GUJARAT STATE ELECTRICITY CORPORATION LIMITED.

1 X 800 MW WANAKBORI TPS

VOLUME – II

TECHNICAL SPECIFICATION FOR

GENERATOR CIRCUIT BREAKER (GCB)

BHEL DOCUMENT NO. : PE-TS-408-510-E001
REV-0

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

CONTENTS

TOTAL NO. OF SHEETS = 79 (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. 9.0 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 FOB European port 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 **1 X 800 MW WANAKBORI TPS**

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

6.0 The documents shall be in English language and MKS system of units.

SECTION – B
(PROJECT INFORMATION)

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Supercritical Thermal Power Project would be set up by Gujarat State Electricity Corporation Limited (GSECL) at Kheda district of Gujarat.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

The proposed site is located in Kheda district about 13 kilometers from the nearest commercial town of Balasinor & 10 kilometers from Sevalia town. The National Highway, NH-08, connecting Dakor – Godhra is about 10 kilometers from the site. The State Highway SH – 59 connecting Balasinor – Sevalia is about 2 Kilometers from the site. Nearest railway station to the existing site is Sevalia, located about 8 kilometers from the site on Anand – Godhara main broad gauge line of Western Railway.

Nearby Air Ports are Ahmedabad at a distance of about 110 kilometers from the site and Vadodara at a distance of about 85 kilometers from the site.

3.00.00 LAND

The proposed extension unit will be developed in the existing Wanakbori Thermal Power Station and will be located north east side of the existing plot in the Kheda District of Gujarat. The land of the proposed plant will be filled in upto a desired level. Existing Ash Pond/ Dyke area will be utilized for the extension unit.

4.00.00 SOURCE OF COAL

Indian coal would be sourced from captive mines Machha Kata in Talcher, State – Orissa which are situated about 1800 Kms from the project site. GSECL will arrange for transportation of the coal required for the extension unit from these captive mines by the existing railway facilities for delivery of coal supply to the Wanakbori power station.

SECTION - C

CONTENT

TECHNICAL SPECIFICATION
FOR
GENERATOR CIRCUIT BREAKER

1.00.00 **SCOPE OF WORK** : For scope of supply refer "BOQ cum price schedule of Generator Circuit Breaker" and Annexure-1 for "Mandatory spares" list.

1.01.00 **Scope of Supply**

Type and rating of the equipment listed below are detailed in the annexure-A The equipment shall be offered in strict compliance with the same.

27kV, 22500A, 160kA Generator Circuit Breaker (GCB) Assembly : One (1) set

2.01.02 Following Auxiliary equipment shall be supplied

a. One (1) set of Portable SF6 gas evacuating & filling equipment

b. Two (2) sets of SF6 gas leakage detectors

c. One (1) set of Circuit Breaker operation analyzer.

2.01.03 One (1) set of special tools and tackles.

2.01.04 Mandatory spare parts.

2.01.05 Recommended spare parts for three (3) years continuous operation.
(Only unpriced list to be provided for recommended spares)

2.01.06 All relevant drawings, data and instruction manuals.

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2.00.00 **GENERAL REQUIREMENTS**

2.01.00 **Codes and Standards**

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

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

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

3.00.00 **DESIGN CRITERIA**

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

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

3.03.00 The Generator Circuit Breaker shall be capable of continuous operation under the following condition :

- Voltage variation : ± 10%
- Frequency variation : ± 5%
- Combined voltage and frequency variation (absolute sum) : 10%

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

- Start up of the turbo-generator auxiliaries via its unit transformers with the Generator circuit breaker is open condition and by back charging Generator Transformer.
- Carry the maximum full load current of the Generator continuously
- Paralleling of the Generator with external network i.e. with grid or other generating units
- Disconnection of the generator from the system under various loading conditions ranging from no load to full load
- Make and break generator-source feed short-circuit currents
- Make and break system-source feed short-circuit currents

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

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

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

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

3.09.00 Each pole of the Circuit Breaker, series disconnectors, earth switch and additional components, if any specified in Annexure-A, shall be mounted in single phase non-magnetic aluminum ~~alloy~~ enclosures. The three single

phase enclosures along with the Control box housing the operating mechanism, supervisory and control equipment shall be factory assembled on a common frame.

3.10.00 The enclosure shall be able to carry the induced reverse current flowing through the isolated phase bus duct. All enclosure connection to isolated phase bus duct shall be welded or via a bellow to provides a physically and electrically continuous ducting connection to the generator and the transformer.

3.11.00 The distance among the centre line of the phase enclosures shall be such that it matches with the bus duct spacing. The exact dimension and center-to-center spacing of the isolated phase bus duct shall be intimated to the successful bidder.

3.12.00 The Circuit Breaker movement during short circuit shall be restricted so as to limit the stresses on Circuit Breaker support insulators within their capabilities.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **Type and Duty**

4.01.01 The Generator Circuit Breaker shall consist of three (3) nos. single-pole interrupter housed in sulphur hexaflouride (SF6) breaking chambers.

4.01.02 The duty of the Circuit Breaker shall involve satisfactory interruption of short circuit currents as listed in the Annexure-A.

4.01.03 The breaker shall be suitable for operation under out of phase condition arising out of faulty synchronization.

4.01.04 Breakers with multi-break interruptions shall be so designed that the voltage developed across a pole is uniformly distributed over the power breaks.

4.02.00 **Constructional Feature**

4.02.01 Each Generator circuit-breaker shall comprise of three (3) identical poles complete with auxiliary components housed in single phase enclosures, all fully assembled on a common frame with mechanical gang operated mechanism.

4.02.02 All poles of the circuit breaker shall be maintained at the same SF6 density by a suitable balancing connection via the refilling pipe. The SF6 gas density shall be monitored and regulated by temperature compensated gas density monitoring devices, which shall be mounted at a convenient and easily approachable location. The device shall signal loss of SF6 gas in several steps for refilling, alarm and blocking annunciation. The system shall also be provided with a Gas density meter.

4.02.03 The Circuit Breaker shall have proper sealing so that leakage of gas outside is not more than 1% per annum under all conditions of operation.

The operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals. All gasketted surfaces shall be

smooth, straight and reinforced, if necessary, to minimize distortion and make a tight seal

4.02.04 SF6 breakers shall be furnished with first charge of SF6 gas, plus 15% additional quantities of SF6 gas required for complete lot.

4.02.05 The SF6 gas shall be supplied in properly treated steel cylinder of adequate strength. Chemical analysis of gas supplied shall be furnished for Owner/Purchaser's reference.

4.02.06 The Circuit Breaker units shall be complete with associated valves, piping, gauges, seals, lubricants and other accessories/materials to ensure their proper assembly and functioning.

4.02.07 Suitable provisions shall be made for connection with Isolated Phase Bus-ducts (IPB) through flexible connection.

4.03.00 **Power Contacts**

4.03.01 The Circuit Breaker shall have two separate power contact systems, one for carrying the normal load current and one for arc interruption.

4.03.02 The main contacts shall have adequate area and contact pressure for carrying rated continuous and short time current without excessive heating liable to cause pitting and welding.

4.03.03 The contacts shall be easily replaceable and shall have minimum movable parts and adjustments.

4.04.00 **Auxiliary Contacts**

4.04.01 Each breaker shall be provided with minimum 12(Twelve) normally open (NO) and 12(Twelve) normally closed (NC) electrically separate spare auxiliary contacts, in addition to those required for its own operation and indication.

4.04.02 The auxiliary contacts shall be convertible type so that normally open (NO) contacts can be converted into normally close (NC) contact and vice versa at site.

4.04.03 The auxiliary contacts shall be rated 10A at 240 V A.C. and 2A at 220 V D.C.

4.05.00 **Interlock**

4.05.01 All electrical and mechanical interlocks, which are necessary for safe and satisfactory operation of the Circuit Breaker, shall be furnished.

4.05.02 Breaker operation shall be locked in case of low SF6 gas density and/or low control fluid pressure at preset values. Alarms shall be provided for low gas density and low control fluid pressure at values higher than lockout density of SF6 gas and/or fluid pressure.

4.05.03 Gas density monitoring contacts, pressure switch contacts, etc. shall be suitable for direct use as permissive in closing, tripping, annunciation and control circuits.

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DC supplies for all auxiliary circuits shall be monitored and provision shall be made for remote annunciations.

4.06.00 **Operating Mechanism**

4.06.01 Circuit Breaker operating mechanism shall be pneumatically or hydraulically controlled spring energy storage type or spring operating mechanism . Anti-pumping and trip free features complete with 2x100% shunt trip coils shall be provided. The mechanism of the breaker shall be such that the position of the breaker is maintained even after leakage of operating media and/or gas.

4.06.02 All three breaker poles shall close simultaneously.

4.06.03 The mechanism shall be designed for electrical control from remote as well as local position. In addition local manual trip button shall be provided.

4.06.04 Operation counters and mechanical ON-OFF indicator shall be provided for the breaker.

4.06.05 The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.

4.06.06 Circuit Breaker shall be provided with two (2) independent tripping circuits, and trip coils. The trip coils shall be suitable for trip circuit supervision during both open and close positions of the breaker.

4.06.07 **Hydraulic Operated mechanism**

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

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

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

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

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

4.06.08 **Pneumatically Operated Mechanism**

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

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

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

i) From minimum operating pressure to maximum operating pressure within 5 minutes of operation.

ii) From atmospheric pressure to maximum operating pressure within 15 minutes of operation.

iii) Normal running air-charging time for the compressor shall not exceed 15 minutes considering 10% leakage/day

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

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

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

4.07.00 **Control Cubicle**

4.07.01 A common control cubicle shall be furnished to house electrical, controls, monitoring devices. The Control cubicle shall be mounted on the C.B system supporting frame work.

4.07.02 The cubicle shall be wired up to suitable terminal block for cable connection..

4.07.03 The cubicle shall have front access door with lock and removable gland plate at the bottom for Owner/Purchaser's cable entry.

4.07.04 An active Mimic with the actual position indications and the integrated local controls of the Circuit Breaker, disconnect switches and earth switches shall be provided at the front.

4.07.05 LOCAL/REMOTE selector switches for Circuit Breaker, disconnect switches and earthing switches, Operation counters and local alarms for faults/ troubles shall be provided in the Control Cubicle.

4.07.06 Potential free contacts shall be provided in the cubicle for the following remote annunciations and indications as a minimum.

ALARMS

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

INDICATIONS

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

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

4.08.00 **Disconnecting switch and earthing switch**

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

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

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

4.08.03 Operating mechanism of the above switches shall be motorized. Electrical motors shall be suitable for 3 phase, 50HZ, 415 V ± 10% A.C.

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

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

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

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

4.09.00 **Short circuit devices**

4.09.01 The Circuit Breaker system shall be equipped with short circuit link (for relay testing).

4.09.02 The short circuit link shall be installed between the Circuit Breaker and the disconnecting switch in order to actuate the 3 phase unearthed short circuit on the generator terminals by closing the Circuit Breaker.

4.09.03 The short circuit link shall be manually mounted by removing the specific doors on the Circuit Breaker system phase enclosures.

4.10.00 **Instrument Transformers**

4.10.01 The voltage transformer shall be three single phase cast-resin type, suitable for nominal operation connected from line to ground, and for 1.73 times rated line to ground voltage under sustained emergency condition.

4.10.02 The high voltage winding of the voltage transformer shall be protected by current limiting fuse mounted on top of the primary bushing.

4.10.03 The secondary leads from the voltage transformer shall be extended to Miniature circuit breaker (MCB) and then to separate terminal block mounted on the Control cubicle. Facility for making the star points shall be kept at the Control cubicle.

4.12.00 **Wiring**

4.12.01 Wiring shall be complete in all respects to ensure proper functioning of the control, protection, and monitoring and interlocking schemes.

4.12.02 DC circuit for trip coil 1 & 2 shall be wired separately so as to connect with duplicate DC supply.

4.12.03 Wiring shall be done with flexible 650V/1100V grade, PVC insulated, fire resistant, switchboard wires with 2.5 mm^2 stranded copper conductor. Wiring between individual poles and control cubicle shall be routed through G.I. / PVC rigid conduits.

4.12.04 Each wire shall identified at both ends with permanent markers bearing wire numbers as per Contractor's wiring diagram.

4.12.05 Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

4.12.06 All spare contacts of relays, push buttons, auxiliary switches etc. shall be wired upto terminal blocks in the control cubicle.

4.12.00 **Terminal blocks**

4.12.01 Terminal blocks shall be 650V/1100V grade, enclosed clamp type with engraved numbers suitable for termination of at least two numbers of 2.5 mm^2 stranded copper conductor.

4.12.02 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.

4.12.03 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

4.13.00 **Sulphur Hexafluoride (SF6) Gas**

4.13.01 The SF6 gas shall be new and comply with relevant IEC/IS and shall be suitable in all respects for use in the Circuit Breakers under the various operating conditions.

4.13.02 SF6 gas shall be tested for quality, dew point, air, hydrolysable fluorides and water content as per IEC quoted above and test certificates shall be furnished covering all tests for each lot of SF6 gas.

4.13.03 The use ,handling & storage of SF6 gas shall comply with requirements of relevant IEC/IS.

4.14.00 **Auxiliary Equipment**

4.14.01 A Portable SF6 gas filling and evacuating system shall be supplied with necessary gas valves, safety devices, gas purity monitoring devices, regulators, vacuum pump, pressure gauges/switches, hose pipes etc.

4.14.02 The sensing probe of SF6 gas leaked detector shall be able to reach all the points on the breaker where leakage is to be sensed. The accuracy of the equipment shall be at least 10 ppm. It shall be free from induced voltage effect.

4.14.03 An Operational Analyzer shall be supplied to record contact travel, speed and for making measurement of operating timings, ~~synchronization of contacts in one pole or all poles.~~

4.15.00 **Name Plate**

4.15.01 Each Circuit Breaker and its operating devices and accessories shall be provided with name plate clearly marked the particulars in accordance with IEEE Std. C37.013 -1997

4.15.02 Instruction and Warning signs shall be provided in accordance with IEEE Std. C37.013 -1997

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

5.00.00 TESTS

5.01.00 **Routine Test**

During manufacture and on completion, Generator Circuit Breaker shall be subjected to the routine tests (Production tests) as laid down in IEEE

Standard C37.013-1997. The disconnecting switches, earthing switches, surge arrester and surge capacitors shall be subjected to routine tests as laid down in relevant IS/IEC standard.

5.02.00 **Type Tests**

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

5.03.00 **Test Witness**

Routine Tests shall be performed in presence of Owner/Purchaser's representative.

5.04.00 **Test Certificates**

5.04.01 Certified reports of all the tests carried out at the works shall be furnished in required number copies for approval of the Owner/Purchaser.

5.04.02 The equipment shall be dispatched from works only after receipt of Owner/Purchaser's written approval of the test reports.

5.04.03 Routine test certificates of bought out components shall be furnished

5.04.04 Type test certificate on any equipment or component if so desired by the Owner/Purchaser, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

6.00.00 DRAWINGS, DATA & MANUALS

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

6.02.00 **Documents to be submitted after award of LOI. (In addition to required in Clause no. 10 below)**

6.02.01 Typical general arrangement drawings of the equipment.

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

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

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

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

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

6.03.03 Foundation plan and loading.(A)

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

6.03.05 Control schematic (A) and wiring diagrams (A)

6.03.06 Symmetrical and asymetrical short circuit current calculation for three phase fault at generator terminals, according to IEEE Std. C37.013, on the basis of the generator and system.

6.03.07 Out of phase current calculation for 90^0 out of phase condition, according to IEEE Std. C37.013, on the basis of the generator and system.

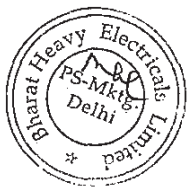
6.03.08 Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance.

6.03.09 Instruction manuals on Circuit Breakers and its accessories.(R)
The manual shall clearly indicate method of installation, check ups and tests to be carried out before commissioning of the equipment.

6.04.00 The drawings and documents marked with (A) above are of 'Approval' category and are subject to review by Owner/Purchaser. Those marked (R) are for 'reference' category.
The Owner/Purchaser may review the documents marked (R) if thought necessary. The GCB supplier shall note that the approval of drawings & documents by the Owner/Purchaser does not relieve him of his contractual obligation.

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

6.06.00 All drawings shall be prepared by using AutoCAD and documents shall be generated using Electronic version. The paper copy of the drawings & document shall be submitted for approval & reference. All final drawings and documents shall be submitted in CD in Auto CAD (approved version) and MS office format as applicable for Owner/Purchaser's future reference.
No. of prints shall be as per Attachement-III



ANNEXURE-A

RATINGS & REQUIREMENTS

GENERATOR CIRCUIT BREAKER ASSEMBLY

1.0	Type	:	Enclosed
2.0	Service	:	Indoor
3.0	P o l e	:	3
4.0	Mounting	:	Horizontal
5.0	Location	:	In between Generator & Generator Transformer, connected to isolated phase bus duct system at both ends.
6.0	Enclosure :		
6.1	Construction	:	3 single phase enclosures assembled on common frame with control cubicle
6.2	Material	:	Aluminum alloy
6.3	Degree of Protection	:	IP-54/ IP-55
6.4	Phase spacing		
	▪ Minimum	:	During detail engineering
	▪ Maximum	:	
7.0	Design ambient temperature °C	:	50
8.0	Additional components		
8.1	Line Disconnect Switch	:	Yes
8.2	Earthing switch – GT side	:	Yes
8.3	Earthing switch – Generator side	:	Yes
8.4	Voltage Transformer – GT side	:	Yes
8.5	Voltage Transformer – Generator side	:	~~Yes~~
8.6	Current Transformer	:	~~Yes (As per project drawing)~~
8.7	Surge Arrester – GT side	:	~~Yes~~
8.8	Surge Capacitor – GT side	:	Yes (For limiting TRV)
8.9	Surge Capacitor – Generator side	:	Yes (For limiting TRV)
8.10	Manual short circuiting connection	:	Yes
8.11	Motorized short circuiting switch	:	~~Yes (Optional)~~

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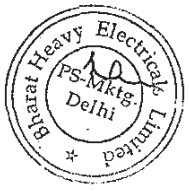
9.0	Cooling	Natural / Forced	:	Natural
10.0	Rated Voltage	kV rms	:	27kV
11.0	Rated Frequency	Hz	:	50 ± 5%
12.0	Rated continuous current	Amp	:	22500A
13.0	Reference Standard		:	IEEE Std.C37.013--IEC-60529, 61166

GENERATOR CIRCUIT BREAKER

1.0	Type		:	SF6
2.0	Operating Mechanism	:		Hydraulic / Pneumatic, Stored energy, Gang operated /Spring
3.0	No. of poles		:	Three
4.0	Rated Maximum Voltage	KV rms	:	1.05 times of the rated voltage of Generator (minimum) (Generator rated voltage is 27kV)
5.0	Rated Frequency	Hz	:	50 ± 5%
6.0	Rated continuous current at site condition	Amps	:	22500A
7.0	Reference Standard		:	IEEE Std.C37.013--IEC-60694
8.0	Rated Insulation			
8.1	Full wave Impulse withstand voltage (1.2 x 50µs wave) KV peak		:	125kV peak
8.2	Rated one minute power frequency withstand voltage		:	60kV rms
9.0	Rated short circuit duty cycle		:	CO – 30 min - CO
10.0	Rated interrupting time	ms	:	60 - 90
11.0	Rated Making & Breaking Capacity		:	
11.1	Rated Short-circuit breaking current (Symmetrical)	KA rms	:	160KA
11.2	Rated short-circuit making current	KA peak	:	As per IEEE Std. C37.013
11.3	Rated peak withstand current	KA peak	:	As per IEEE Std. C37.013



11.4	Rated short time withstand current for rated duration of 1sec.	KA rms	:	160kA
11.5	Transient Recovery Voltage (TRV) rating		:	As per IEEE Std. C37.013
11.6	Rated load current switching capability & Operation endurance capabilities		:	As per IEEE Std. C37.013
11.7	Rated Out of phase breaking current In % of rated Short Ckt. Breaking current		:	As per IEEE Std. C37.013
11.8	Rated Out of phase making current In % of rated Short Ckt. Breaking current		:	As per IEEE Std. C37.013
12.0	First pole to clear factor		:	1.5
13.0	Amplitude factor		:	1.5
14.0	Temperature rise			
14.1	Design ambient temperature °c		:	50
14.2	Allowable temperature limits		:	As per IEEE Std. C37.013
15.0	Number of trip coils		:	Two
16.0	Rated auxiliary Supply Voltage and frequency for			
16.1	Closing		:	220 V D.C [85% to 110%]
16.2	Tripping		:	220 V D.C. [70% to 110%]
16.3	Compressor / Pump Motor		:	415V, 3 Ph, 3W, 50Hz
16.4	Heater/Lamp/Socket		:	240V ± 10%, 1 Ph, 2W AC
17.0	Seismic Acceleration		:	0.5 g (horizontal)
18.0	SF6 Gas		:	As Per IEC60376 & 61634

DISCONNECTING SWITCH & EARTH SWITCH

1.0	Type	:	Air break
2.0	Operating Mechanism	:	A.C. Motor Operated as well as Manual
3.0	No. of poles	:	Three
4.0	Rated Maximum Voltage KV rms	:	Max. voltage of generator circuit breaker

5.0	Rated Frequency	Hz	:	50 ± 5%
6.0	Rated continuous current at site condition for DS	Amps	:	22500A
7.0	Short time current for 1secs	KA rms	:	160kA
8.0	Peak Withstand current	KA peak	:	400kA
9.0	Reference Standard		:	IEC-62271-102
10.0	Rated Insulation Level			
10.1	Rated Lightning Impulse Withstand Voltage (KV peak)			
	a. Across isolating distance		:	145kV Peak
	b. To Earth & Between Poles		:	145kV Peak
10.2	One Minute Power Frequency Withstand Voltage (KV rms)			
	a. Across isolating distance		:	70kV
	b.To Earth & Between Poles		:	70kV

VOLTAGE TRANSFORMER

1.0	Type	:	Cast-resin,
2.0	Service	:	Indoor/ Outdoor.
3.0	Rated Voltage		
	a. Primary	:	27kV/ √3 volt
	b. Secondary	:	110/ √3 volt – 110/3 volt (Core-1) (Core-2)
4.0	Winding Connection		
	a. Primary	:	Grounded Wye
	b. Secondary	:	Grounded Wye
5.0	Insulation Class	:	36 KV (generation voltage 27kV)
6.0	Over Voltage Factor		
	a. Continuous	:	1.2
	b. 30 seconds	:	1.9

7.0	Voltage Transformer (VT) Parameters	:	Accuracy Class	Rated VA
	Core-1 (27kV/√3 / 110/√3)		3P	60
	Core-2 (27kV/√3 / 110/√3)		0.2	60

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ANNEXURE-B

FITTINGS & ACCESSORIES

The following fittings and accessories shall be provided.

1.0 Generator Circuit Breaker

a) Mechanical position indicator marked `ON' and `OFF' visible externally to the operating mechanism.

b) Manual mechanical trip, three-pole.

c) Operations counter, one per pole

d) Device for manual slow closing and opening during maintenance

e) Anti-pumping and trip-free mechanism

f) SF6 gas density monitoring system (for SF6 interrupter)

g) Hydraulic/ Pneumatic operating mechanism

h) Control cabinet

2.0 Disconnecting Switch

a) Motorized drive

b) Mechanical position indicator marked `ON' and `OFF' visible externally to the operating mechanism.

c) Emergency manual operation-hand crank

d) Key interlocking in closed and open position

e) Operating mechanism & Control

3.0 Earthing Switch

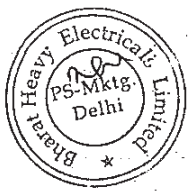
a) Motorized drive

b) Mechanical position indicator marked `ON' and `OFF' visible externally to the operating mechanism.

c) Key interlocking in closed and open positions

d) Operating mechanism & Control.

4.0 Voltage Transformers



9.0 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**) indicating **"Quoted"** against each item

i] Schedule of start-up and commissioning spares (**Unpriced**) indicating **"Quoted"** against each item

j] Schedule of Mandatory spares as per Annexure-1 **(Unpriced)** indicating **"Quoted"** against each item

j] Schedule of special tools and tackles **(Unpriced)** indicating **"Quoted"** against each item

k] Reference list.

M] List of recommended spare parts for three (3) years continuous operation (**Only unpriced** list to be provided for recommended spares. Price for recommended spare is not to be quoted by bidder)

10.0 DOCUMENTS REQUIRED AFTER THE AWARD OF LOI

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

a] Filled in data sheet – C.

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.

10.2 All drawings, documents shall be in English.

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

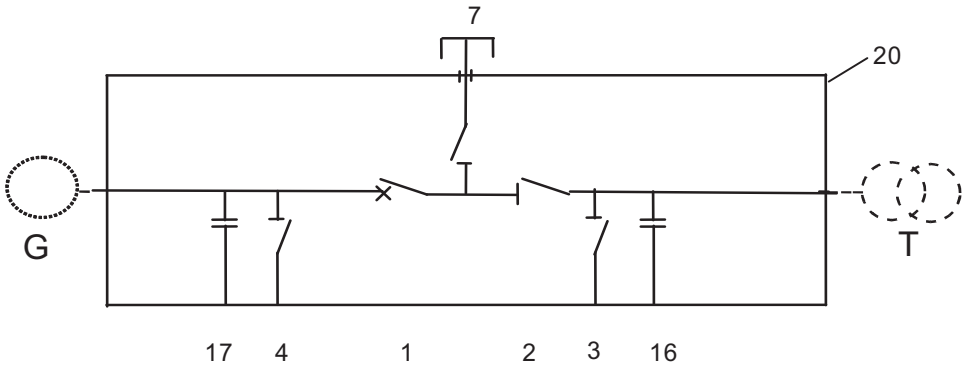
DATA SHEET –A

SL.NO.	PARAMETER	UNIT	VALUE
1.00	**Generator**		
1.01	Rated voltage	kV	27
1.02	Generator voltage variation	±%	5
1.03	Generator rated MW Rating at 50 deg C ambient	MW	800
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 bus-duct
2.02	Maximum continuous current		
	at 50 °C	A	22500 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	22500 A (Minimum)
3.02	Rated voltage	kV	27
3.03	No. of poles	Nos.	3
3.04	Rated short time withstand current [1 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.	1
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 stator	KVpeak	113 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	Yes

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	7	Short-circuiting switch
2	Disconnector	16, 17	Surge capacitors
3, 4	Earthing switches	20	System enclosure

(VT details shall be as mentioned in the specification.)

REF. SINGLE LINE CONFIGURATION OF GENERATOR CIRCUIT BREAKER

ATTACHMENT – II
GENERATOR DATA

SL. NO.	DESCRIPTION	UNIT	VALUE
1	RATED POWER	MVA MW	941.18 800
2	RATED FREQUENCY	Hz	50
3	RATED VOLTAGE	KV	27
4	MINIMUM / MAXIMUM GENERATION VOLTAGE	%	+/-5
5	RATED POWER FACTOR		0.85
6	REACTANCE VALUE (SATURATED):		
	SYNCHRONOUS REACTANCE, DIRECT AXIS, Xd	pu	1.8213
	TRANSIENT REACTANCE, DIRECT AXIS, Xd'	pu	0.233
	SUB TRANSIENT REACTANCE, DIRECT AXIS, Xd"	pu	0.1502
	SYNCHRONOUS REACTANCE, QUADRATURE AXIS, Xq	pu	2.102(Unsaturated)
	TRANSIENT REACTANCE, QUADRATURE AXIS, Xq'	pu	0.592 (Unsaturated)
	SUB TRANSIENT REACTANCE, QUADRATURE AXIS, Xq"	pu	0.1655
	ZERO SEQUENCE REACTANCE	pu	0.0974
7	TIME CONSTANTS (SHORT CIRCUIT TIME CONSTANTS):		
	TRANSIENT TIME CONSTANT, DIRECT AXIS, Td'	s	0.831
	SUB TRANSIENT TIME CONSTANT, DIRECT AXIS, Td"	s	0.031
	TRANSIENT TIME CONSTANT, QUADRATURE AXIS, Tq'	s	0.519
	SUB TRANSIENT TIME CONSTANT, QUADRATURE AXIS, Tq"	s	0.081
	ARMATURE TIME CONSTANT	s	0.27
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 + 4 Hard copies	NIL	
2	Drgs. / docs. for approval (Second & subsequent submission till approval)	PDF File + 4 Hard copies	NIL	
3	Final approval drgs. / docs. for Distribution after CAT-1.	PDF File + 15 Hard Copies	1 CD-ROM	
4	As Built drgs./doc.	15 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 + 15 Hard Copies	6 CD-ROMS	
7	Type Test Certificates/ Reports for approval	PDF+ 2 hard Copies	NIL	
8	Type Test Certificates/ Reports for distribution	11 hard Copies	6 CD-ROMS	

1 X 800 MW WANAKBORI TPS
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 ITEMS AT S.NO. 1.0(a), 1.0(b) AND 1.0(c)	SET	1			
1.0(a)		PORTABLE SF6 GAS EVACUATING & FILLING EQUIPMENT.	SET	1			
1.0(b)		SF6 GAS LEAKAGE DETECTORS	SETS	2			
1.0(c)		CIRCUIT BREAKER OPERATION ANALYZER	SET	1			
2.0	510-11007-A	START-UP AND COMMISSIONING SPARES	LOT	1			BIDDER TO FURNISH THE LIST
3.0	510-11008-A	SUPERVISION OF ERECTION, TESTING AND COMMISSIONING					
3.0(a)		CHARGES PER VISIT	VISIT	1			REFER NOTE-1 & 2
3.0(b)		MANDAYS CHARGES	DAYS	4			REFER NOTE-1 & 2
4.0	510-11011-A	SPECIAL TOOLS AND TACKLES	LOT	1			BIDDER TO FURNISH THE LIST
5.0	510-11000-B	MANDATORY SPARES	LOT	1			REFER ANNEXURE-1 FOR DETAILED 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(TO & FRO), BOARDING, LODGING, VISA, MEDICAL, INSURANCE ETC.

2 AMOUNT PAYABLE PER VISIT = VISIT CHARGES AS PER SL. NO. 3.0(a) ABOVE (+) UNIT PRICE FOR MANDAYS CHARGES AS PER SL. NO. 3.0(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 COST OF AIRFARE (TO & FRO), BOARDING, LODGING, VISA, MEDICAL, INSURANCE SHALL BE BORNE BY PURCHASER.

1 X 800 MW WANAKBORI TPS
MANDATORY SPARES LIST (ANNEXURE-1)

SL. NO.	ITEM CODE	ITEM DESCRIPTION	UNIT	QTY.	UNIT PRICE	TOTAL PRICE	REMARKS
5.0	**510-11000-B**	**MANDATORY SPARES**					
1		SUPPORT INSULATOR OF EACH TYPE	%	10			10% OF THE TOTAL NUMBER OF EACH TYPE
2		CIRCUIT BREAKER CLOSING COILS	NO.	1			
3		CIRCUIT BREAKER TRIPPING COILS	NO.	1			
4		CIRCUIT BREAKER FIXED CONTACT(MAIN & ARCHING)	SET	1			1 SET EACH FOR MAIN & ARCHING
5		CIRCUIT BREAKER MOVING CONTACT(MAIN & ARCHING)	SET	1			1 SET EACH FOR MAIN & ARCHING
6		SF6 BOTTLE	NOS.	3			3 NOS. OF 50 KG EACH
7		GAS FILLING UNIT (FOR SF6 BREAKER)	NOS.	1			
8		VOLTAGE TRANSFORMER (1 PHASE UNIT)	NOS.	3			
9		DISCONNECTING SWITCH, EARTH SWITCH, START SWITCH COMPLETE WITH OPERATING MECHANISM (1 PHASE UNIT)	SET	1			
10		CIRCUIT BREAKER COMPLETE OPERATING MECHANISM	SET	1			
11		ISOLATOR SWITCH, SELECTOR SWITCH, CIRCUIT BREAKER CONTROL SWITCH, POSITION INDICATORS, CONTACTOR, RELAYS, PUSH BUTTON, TIMER	NO. EACH	1			1 NO. OF EACH TYPE
12		POWER AND CONTROL FUSES/CIRCUIT BREAKERS OF DIFFERENT RATING	%	10			10% OF THE TOTAL QUANTITY
13		INDICATING LAMP (RED, AMBER, GREEN, WHITE, YELLOW, BLUE, ETC.)	%	10			10% OF EACH COLOR WITH MINIMUM 1 NO.
14		AUXILIARY SWITCH ASSEMBLE	SET	1			1 SET OF EACH TYPE
15		SF6 GAS LEAKAGE DETECTOR	NO.	1			

NOTES

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

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 which shall comply with 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) 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 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. (Only list is to be provided)

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 "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)	As per IEEE	
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) Generator side (nF/phase)		
1.45	a) DOP of GCB local control panel b) Is DOP type test certificate for GCB LCP enclosed?		
1.46	Whether cable glands and lugs are included as per the specification?		
1.47	Whether all interconnecting cables between various equipment of GCB and associated devices in bidder's scope are included?		
1.48	Whether sufficient **quantity and types** of spares are included for start up & commissioning of specified no. of GCBs?		
1.49	No. of series isolators provided per GCB on: Gen. trfr. side: 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		

DATA SHEET - C

GENERATOR CIRCUIT BREAKER

1.0	Name of Manufacturer		:	
2.0	Reference standard		:	
3.0	Type		:	
4.0	Service		:	
5.0	Cooling		:	
5.1	Detail write-up on forced cooling system furnished ?		:	Yes/ No
6.0	P o l e		:	
7.0	Rated Voltage (maximum)	kV rms	:	
8.0	Rated Power Frequency	Hz	:	
9.0	Electromagnetic Compatibility (EMC)		:	
10.0	Rated Insulation Level			
10.1	Rated Lightning Impulse withstand voltage (dry)	KV peak	:	
	a) between phase to earth		:	
	b) between phases and CB open		:	
	c) across isolating distance		:	
10.2	Rated one minute power frequency withstand voltage (dry)	KV rms		
	a) between phase to earth		:	
	b) between phases and CB open		:	
	c) across isolating distance		:	

11.0 Rated continuous Current at site condition Amps :

12.0 Rating under emergency condition (loss of cooling of GCB) : Applicable for forced cooled GCB.

12.1 Allowable duration of working at rated current Min. :

12.2 The rate at which load current to be reduced after allowable duration KA / Min :

12.3 Emergency Current rating for :

a) 1 hour KA :
b) 4 hour KA :
a) Continuous KA :

Note: Generator bus duct shall be considered ‘ naturally cooled ’

13.0 Limit of temperature rise

- Insulating materials :
- Main contacts :
- Terminals & joints :
- Parts handled by operator :
- Parts accessible to human contact :

14.0 Rated short circuit duty cycle :

15.0 Rated interrupting time :

16.0 Rated closing time :

17.0 Rated Making & Breaking Capacity

17.1 Rated Short-circuit breaking current (Symmetrical) kA rms :

17.2 Rated interrupting capability

- Symmetrical three phase fault :
- Asymmetrical three phase fault :

- Single phase to ground fault :

17.3 Calculated short circuit current

- Generator-source feed Short Circuit current (Symmetrical) :
- Generator-source feed Short Circuit current (Asymmetrical) :
- System-source feed Short Circuit current (Symmetrical) :
- System-source feed Short Circuit current (Asymmetrical) :

17.4 Rated short-circuit making current (kA Peak) :

17.5 Rated short circuit current withstand time Sec. :

17.6 Rated short time withstand current for rated duration of 1 sec. KA rms :

17.7 Rated excitation current switching Capability without exceeding over voltage by 2.0 pu Amps rms :

17.8 Rated Out of phase breaking current In % of rated Short Ckt. Breaking current :

17.9 Rated Out of phase making current In % of rated out of phase Breaking current :

18.0 Operation endurance capability : Number of operations (1 C + 1 O)

18.1 Between servicing : Nos.

18.2 No load mechanical : Nos

18.3 Continuous current switching : Nos.

19.0 Total break time measured from the instant of trip circuit energisation :

19.1 At 10% breaking capacity mS :

19.2	At 100% breaking capacity	mS	:	
20.0	Arcing time		:	
20.1	At 10% breaking capacity	mS	:	
20.2	At 100% breaking capacity	mS	:	
21.0	Total length of arc. mm		:	
22.0	Breaks per pole	No.	:	
23.0	Length of break per pole	mm	:	
24.0	Contact Travel	:		
24.1	Length of travel	mm	:	
24.2	Rate of travel	meter/s	:	
25.0	TRV Characteristics		:	
	▪ Load current switching			
	▪ Out of phase current switching			
26.0	First pole to clear factor		:	
27.0	Amplitude factor		:	
28.0	Operating mechanism	:		
28.1	Type with functional description / write-up submitted		:	Yes / No
28.2	Whether trip free operation with anti pumping arrangement provided	:	Yes / No	
28.3	Electro hydraulic operated mechanism			
	• Rated Power	KW	:	
	• Rated Supply Voltage, Phase and frequency		:	
	▪ Safety interlock provided		:	

- Pump and drive details :

- Rated mechanism fluid Operating Pressure & range Kg/m^2 :

28.4 Pneumatic Operated Mechanism

- Rated Power KW :

- Rated supply voltage, Phase and frequency V & Hz :

- Safety interlock provided ? :
- Compressor and drive details :

- Rated mechanism fluid Operating Pressure & range Kg/m^2 :

29.0 Supervisory & Control equipment :

29.1 Detail description / write-up furnished : Yes/ No

29.2 Provision for remote control, indication and annunciation furnished as per Specification : Yes/ No

29.3 SF6 Gas density monitoring device provided? : Yes/ No

30.0 Rated Supply Voltage, range and frequency for

30.1 Closing :

30.2 Tripping :

30.3 Spring Charge Motor :

30.4 Compressor / Pump Motor :

30.5 Heater/Lamp/Socket :

31.0 Power requirement at 220V D.C. :

31.1 Closing coil Watt :

31.2	Tripping coil	Watt	:	
31.3	Spring charging motor	Watt	:	
32.0	Phase to phase spacing of terminal conductor	mm	:	
33.0	Noise level (db) at 1.5M distance		:	
34.0	Seismic Acceleration		:	
35.0	SF6 Gas		:	
35.1	Complying standard		:	
35.2	Normal operating density	Kg/M^2	:	
35.3	Minimum operating density with full rating (For re-filling)	Kg/M^2	:	
35.4	Alarm density	Kg/M^2	:	
35.5	Lock out density	Kg/M^2	:	
35.6	Pressure relief valve operating pressure (if provided)	psig	:	
36.0	Short circuit type test certificate furnished ?		:	Yes/No
36.1	Certificate/Report	No.	:	
36.2	Oscillogram	No.	:	
37.0	Contacts			
37.1	Type			
	a. Main		:	
	b. Arcing		:	
37.2	Material			
	a. Main		:	
	b. Arcing		:	
37.3	Whether the contacts are silver plated		:	Yes/No

37.4	Thickness of silver coating	mm	:		
37.5	Contact pressure	Kg/Cm^2:	:		
38.0	Auxiliary Contacts				
38.1	Total nos. of contacts furnished				
	a. Normally open	Nos.	:		
	b. Normally closed	Nos.	:		
38.2	Spare contacts available for interlocks in addition to those required for breaker's own operation and indication		:		
	a. Normally open	Nos.	:		
	b. Normally closed	Nos.	:		
38.3	Contact type - convertible or fixed ?		:		
38.4	Contact Rating at			**220V D.C.**	**240V A.C.**
	a. Make and Continuous	Amps	:		
	b. Break (Inductive)	Amps	:		
39.0	Permissible variation of working pressure of Breaker		:		
39.1	Closing		:		
39.2	Tripping		:		
40.0	Arrangement provided for				
40.1	Pole discrepancy		:		
40.2	Trip free/Fixed trip		:		
40.3	Anti pumping		:		
41.0	Type of interlocks furnished				

41.1			:		
41.2			:		
41.3			:		
42.0	Enclosure		:	Phase enclosure	Control cabinet
42.1	Material		:		
42.2	Thickness		:		
42.3	Degree of Protection		:		
43.0	Overall dimensions of the GCB assembly and phase spacing center to center	mm	:		
44.0	Circuit Breaker Weight				
44.1	Total Weight	Kg	:		
44.2	Impact for foundation design to include dead load plus impact value on opening at max. interrupting rating in dead load	Kg	:		
45.0	Shipping dimension of the largest package (LxBxH).	mm	:		
46.0	Shipping weight of the heaviest package	Kg	:		
47.0	Spare quantity of SF6 gas furnished ? If so, indicate the total quantity		:		
48.0	Number of openings, the Circuit Breaker is capable of performing without inspection, replacement of contacts or other main parts				
48.1	At 50% rated current		:		
48.2	At 100% rated current		:		
48.3	At 50% rated breaking capacity		:		
48.4	At 100% rated breaking capacity		:		
49.0	Painting				

49.1	Finish of GCB assembly -			
	a. Inside		:	
	b. Outside		:	
50.0	Catalogue furnished for			
50.1	Portable SF6 evacuating & filling equipment		:	Yes / No
50.2	SF6 gas leakage detector		:	Yes / No
50.3	Circuit breaker operation analyzer		:	Yes / No

DISCONNECTING SWITCH

1.0	Make		:
2.0	Reference standard		:
3.0	Type		:
4.0	Service		:
5.0	Poles	No.	:
6.0	Rated frequency	Hz	:
7.0	Rated voltage KV		:
8.0	Rated current		
8.1	Rated continuous current At site condition	Amps	:
8.2	Short time current for 1 sec.	KA rms	:
8.3	Dynamic	KA peak	:
9.0	Temperature rise above 40 Deg.C ambient		
9.1	At rated normal current	Deg.C	:
9.2	At rated short time current	Deg.C	:
10.0	Maximum current the isolator can safely interrupt		:

11.0	Insulation level			
11.1	Rated Lightning impulse withstand voltage			
	a.	Across the isolating distance	KV peak	:
	b.	To earth & between poles	KV peak	:
11.2	One minute power frequency withstand voltage			
	a.	Across the isolating distance	KV rms	:
	b.	To earth & between poles	KV rms	:
12.0	Operating mechanism			
12.1	Type			:
12.2	Motor rating			
	a.	Output	KW	:
	b.	Voltage	Volts	:
12.3	Range of operating voltage		%	:
12.4	Control voltage with range		V±%	:
13.0	Main Contacts			
13.1	Type			:
13.2	Material			:
13.3	Contact pressure		Kg/cm^2	:
13.4	Contact area		mm^2	:
13.5	Whether silver plated ?			:
13.6	Thickness of silver plating		mm	:
14.0	Auxiliary Contacts			
14.1	Spare contacts furnished			

	a. Normally open	Nos.	:		
	b. Normally close	Nos.	:		
14.2	Type : convertible or fixed ?		:		
14.3	Contact Rating at		:	220V D.C.	240V A.C.
	a. Make and continuous	Amps	:		
	b. Break (Inductive)	Amps	:		
15.0	Operating time of motor operated mechanism				
15.1	Opening	Secs.	:		
15.2	Closing	Secs.	:		
16.0	No. of operations that disconnecting switch can withstand without deterioration of contacts		:		
17.0	Type of interlocks furnished		:		
17.1			:		
17.2			:		
17.3			:		
18.0	Cable gland				
	a. Type		:		
	b. Material		:		
	c. With tapered washer		:		
	d. With armor clamp		:		

EARTHING SWITCH

1.0	Make		:

2.0	Type		:
3.0	Reference standard		:
4.0	Service		:
5.0	Poles		:
6.0	Current Rating		
6.1	Short time for 1 sec	KA rms	:
6.2	Peak Withstand current	KA peak	:
6.3	Making current	KA peak	:
7.0	Insulation level		
7.1	Rated Lightning impulse withstand voltage		
	a. Across the isolating distance	KV peak	:
	b. To earth & between poles	KV peak	:
7.2	One minute power frequency withstand voltage		
	a. Across the isolating distance	KV rms	:
	b. To earth & between poles	KV rms	:
8.0	Operating mechanism		
8.1	Type		:
8.2	Motor rating		
	a. Output	KW	:
	b. Voltage	Volts	:
8.3	Range of operating voltage %		
8.4	Control voltage with range	V±%	:

9.0	Mounting		:		
10.0	Auxiliary contacts				
10.1	No. of contacts furnished				
	a. Normally open	Nos.	:		
	b. Normally close	Nos.	:		
10.2	Type : Convertible or fixed ?		:		
10.3	Contact Rating at		:	220V D.C.	240V A.C
	a. Make and continuous	Amps	:		
	b. Break (Inductive)	Amps	:		
11.0	Operating time of motor operated mechanism				
11.1	Opening	Secs.	:		
11.2	Closing	Secs.	:		
12.0	No. of operations that earth switch can withstand without deterioration of contacts		:		
13.0	Type of interlocks furnished		:		
13.1			:		
13.2			:		
13.3			:		

VOLTAGE TRANSFORMER

1.0	Make		:
2.0	Type		:
3.0	Reference Standard		:
4.0	Voltage Class	KV	:
5.0	Basic Impulse Level	KV Peak	:

6.0	Type of Insulation			:
7.0	Maximum temperature rise over …. Deg.C ambient		Deg.C	:
8.0	Rated Frequency		Hz	:
9.0	Over voltage factor			
	a.	Continuous		:
	b.	30-Seconds		:
10.0	No. of secondary windings per voltage transformer			:
11.0	Winding Connections			
	a.	Primary		:
	b.	Secondary		:
12.0	V.T. Ratings			
	a.	Primary Voltage	KV	:
	b.	Secondary Voltage	Volt/Volt	:
	c.	Rated Output	VA	:
	d.	Accuracy Class		:
13.0	V.T. Fuses			
	a.	Continuous Current	Amp	
		H.V.		:
		L.V.		:
	b.	Short Circuit Rating	KA Symm	
		H.V.		:
		L.V.		:
	c.	Rated voltage	Volt	

	H.V.			:
	L.V.			:

LIGHTNING ARRESTOR

1.0	Make			:
2.0	Type			:
3.0	Reference Standard			:
4.0	L.A. Rating			
	a.	Rated Voltage	KV	:
	b.	Nominal discharge current	KA	:
	c.	Discharge Class		:
5.0	Insulation Level			
	a.	1-min.50 Hz withstand		:
		i) Dry	KV r.m.s.	:
		ii) Wet	KV r.m.s	:
	b.	Impulse withstand	KV peak	:
6.0	Spark Over Voltage			
	a.	Minimum 50 Hz	KV peak	:
	b.	Maximum 1.2/50 micro-sec.	KV peak	:
	c.	Maximum front-of-wave	KV peak	:
7.0	Maximum Residual Voltage at 8/20 micro-sec. current wave			
	a.	10 KA	KV peak	:
	b.	20 KA	KV peak	:
	c.	40 KA	KV peak	:
	d.	100 KA	KV peak	:

8.0	Impulse current withstand			
	a. High current 4/10 micro-sec	KA peak	:	
	b. Long duration current for		:	
	i) 1000 Microsec	KA peak	:	
	ii) 2000 Microsec	KA peak	:	
9.0	Operation counter furnished		:	Yes/No
10.0	Catalogue furnished		:	Yes/No
11.0	Characteristic curve furnished		:	Yes/No

SURGE CAPACITOR

1.0	Make		:	
2.0	Service		:	
3.0	Type & Catalogue No.		:	
4.0	Reference Standard		:	
5.0	Rated voltage	KV	:	
6.0	Rated frequency	Hz	:	
7.0	Rating			
	a. Capacity in micro farad/pole		:	
	b. Guarantee tolerance		:	
8.0	Insulation Class	KV	:	
9.0	Test voltage between terminals			
	a. A.C. for 1 minute		:	
	b. D.C. - 10 seconds		:	
10.0	Dimensions	mm	:	
11.0	Weight	Kg	:	
12.0	Bushings			

	a.	1 minute dry withstand test	KV	:
	b.	10 second wet withstand test	KV	:
	c.	Basic impulse withstand	KVP	:
13.0	Catalogue furnished ?			:
14.0	Discharge resistor furnished ?			: