TECHNICAL SPECIFICATION
FOR
GENERATOR CIRCUIT BREAKER

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

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UP [INDIA]
<table>
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<tr>
<th>SL.NO.</th>
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<tr>
<td><strong>GENERATOR CIRCUIT BREAKER</strong></td>
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</tr>
<tr>
<td>1</td>
<td>Manufacturer</td>
<td>Reputed make</td>
</tr>
<tr>
<td>2</td>
<td>Applicable Standard</td>
<td>ANSI/IEEE (C37.013)</td>
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<tr>
<td>3</td>
<td>Rated voltage (kV)</td>
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<tr>
<td>4</td>
<td>Rated frequency</td>
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<tr>
<td>5</td>
<td>Rated continuous current (A) at ambient temperature of 50°C</td>
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<tr>
<td>6</td>
<td>Type of operating mechanism provided</td>
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<tr>
<td>7</td>
<td>Interrupting medium</td>
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</tr>
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<td>8</td>
<td>Rated short time withstands current [1 sec.]</td>
<td>kA</td>
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<td>9</td>
<td>Interrupting capacity (symmetrical) at rated voltage and operating duty</td>
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<tr>
<td>10</td>
<td>Rated making current (kApeak)</td>
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<td>11</td>
<td>Rated duty cycle</td>
<td>CO - 30 - CO</td>
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<td>12</td>
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<td>13</td>
<td>Impulse withstand voltage</td>
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<td>14</td>
<td>Type of cooling</td>
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<td>15</td>
<td>Maximum allowable temperature of main contacts (Deg. C)</td>
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<tr>
<td>16</td>
<td>No. of series isolators per GCB</td>
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<tr>
<td>17</td>
<td>No. of earth-switches per GCB on:</td>
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<tr>
<td></td>
<td>Gen. trfr. side:</td>
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<td><strong>Earth switch</strong></td>
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<td></td>
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<td>Rated short time withstand current</td>
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<td></td>
<td>Rated peak withstand current</td>
<td>kAp</td>
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<td></td>
<td>Rated power frequency withstand voltage</td>
<td>kV</td>
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<td></td>
<td>Rated impulse withstand voltage</td>
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<td>Rated normal current at 50 deg C</td>
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<td>kAp</td>
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<tr>
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<td>Rated power frequency withstand voltage</td>
<td>kV</td>
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<td></td>
<td>Rated impulse withstand voltage</td>
<td>kVp</td>
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<td>20</td>
<td><strong>Auxiliary supplies</strong></td>
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<td>AC [Any single phase power for lighting and heating circuits to be derived by vendor from this supply]</td>
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1.00.00 SCOPE

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

- Generator circuit breaker
- 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 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. The total stored energy in the operating system offered shall be sufficient for 2CO operations.

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
2.19.00 Requirement of potential free auxiliary contacts for purchaser's use is indicated below:

- **GCB**: 12NO + 12NC
- **Each Isolator**: 4NO + 4NC
- **Each Earth Switch**: 4NO + 4NC

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 along with `lamp reset' and `lamp test' push buttons on GCB LCP.

b) Separate sets of contacts for annunciation of various abnormal conditions of GCB in CCR shall be provided.

c) Two sets of contacts of GCB lockout conditions (when GCB is `closed') shall be provided for interlocking in generator protection scheme. This is in addition to the requirements of GCB abnormal condition contacts given in b) above.

d) Potential-free contacts shall be provided on GCB LCP for indication in CCR for following conditions:

   i) GCB selected for remote control
   ii) GCB ready for `close'

e) Potential-free contacts shall also be provided on GCB LCP for `DC failure at GCB'.

2.22.00 Operation counter for GCB shall be provided in Local Control Panel.

2.23.00 Gland plate of local control panel shall be of adequate size for terminating external cables using glands. No. of external cables shall be finalized after the award of LOI.

2.24.00 Spare terminals shall be provided in local control panel. Number of spare terminals shall not be less than 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 alongwith 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.

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

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.
      vii/ 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, along with 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 along with technical offer:

a] Filled in Data Sheet -B.


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

11.01.00 All drawings, documents shall be in English.
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.
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<th>TITLE</th>
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