temperature of busbar connection	°C
	d. Temperature of busbar enclosure	°C
	* Service currents for other conditions, e.g.outdoor, on request	
1.04.00	Rated insulation level: Power frequency, 1 min	
	a. to earth and across circuit-breaker/ switch contacts	kV,rms
	b. phase enclosure to ground/earth	kV,rms
	impulse, 1.2/50 µs wave	
	c. to earth and across circuit-breaker/switch contacts	kV, peak
	d. across isolating distance of disconnector	kV, peak
1.05.00	Seismic acceleration withstand	IEC 61166
1.06.00	Degree of protection:	
	a. Control cubicle and mechanism	IEC 60529
	b. Phase enclosure Installation, horizontal	IEC 60529
1.07.00	Circuit-breaker	IEEE (ANSI) C37 013
1.08.00	Rated short-circuit	kA, rms
1.09.00	System-source interrupting capability	
	a. Symmetrical	kA, rms
	b. Degree of asymmetry	%
	c. Transient recovery voltage (TRV) rating	kV/µs
1.10.00	Generator-source interrupting capability	
	a. Symmetrical	kA, rms
	b. degree of asymmetry	
	c. Transient recovery voltage (TRV) rating	kV/µs
1.11.00	Out of-phase interrupting capability (180°)	
	a. Symmetrical	kA, rms

DATASHEET - C

	b. degree of asymmetry		
	d. Transient recovery voltage (TRV) rating	kV/μs	
1.12.00	Load current interrupting capability		
	a. Symmetrical	A, rms	
	b. Transient recovery voltage (TRV) rating	kV/μs	
1.13.00	Closing, latching, and carrying capability	kA, peak	
	Short-time current-carrying capability *	kA,peak	
	Rated duty cycles		
	a. short-circuit		
	b. load currents up to rated current		
	c. mechanical		
1.14.00	Interrupting time (till arc extinction)	ms	
1.15.00	Opening time (till contact separation)	ms	
1.16.00	Closing time (till contact touch)	ms	
1.17.00	Service capability/maintenance		
	a. short-circuit current interruptions, 160kA	CO	
	b. rated current interruptions, 10000A	CO	
	c. mechanical and currents up to 1000A	CO	
	d. elapsed time in service	years	
	f. Excitation current switching capability (no -load transformer)		A, rms
1.18.00	Control voltage	VDC	
1.19.00	Operating mechanism		
	a. Type		
	b. Pump motor, 220VDC or AC	W	
	c. Number of stored operations	CO	
1.20.00	SF6 gas		
	a. filling pressure at 20°C	k Pa	
	b. leakage rate	%/a	
1.21.00	Noise level, at 1.5m distance	IEC 60651	dB peak
1.22.00	Disconnector	IEC 60129	
1.23.00	Peak withstand current	kA, peak	

DATASHEET - C

1.24.00	Short-time withstand current*	kA/3s
1.25.00	Operating time, close or open	s
1.26.00	Operating mechanism: motor, 3x380V, 3-phase	W
1.27.00	Service capability a. mechanical b. elapsed time in service	 CO years
1.28.00	Capacitor	IEC 60358
1.29.00	Capacitance (transformer side)	µF
1.30.00	Capacitance (generator side)	µF
1.31.00	Rated voltage	µF

S.no	Description	
3.00.00	**400 kV GIS**	
1.01.00	Type of GIS	
1.02.00	Location	
1.03.00	Maximum ambient temperature	
1.04.00	Minimum ambient temperature	
1.05.00	Nominal voltage class, kV rms	kV
1.06.00	Rated voltage	kV
1.07.00	Rated frequency	Hz
1.08.00	Number of phases	
1.09.00	Number of busbars	
1.10.00	Rated normal current at 50 Hz, A, rms	A
1.11.00	Rated short circuit current at rated Maximum voltage, not less than, kA, rms (Symmetrical)	kA
1.12.00	Lightning impulse withstand voltage (phase to phase and phase to earth) At minimum operating gas pressure	kVp
1.13.00	Switching impulse withstand voltage	kVp
1.14.00	1 minute power frequency withstand	