

**BHAVNAGAR ENERGY CORPORATION LIMITED**

**2X250 MW CFBC LIGNITE BASED TPP**

**VOLUME - IIB**

**TECHNICAL SPECIFICATION**

**FOR**

**GENERATOR CIRCUIT BREAKER**

**SPECIFICATION NO.: PE-TS-356-510-E001 (REV. 00)**



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



**BHAVNAGAR ENERGY CORPORATION  
LIMITED**

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**VOLUME II B**

**SECTION**

**REVISION 0**

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TOTAL NO. OF SHEETS =77 (INCLUDING COVER/ CONTENTS/ 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')



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INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFERS

1. In line with clause no. 6.0 of Section-C, Volume-II-B of the specification, two signed and stamped copies of the following shall be furnished by all bidders as technical offer:
  - a. Unpriced BOQ-Cum-Price Schedule with 'QUOTED' word against each item with bidder's signature and company stamp.
  - b. A copy of this sheet ("Instructions to Bidders for Preparing Technical Offer"), with bidder's signature and company stamp.
  - c. A copy of previous sheet ("List of Contents"), with bidder's signature and company stamp.
  - d. Other document as listed in clause no. 6.0 of Sec-C, Vol-II-B.
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

	BHAVNAGAR ENERGY CORPORATION LIMITED	Doc. No. PE-TS-356-510-E001	
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### 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.

	<b>BHAVNAGAR ENERGY CORPORATION LIMITED</b>	<b>Doc. No. PE-TS-356-510-E001</b>	
	<b>2X250 MW CFBC LIGNITE BASED TPP</b>	<b>Volume</b>	<b>Section</b>
		<b>IIB</b>	
	<b>TECHNICAL SPECIFICATION FOR GENERATOR CIRCUIT BREAKER</b>	<b>Rev. : 00</b>	


## **SECTION – A**

### **SCOPE OF ENQUIRY**

	<b>BHAVNAGAR ENERGY CORPORATION LIMITED</b>	<b>Doc. No. PE-TS-356-510-E001</b>	
	<b>2X250 MW CFBC LIGNITE BASED TPP</b>	<b>Volume</b>	<b>Section</b>
		<b>IIB</b>	<b>A</b>
	<b>TECHNICAL SPECIFICATION FOR GENERATOR CIRCUIT BREAKER</b>	<b>Rev. : 00</b>	
		<b>Page : 1 of 1</b>	



**SECTION- A**  
**SCOPE OF ENQUIRY**


- 1.0 This specification covers design, manufacture, assembly, inspection & testing at manufacturer's works, proper packing, delivery to site and supervision of E&C **of Generator Circuit Breaker** as mentioned in different sections of this specification, complete with all accessories for efficient and trouble-free operation of 2X250 MW CFBC LIGNITE BASED TPP
- 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 Deviation if any should be brought out very clearly on deviation sheet enclosed with the specification only. Otherwise it will be presumed that the bidder's offer is in line with what has been stated/ asked for in this specification.
- 6.0 The documents shall be in English language and MKS system of units.


	<b>BHAVNAGAR ENERGY CORPORATION LIMITED</b>	<b>Doc. No. PE-TS-356-510-E001</b>	
	<b>2X250 MW CFBC LIGNITE BASED TPP</b>	<b>Volume</b>	<b>Section</b>
		<b>IIB</b>	
	<b>TECHNICAL SPECIFICATION FOR GENERATOR CIRCUIT BREAKER</b>	<b>Rev. : 00</b>	


## **SECTION – B**


### **PROJECT INFORMATION**

SPEC NO : TCE. 5403A-C- 510-001	 <b>BECL</b> <b>Bhavnagar Energy Company Limited</b> <b>2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP</b> <b>AT PADVA, BHAVNAGAR DIST.</b>	VOLUME - II SECTION: C2 Sheet 1 OF 4	
	TITLE <b>GENERAL PROJECT INFORMATION</b>		
<b>GENERAL PROJECT INFORMATION</b>			
1.	OWNER/PURCHASER	: Bhavnagar Energy Company Limited	
2.	Consultant	: TCE Consulting Engineers Limited	
	Sheriff Centre		
	73/1 St Mark's Road		
	Bangalore - 560001		
3.	Project Title	: 2 X 250 ( +20 % Maximum) MW Lignite	
		Based Thermal Power Plant	
4.	Location	: Near Village Padva, Taluka Ghogha,	
		District Bhavnagar in the state of Gujarat in	
		India, located at ---- km from Ahmedabad	
5.	Nearest Railway station	: Bhavnagar, 25 kms from the plant location.	
6.	Site elevation	: 34.0 to 42.0 m above mean sea level.	
7.	Access Road	: 1 Km from State Highway ( SH-25/1)	
8.	Nearest Airport	: Bhavnagar	
9.	Nearest Sea port	: Pipavav.	
10.	Latitude of site	: 21 deg 35 minutes North	
11	Longitude of site	: 72 deg 14 minutes East	
12	Metrological data	: Weather data of Bhavnagar from the period	
		1952 to 1980 indicates the following :	
	a) <b>Temperature</b>	:	
	i) Average Max . Temp	: 33.6 deg. C	
	ii) Average Minimum temp	: 21.1 deg. C	
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SPEC NO : TCE. 5403A-C- 510-001	<b>BECL</b> <b>Bhavnagar Energy Company Limited</b> <b>2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP</b> <b>AT PADVA, BHAVNAGAR DIST.</b>	VOLUME - II SECTION: C2 Sheet 2 OF 4																																																																																					
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	TITLE <b>GENERAL PROJECT INFORMATION</b>	
<p>(g) Space heaters (for motors rated 30KW and above) : 240V, 1 phase, 2 wire, 50Hz AC system with effectively earthed neutral. The power supply shall be derived by CONTRACTOR by providing 415V/ 240V transformer of adequate rating with MCCB/ MCB on primary/secondary sides.</p> <p>(h) Solid state controls (including solenoid valves) : 24 V DC, 2 wire, supply from (24V DC supply derived from 110 V AC UPS supply)</p> <p>(i) Lighting fixtures : 240 V, 1 phase, 2 wire, 50Hz earthed AC system.</p> <p>(j) Lighting fixtures and space heaters in panels : 240 V, AC 1 phase, 2 wire, 50Hz earthed AC system.</p> <p>(k) Construction Supply : 11 Kv AC , 3 phase , 50 Hz, Medium resistance earthed and 415 V , AC 50 Hz, 3 phase 3 wire solidly earthed.</p> <p>(l) The above voltages may vary as follows :</p> <p>All devices shall be suitable for continuous operation over the entire range of voltage and frequency indicated below without any change in their performance.</p> <p>i. AC supply : Voltage variation <math>\pm 10\%</math>          Frequency variation <math>\pm 5\%</math>          Combined voltage &amp; frequency variation <math>\pm 10\%</math></p> <p>DC supply : Voltage variation +2% or -2%</p> <p>iii UP's Supply : 110 V +/- 5 %</p>		
CONSULTANTS: TCE CONSULTING ENGINEERS LIMITED		ISSUE R0

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	<b>TECHNICAL SPECIFICATION FOR GENERATOR CIRCUIT BREAKER</b>	<b>Rev. : 00</b>	

## **SECTION – C**

### **SPECIFIC TECHNICAL REQUIREMENTS**

SPEC NO. TCE. 5403A-C-540-002-TURBINE	<b>BECL</b> <b>Bhavnagar Energy Company Limited</b> 2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT PADVA, BHAVNAGAR DIST.	VOLUME - IV SECTION: D3.3 SHEET 1 OF 14
TITLE	<b>GENERATOR CIRCUIT BREAKER</b> 	

**1. GENERAL**


- 1.1 The Generator circuit breaker (GCB) offered shall be complete in all respects. Any material and component not specifically stated in this specification and which is necessary for trouble free operation of the GCB and accessories specified in this specification shall be deemed to be included unless specifically excluded.
- 1.2 Design and manufacture shall be such that GCB / accessories of same type and rating are inter-changeable.
- 1.3 The GCB shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous operation.
- 1.4 The GCB shall be designed taking into consideration, a maximum ambient temperature as indicated in Project specific requirements.

**2.0 CODES AND STANDARDS:**

- 2.1 The equipment covered by this specification shall be designed, constructed and tested in accordance with the latest revisions of applicable IEC / IEEE/ANSI publications:

Standard	Title
IEC 62271-100	HV AC Circuit Breakers
IEC 376, 376A, 376B	Specification and acceptance of new Sulphur Hexafluoride.
IEEE C37.013	IEEE Standard for AC High Voltage Generator Circuit Breakers Rated on Symmetrical Current Basis.
IEC 694	Common clauses for high voltage switchgear and control gear standards.
IEC 298	AC metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.

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SPEC NO. TCE. 5403A-C- 540-002-TURBINE	<b>BECL</b> <b>Bhavnagar Energy Company Limited</b> <b>2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT PADVA, BHAVNAGAR DIST.</b>	VOLUME - IV SECTION: D3.3 SHEET 2 OF 14
	TITLE <b>GENERATOR CIRCUIT BREAKER</b>	

IEC 144	Degree of protection of metal enclosed control gear and switchgear.
IEC 185	Current Transformers
IEC 186	Voltage Transformers
IEC 99	Surge Arresters without gaps for AC systems
IEC 358	Coupling Capacitors and Capacitor Dividers.
IEC 129	Alternating Current Disconnectors (Isolators) and Earthing Switches
IEC 44-2	Voltage transformers surge protection equipment


**3.0 TECHNICAL REQUIREMENTS:**


**3.1 General: Generator Circuit Breaker System**

3.1.1 The generator circuit-breaker system (GCB - system) shall be designed and fabricated for installation in the run of an isolated phase busduct, between the generator and the main step-up generator transformer, capable to carry 100% return current during load and in case of short-circuit conditions. The components of each phase of the GCB - system shall be shielded in an aluminium enclosure to form a straight section in the run of the isolated phase busduct. Each GCB - system shall be factory tested and shipped as a three-phase unit package. In addition to the circuit breaker the GCB - system shall include the following components:

- series disconnecter
- earthing switch on transformer side
- ~~• Voltage transformers on transformer side (Number of windings as per Main one line diagram).~~
- ~~• current transformer on transformer side (Number of cores as per Main one line diagram).~~
- ~~• Surge arrester on transformer side~~
- Earthing switch on generator side
- ~~• Voltage transformers on generator side (Number of windings as per Main one line diagram).~~

ISSUE  
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SPEC NO. TCE. 5403A-C-540-002-TURBINE	<b>BECL</b> <b>Bhavnagar Energy Company Limited</b> <b>2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT PADVA, BHAVNAGAR DIST.</b>	VOLUME - IV SECTION: D3.3 SHEET 3 OF 14
TITLE		
<p> <del>• Current transformer on generator side (Number of cores as per Main one line diagram).</del> </p> <ul style="list-style-type: none"> <li>• Short-circuiting connection <del>with switch or</del> manually mounted for braking or relay setting.</li> </ul> <p>3.1.2 Protective capacitors on the generator side and on the transformer side, shall be provided in each phase of the GCB system, in order to limit the rate-of-rise of the transient recovery voltage appearing across the contact of the circuit-breaker after a short-circuit current interruption. These capacitors at the same time serve as surge capacitors.</p> <p>3.1.3 The circuit breaker shall perform the following functions:</p> <ul style="list-style-type: none"> <li>• With GCB open, start up of power plant via its main step-up generator transformer.</li> <li>• synchronising the generator with the system</li> <li>• carry full load current of the generator with negative tolerance of generator output voltage and VWO condition of turbine.</li> <li>• interrupt load currents (up to the full load current of the generator)</li> <li>• Shut down of power plant, by opening the GCB.</li> <li>• separate the generator from the system (switching off the unloaded or slightly loaded generator)</li> <li>• Make and break generator-source short-circuit currents</li> <li>• Make and break system-source short-circuit currents</li> <li>• Make and break currents under out-of-phase conditions.</li> </ul> <p>3.1.4 Air inside the isolated phase bus and the generator circuit-breaker system shall be dry and free of dust, oil, etc.</p> <p>3.1.5 Generator Circuit breaker (GCB) design rating shall be suitable for the Generator parameters.</p> <p>3.2 <b>CIRCUIT-BREAKER</b></p> <p>3.2.1 <b>General</b></p> <p>The circuit breaker shall use SF6-gas as insulating- and interrupting medium. For current interruption, the self-blast interrupting principle shall be applied. The arc voltage of the circuit breaker shall be high enough to ensure current zeros in case of generator-source short-circuit currents with delayed current zeros.</p>		
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SPEC NO. TCE. 5403A-C-540-002-TURBINE	<b>BECL</b> <b>Bhavnagar Energy Company Limited</b> <b>2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT PADVA, BHAVNAGAR DIST.</b>	VOLUME - IV SECTION: D3.3 SHEET 4 OF 14
TITLE	<b>GENERATOR CIRCUIT BREAKER</b> 	

The circuit breaker shall have two separate contact systems, one for load current carrying and one for arc interruption.

All parts of the insulation structure, including those between phases to earth and across the open contacts, shall be of an inherently stable nature with a minimum susceptibility to dielectric tracking.

The completely assembled circuit-breaker, including drive linkages and all other parts, shall have ample mechanical strength to withstand without damage all stresses incident to operation within the rated short-circuit current or the related required capabilities of the circuit-breaker, as well as stresses resulting from mounting, moving or maintaining the circuit-breaker in a proper manner.

The time between the first and last pole to open or close shall not exceed equivalent of 120 electrical degrees rotation.

The circuit breaker shall be electrically trip-free and anti pumping.

**3.2.2 Operating mechanism** *or motorised*

A hydraulically <sup>or</sup> charged spring drive mechanism shall be furnished for the circuit breaker, complete with all control equipment. The only external requirement for operation shall be the electrical supplies. The mechanism shall operate the circuit breaker through a mechanical linkage, which operates all the three poles simultaneously.


The hydraulic pump shall have <sup>1</sup> x 100% capacity with manual charging facility.


The capacity of energy facilities shall be of sufficient size to store at least 2 complete close-open operations.

The design of the operating mechanism shall be co-ordinated with the circuit-breaker design to ensure positive opening of the circuit breaker and circuit interruption, whether the tripping impulse is received in the fully closed or any partially closed positions.


For purposes of inspection and adjustment, means shall be provided to permit local operation of the circuit breaker. In addition, an emergency operating lever shall be supplied to allow manual opening and closing of the circuit breaker.


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SPEC NO. TCE. 5403A-C-540-002-TURBINE	<b>BECL</b> <b>Bhavnagar Energy Company Limited</b> <b>2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT PADVA, BHAVNAGAR DIST.</b>	VOLUME - IV SECTION: D3.3 SHEET 5 OF 14
TITLE	<b>GENERATOR CIRCUIT BREAKER</b>	
<p>The following clauses shall be applicable in addition to the above in case Pneumatic operated mechanism is offered.</p> <p>Protection shall be provided to take care of possible failure of the compressed air system that drives the breaker. Upon loss of the compressed air supply in the open position, the breaker shall remain locked in open position and shall not tend to close. Upon loss of the compressed air supply in the closed position, the breaker shall remain locked in closed position.</p> <p>Each three-phase circuit breaker shall have a compressed air plant complete with all associated pipework etc. The compressed air plant shall have 2 x 100% compressors and dryers (if required). The total stored energy in the air receiver offered shall be sufficient for 2CO operations. The receiver shall conform to BS-5169, BS - 5500 as relevant.</p> <p><b>3.2.3 SF6 supervision</b></p> <p>A SF6 gas density monitor shall be supplied for monitoring the three phases of the circuit breaker. The gas density monitor shall be equipped with a temperature compensated pressure switch and shall be adjustable.</p> <p>One contact of the pressure switch shall be provided to indicate that the gas density has reached a level where refilling the gas volume is necessary. Two additional contacts shall be provided, connected to each trip circuit, to prevent tripping of the circuit breaker when gas density falls below a level "too low" to successfully complete an operation of the circuit breaker at its ratings.</p> <p>Operating hydraulic pressure lock out annunciation shall be included in DCS. To avoid opening/closing of breaker during lockout necessary logic shall be included in GCB control circuit.</p> <p><b>3.2.4 Circuit-breaker control</b></p> <p>For each circuit breaker, two trip coils shall be provided. One circuit (primary) shall be wired in the normal circuit-breaker control scheme and the secondary circuit shall be used for backup protection. This secondary trip circuit shall include all the interlocking associated with the primary circuit.</p>		
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SPEC NO. TCE. 5403A-C 540-002-TURBINE	<b>BECL</b> <b>Bhavnagar Energy Company Limited</b> <b>2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT PADVA, BHAVNAGAR DIST.</b>	VOLUME - IV SECTION: D3.3 SHEET 6 OF 14
	TITLE <b>GENERATOR CIRCUIT BREAKER</b>	
<p>Upon loss of drive energy, control power supply or SF6-gas, the breaker shall remain in the fully closed or open position.</p> <p><b>3.2.5 Accessories</b></p> <ul style="list-style-type: none"> <li>• Each circuit breaker shall be equipped with operation counter and SF6 pressure gauge.</li> <li>• A reliable, mechanical position indicator shall be furnished to indicate the open or closed position of the circuit-breaker</li> <li>• A manual operation device for maintenance purposes shall be provided.</li> <li>• SF6 gas charging unit along with accessories shall be supplied along with GCB.</li> </ul> <p><b>3.2.6 Insulation</b></p> <p>The circuit-breaker with its main contacts open and insulating gas at atmospheric pressure must be capable of withstanding an out-of-phase voltage (which can go up to 3 times the phase voltage) across the terminals with the phase angle between two voltages continuously varying. This requirement is to assure that the circuit breaker in the open position is capable of withstanding voltages to which they can be subjected under such conditions as system being out-of-phase. Provisions shall be made to keep the insulation structure, not normally exposed to the weather, dry during shipment.</p> <p><b>3.2.7 Control cubicle</b></p> <p>The control cubicle shall accommodate all the necessary equipment for local/remote changeover facilities, control, monitoring, supervision and interlocking of the GCB-system. A degree of protection of IP54 shall apply (IEC 529).</p> <p><b>3.2.8 Conventional (wired) control equipment</b></p> <p>The control cubicle shall be provided with conventional, hard-wired control and supervisory equipment.</p> <p>An active mimic diagram with position indicators integrated in the lighted (LED's) push-button switches for the circuit breaker,</p>		
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TITLE	<b>GENERATOR CIRCUIT BREAKER</b>	
<p>disconnecter and earthing switch(es) shall be provided, mounted behind a glass window in the control cubicle front panel.</p> <p>The control cubicle shall accommodate all the necessary equipment for local/remote changeover facilities, control, monitoring, supervision and interlocking of the GCB-system.</p> <p><del>A minimum of 4NO and 4NC auxiliary contacts shall be provided for each of the individual GCB system operating mechanism for customer use.</del></p> <p>All spare auxiliary contacts on the proposed equipment shall be wired to terminal blocks.</p> <p>All terminals and control wires shall be identified in a proper manner.</p> <p><b>3.2.9 Nameplate</b></p> <p>A non-metallic nameplate shall be attached to the GCB-system unit. The nameplate shall be placed in such position that it is clearly readable when standing in front of the GCB-system control cubicle. Each GCB - system assembly shall have a unique serial number.</p> <p><b>3.2.10 Painting</b></p> <p>All surfaces of the circuit breaker, operating mechanism and other parts exposed to possible corrosion, shall be weather proofed and designed to prevent accumulation of moisture. Those surfaces, which require paint, shall be shotblasted, sandblasted or chemically cleaned and pure white shade of RAL 9010</p> <p><b>3.2.11 Conductors of active parts</b></p> <p>Conductors shall be of highly conductive copper. (Busduct conductor shall be aluminium. In case, copper conductor shall be provided for GCB, necessary bimetallic connectors shall be supplied). All bus joints shall have silver-to-silver contact surfaces. Insulating supports shall meet the dielectric strength requirements and shall be capable of withstanding the mechanical forces imposed by closing and opening operations and by the short circuit currents.</p> <div style="text-align: right; border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">       ISSUE R0     </div>		

SPEC NO. TCE. 5403A-C-540-002-TURBINE	<b>BECL</b> <b>Bhavnagar Energy Company Limited</b> <b>2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT PADVA, BHAVNAGAR DIST.</b>	VOLUME - IV SECTION: D3.3 SHEET 8 OF 14
	TITLE <b>GENERATOR CIRCUIT BREAKER</b>	
<p><b>3.2.12 Generator circuit-breaker system enclosure</b></p> <p>GCB-system enclosures shall be designed for welded connections to the isolated phase busduct (IPB) - enclosures. Each single-phase enclosure shall be made out of aluminium and capable of carrying the induced sheath current equal to the current ratings specified. In order to avoid pollution due to ingress of dust and moisture, the GCB-system enclosure shall be designed to allow air tightness and to withstand a slight internal overpressure. Inspection windows shall be provided in each single-phase enclosure to allow visual checks of the individual positions of the GCB-system assemblies.</p> <p><b>3.2.13 Earthing pads</b></p> <p>Two copper or stainless steel earthing pads shall be provided on the GCB-system unit, close to earth level and located opposite of each other. For the control cubicle, an adequate separate earthing facility shall also be provided.</p> <p><b>3.2.14 Testing</b></p> <p>The manufacturer shall furnish type test reports for the equipment offered. All routine tests shall be performed on the furnished equipment and shall provide a list of site tests. The manufacturer shall also provide a quality plan to review the manufacturing procedure of the equipment. All tests shall comply with relevant standards and consider the requirements according to the system data.</p> <p><b>3.2.15 Design tests / type tests</b></p> <p>Design tests to verify the adequacy of the design to meet the specified ratings under the specified operating conditions shall be made only on representative GCB-system assembly. Equipment ratings exceeding available testing facility capabilities, using presently available testing procedures, shall be substantiated by calculation methods. All equipment ratings shall be verified.</p> <p><b>3.2.16 Production tests / routine tests</b></p> <p>Routine tests shall be performed. List of routine tests foreseen to be conducted shall be submitted along with the offer.</p> <div style="text-align: right; border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">             ISSUE R0           </div>		

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	TITLE <b>GENERATOR CIRCUIT BREAKER</b>	
<p><b>3.2.17 Tests after delivery / site tests</b></p> <p>Site tests shall be performed on the GCB-system to confirm that the equipment was not damaged during shipping and to check the operation of the GCB-system under actual conditions at site. The manufacturer shall furnish technical support to review the commissioning procedures and a list of-tests to be performed at site.</p> <p><b>3.2.18 Instruction manuals</b></p> <p>The instruction manuals shall provide complete information necessary for the handling, installation, operation and maintenance throughout the life of the equipment.</p> <p><b>3.3 DISCONNECTOR</b></p> <p><b>3.3.1 General</b></p> <p>A disconnecter shall be provided on the transformer-side in series to the circuit breaker. The disconnecter shall be of a telescopic unit with a sliding tubular contact, with its hinged point on the transformer-side and with an operating mechanism, which shall operate through a mechanical linkage all three poles. The isolating gap of the disconnecter shall be in air of atmospheric pressure and a window shall be provided in the GCB-system enclosure to allow visual checking of its position.</p> <p>The control of the disconnecter including the interlocking circuit shall be accommodated in the GCB-system control cubicle. A local/remote switch and push buttons for local control shall be provided.</p> <p><b>3.3.2 Operating mechanism</b></p> <p>The operating mechanism, operated by a 3-phase motor, shall be of a heavy duty construction type and shall be designed to complete its normal travel to either "open" or "close" position, once started, without holding the control switch continuously in that position. Means for stopping the travel between fully open and closed position shall not be acceptable.</p> <p>A key interlocking shall be available to allow different modes of operation to be selected. Mechanically driven semaphore shall be provided for signalling close/open-position. A crank handle shall be provided for manual operation in case of emergency.</p> <div style="text-align: right; border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">       ISSUE R0     </div>		

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	TITLE <b>GENERATOR CIRCUIT BREAKER</b>	

**3.4 EARTHING SWITCHES**

**3.4.1 General**

Earthing switches shall be provided on both sides of the circuit breaker. They shall be of a blade type, air insulated, gang operated with motor drive, with their hinge point connected to earth and shall be integrated together with the circuit-breaker and disconnecter into each of the single phase tubular aluminium enclosure, forming a straight section in the run of the isolated phase bus. Making- or breaking capability is not required for the earthing switches. The earthing switches operation shall be interlocked with the circuit breaker and disconnecter. The control of the earthing switches including the interlocking circuits shall be accommodated in the GCB-system control cubicle. A local/remote switch and push buttons for local control shall be provided.

**3.4.2 Operating mechanism**

The operating mechanism, operated by a 3-phase motor, shall be of a heavy duty construction type and shall be designed to complete its normal travel to either "open" or "close" position, once started, without holding the control switch continuously in that position. Means for stopping the travel between fully open and closed position shall not be acceptable. A key interlocking shall be available to allow different modes of operation to be selected. Mechanically driven semaphore shall be provided for signalling close/open-position. A crank handle shall be provided for manual operation in case of emergency.


**MANUAL**

**3.5 ~~A~~ SHORT - CIRCUITING CONNECTION ~~WITH SWITCH~~ FOR RELAY SETTING AND BRAKING OF THE GENERATOR**

**3.5.1 General**

**MANUAL** The short-circuiting connection ~~with switch~~ shall facilitate an unearthed three phase short-circuit on generator side of the GCB-system unit, which can be switched to the generator terminals by means of closure of the circuit breaker. The short-circuiting point shall be placed between the circuit breaker and disconnecter.

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~~The operating mechanism of the switch shall be the same as used for the disconnecter etc.~~

**3.5.2 Adjustment of protection**

The short-circuiting connection ~~with switch~~ shall help to expedite the testing and adjustment of the power plant protection system. Closure of the switch shall establish an unearthed three phase short-circuit, which can be switched to the generator terminals by closing the circuit breaker.

**4.0 DOCUMENTS TO BE FURNISHED ALONG WITH THE OFFER**

The Bidder shall submit the following information with the offer:

- DC component calculation
- outline dimensions of complete GCB-system and ancillary equipment
- weight of complete GCB-system and ancillary equipment
- weight of the largest component for shipping and maintenance purposes
- watt-ratings, starting/running current values for the operating mechanism motor(s) and for tripping and closing solenoids
- quantity of SF6-gas required per three-phase circuit-breaker unit
- recommended pressure switch settings of the SF6 density monitor for gas alarms –“too low“- and –“blocking“- of the closing- and tripping-command of the circuit-breaker
- list of tests
- list of recommended and mandatory spare parts.
- list of tools, tackles and test equipment.


**5.0 TECHNICAL PARTICULARS OF GENERATOR CIRCUIT-BREAKER SYSTEM**

Generator Circuit Breaker system shall comply with the particulars as per the technical requirements specified below:

S.No.	Description	Unit	Value
1	General		

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	<b>BHAVNAGAR ENERGY CORPORATION LIMITED</b> <b>2X250 MW CFBC LIGNITE BASED TPP</b>	<b>Doc. No. PE-TS-356-510-E001</b>	
		<b>Volume</b>	<b>Section</b>
		<b>IIB</b>	<b>C</b>
	<b>TECHNICAL SPECIFICATION FOR GENERATOR CIRCUIT BREAKER</b>	<b>Rev. : 0</b> <b>Page : 13 OF 14</b>	

## 6.0 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] 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 (For all test indicated at clause no. 5.02.01 of specification E4)
- f] Write up on operating mechanism of GCB.
- g] Schedule of deviations
- h] Schedule of prices(Unpriced)
- i] Schedule of start-up and commissioning spares. (Unpriced)
- j] Schedule of special tools and tackles. (Unpriced)
- k] Reference list.

	<b>BHAVNAGAR ENERGY CORPORATION LIMITED</b> <b>2X250 MW CFBC LIGNITE BASED TPP</b>	<b>Doc. No. PE-TS-356-510-E001</b>		
		<b>Volume</b>	<b>Section</b>	
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	<b>TECHNICAL SPECIFICATION FOR GENERATOR CIRCUIT BREAKER</b>	<b>Rev. : 0</b>		
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## **7.0 DOCUMENTS REQUIRED AFTER THE AWARD OF LOI**

- 7.1 Bidder shall submit following documents after the award of LOI for approval and distribution:
- a] Filled in data sheet – C.
  - 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 (For all test indicated at clause no. 5.02.01(b) of specification E4).
  - 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] Detailed calculations for short circuit capability for system side/ generator side fault contribution.
- 7.2 All drawings, documents shall be in English.
- 7.3 The vendor after LOI shall submit drawings/documents in requisite number of copies as indicated in ATTACHMENT-II ("DOCUMENTS / DRAWINGS DISTRIBUTION SCHEDULE").


	BHAVNAGAR ENERGY CORPORATION LIMITED	Doc. No. PE-TS-356-510-E001	
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### DATA SHEET –A


SL.NO.	PARAMETER	UNIT	VALUE
<b>1.00</b>	<b>Generator</b>		
1.01	Rated voltage	kV	16.5
1.02	Voltage variation	±%	5
1.03	Peak MW Rating at 50 deg C ambient	MW	250
1.04	Rated power factor		0.85
1.05	Frequency	Hz	50
1.06	Generator Reactances and Time Constants		As per Attachment - I
<b>2.00</b>	<b><u>Generator Bus Duct details [GCB to comply to these requirements]</u></b>		
2.01	Type		Isolated phase bus-duct
2.02	Maximum continuous current		
	at 50 °C	A	10833
2.03	One minute power frequency withstand voltage	kV(RMS)	60
2.04	Impulse withstand voltage	kV(Peak)	125
2.05	Overall diameter of enclosure (Inside)	mm	1054(Tentative)
2.06	Thickness of enclosure	mm	8
2.07	Phase-phase spacing	mm	1300(Tentative)
2.08	Enclosure material		Al. alloy
2.09	Conductor material		Al. alloy
2.10	Conductor profile		Round
2.11	Cooling		Natural
2.12	Pressurization System provided	Yes/No	No (Hot air blowing Equipment for IR maintenance is provided)
2.13	Pressure of air inside the enclosure	mm of water col.mn	<b>NA</b>
2.14	Maximum temperature of enclosure at 50°C	°C	70
2.15	Maximum temperature of silver plated conductor joints at 50°C	°C	115

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<b>3.00</b>	<b>Generator Circuit Breaker details</b>		
3.01	Maximum continuous current		
	at 50 °C	A	10833
3.02	Rated voltage	kV	24
3.03	No. of poles	Nos.	3
3.04	Rated short time withstand current [1 sec.]	kA	100
3.05	Interrupting capacity at rated voltage and operating duty		
	a) Symmetrical	kArms	115
	b) Asymmetrical	kApeak	300
3.06	One minute power frequency withstand voltage	kV(RMS)	60
3.07	Impulse withstand voltage	kV(Peak)	125
3.08	Location of GCB	Indoor / Outdoor	Indoor
3.09	Quantity of GCB	Nos.	2
3.10	Quantity of Earth Switch per GCB	Nos.	2
3.11	Quantity of Series Isolator per GCB	Nos.	1
3.12	Configuration of Earth Switch, Series Isolator & Short circuiting connection with switch		As per Attachment - III
<b>4.00</b>	Generator Neutral Earthing		High Resistance (Through Transformer loaded with Resistance on secondary)
<b>5.00</b>	Gen. Stator Winding Basic Insulation Level	KVpeak	71
<b>6.00</b>	<b>Type Tests</b>		
6.01	Validity period of type test reports		
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		<b>NA</b>
<b>7.00</b>	<b>Mandatory Spares</b>		

	BHAVNAGAR ENERGY CORPORATION LIMITED	Doc. No. PE-TS-356-510-E001	
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7.01	Mandatory Spares to be quoted for this contract	Yes/ No	NO
7.02	If yes, list of mandatory spares		-
<b>8.00</b>	<b><u>Auxiliary supplies</u></b>		
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 pahse, 2 wire, 50 Hz with one point earthed.

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## ATTACHMENT – I

### 1.1. GENERATOR DATA


SL. NO.	DESCRIPTION	UNIT	VALUE
1	Rated Power	MVA	294
2	Rated Frequency	Hz	50
3	Rated Voltage	KV	16.5
4	Minimum / Maximum generation Voltage	%	+/-5
5	Rated Power Factor		0.85
6	Reactance value (saturated):		
	Synchronous Reactance, Direct Axis	pu	1.91
	Transient Reactance, Direct Axis	pu	0.253
	Sub transient Reactance, Direct Axis	pu	0.169
	Synchronous Reactance, Quadrature Axis	pu	NA
	Transient Reactance, Quadrature Axis	pu	0.535
	Sub transient Reactance, Quadrature Axis	pu	0.181
	Zero Sequence Reactance	pu	0.101
7	Time Constants (Short Circuit Time Constants):		
	Transient Time Constant, Direct Axis	s	0.96
	Sub transient Time Constant, Direct Axis	s	0.03
	Transient Time Constant, Quadrature Axis	s	0.65
	Sub transient Time Constant, Quadrature Axis	s	0.07
	Armature Time Constant	s	0.43
8	Speed	rpm	3000

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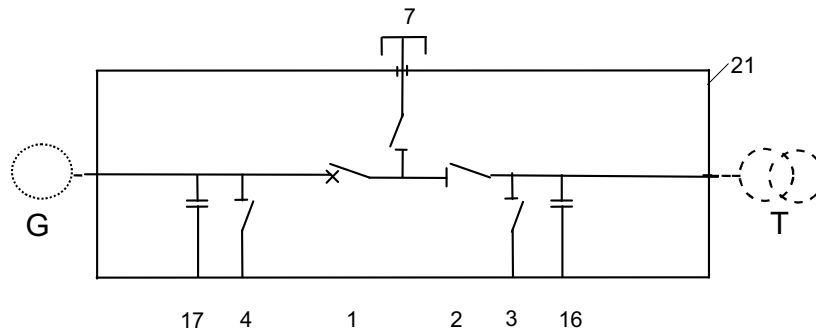
**ATTACHMENT – II**

**VENDOR DRAWING/ DOCUMENT SCHEDULE**

<b>SL. NO.</b>	<b>DESCRIPTION</b>	<b>HARD COPY (Nos.)</b>	<b>SOFT COPY (AutoCAD/pdf)</b>	<b>CD</b>
<b>1</b>	All Drawings/ documents- First submission/ resubmission	10	YES	-
<b>2</b>	Final Drawings/ Documents after approval for distribution purpose	20	-	4
<b>3</b>	As built drawings/ documents	20	-	4
<b>4</b>	Quality Plan- First submission/ resubmission	20	YES	-
<b>5</b>	Quality Plan- after approval for distribution purpose	6	YES	1
<b>6</b>	Instruction Manual (Erection, O&M), commissioning procedure, Data books/ Plant Handbooks/ Catalogues etc			
	a) Draft copy	6	-	-
	b) Final submission	20	-	4
<b>7</b>	Performance and Guarantee Test report	10		1

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**ATTACHMENT – III**



- |      |                   |        |                                 |
|------|-------------------|--------|---------------------------------|
| 1    | Circuit-breaker   | 7      | Short-circuiting/braking switch |
| 2    | Disconnecter      | 16, 17 | Surge capacitors                |
| 3, 4 | Earthing switches | 21     | System enclosure                |


**SINGLE LINE CONFIGURATION  
OF GENERATOR CIRCUIT BREAKER**

**2X250 MW BHAVNAGAR TPP**  
**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 isolators, earth-switches, surge capacitors & short circuiting connection link	SET	1			
2.0	510-11007-A	START-UP AND COMMISSIONING SPARES	LOT	1			BIDDER TO FURNISH THE LIST
3.0	510-11011-A	SPECIAL TOOLS AND TACKLES	LOT	1			BIDDER TO FURNISH THE LIST
4.0	510-11008-A	SUPERVISION OF ERECTION, TESTING AND COMMISSIONING					
4.0(a)		VISIT CHARGES (EXCEPT DAILY CHARGES)	VISIT	1			REFER NOTE-1 & 2
4.0(b)		DAILY CHARGES	DAYS	4			REFER NOTE-1 & 2

NOTES

- 1 THE PRICES OF VISIT CHARGES [4.0(a)] & DAILY CHARGES [4.0(b)] SHALL BE INCLUSIVE OF OF AIRFARE, BOARDING/LODGING, VISA, MEDICAL, INSURANCE ETC.
- 2 TOTAL AMOUNT PAYABLE PER VISIT = VISIT CHARGES AS PER SL. NO. 4.0(a) ABOVE (+) CHARGES PER DAY AS PER SL. NO. 4.0(b) ABOVE (X) NO. OF DAYS AT SITE( TO BE CERTIFIED BY BHEL SITE)
- 3 WHEREEVER SET IS INDICATED ABOVE, IT MEANS THE TOTAL PARTS/ACCESSORIES REQUIRED TO REPLACE THE PARTICULAR ITEM FOR A GIVEN EQUIPMENT.

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## **SECTION – D**

### **GENERAL TECHNICAL REQUIREMENTS**



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3.00.00	COLOUR OF PAINT	7
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5.00.00	QUALITY PLAN	9
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**1.00.00 SCOPE**

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

- Generator circuit breaker [as per quantity indicated in Data Sheet –A].
- 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.



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## **2.00.00 GENERATOR CIRCUIT BREAKER**

- 2.01.00 The generator circuit breaker (GCB) shall be of the metal enclosed type suitable for direct connection to phase isolated generator bus duct in a manner designed to preserve the phase isolated principle. The breaker shall have continuous and short time current ratings as those indicated for Generator Bus Duct in the Data Sheet - A.
- 2.02.00 The interrupters of the circuit breaker shall be SF6 type. The rated 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



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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



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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 : 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 alongwith 'lamp reset' and 'lamp test' push buttons on GCB LCP.

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

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

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

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

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

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

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

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



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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.



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### **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.



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#### **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).



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### **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.



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**2. ROUTINE TESTS ON ISOLATOR AND EARTH-SWITCH**

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



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### **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.



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### **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.



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### **8.00.00 SUPERVISION OF ERECTION, TESTING AND COMMISSIONING**

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

Required instruments for site testing of GCB shall be arranged by the vendor, in case the same are not available at site. These instruments shall be brought by the vendor and shall be taken back after completion of commissioning.



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**9.00.00 TRAINING OF ENGINEERS**

Bidder shall provide training for a maximum of six (6) engineers from BHEL/ultimate customer at works, training centre etc. The training shall also include application, layout, design, construction, operating principle, operating mechanism, local control panel, operation, maintenance, site inspection, erection, site testing, spares etc. of GCB.

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

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



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### **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 recommended spares for 3 years of plant operation. (Unpriced)
- l] Schedule of special tools and tackles. (Unpriced)
- m] Reference list.



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### **11.00.00 DOCUMENTS REQUIRED AFTER THE AWARD OF LOI**

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

- a] Filled in data sheet.
- b] Detailed general arrangement drawing of GCB showing various dimensions, space required for operation and maintenance, weights etc. (GA drawing to be complete for GCB and auxiliaries.)
- c] Foundation arrangement drawing showing loading, forces at various points etc.
- d] General arrangement drawing of local control panel.
- e] Logic for closing/tripping of GCB, isolator and earth-switch.
- f] Electrical control scheme of local control panel.
- g] Drawings for operating mechanism.
- h] P & I Diagram.
- i] Type tests certificates.
- j] Manufacturing Quality Plan.
- k] Field quality plan for equipment storage, handling, erection, testing and commissioning at site, recommended by vendor.
- l] O & M Manual.
- m] Routine test certificates.

11.01.00 All drawings, documents shall be in English.

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



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**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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### **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.

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540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
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TITLE

**GENERATOR CIRCUIT BREAKER**



**DATA SHEET-C**

To be furnished by Vendor after award of contract for approval

- 1.0 GCB CUBICLE
- 1.1 Make :
- 1.2 Type
- 1.3 Reference standard :
- 1.4 Voltage (Nom./ Max) kV :
- 1.5 Phase / frequency No. / Hz :
- 1.6 Short circuit rating
  - a. Peak withstand KAp :
  - b. Short-time for 3 sec KA rms :
- 1.7 Insulation level
  - a. Impulse voltage withstand KVp :
  - b. One minute power frequency withstand voltage KVp :
- 1.8 Construction :
- 1.9 Degree of protection :
- 1.10 Sheet metal used :
- 1.11 Minimum thickness of sheet metal used mm :
- 1.12 Switchgear completely assemble wired and tested at factory :

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 2 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 2.0 CIRCUIT BREAKER
- 2.1 Make :
- 2.2 Type :
- 2.3 Reference standard :
- 2.4 Rated voltage KV :
- 2.5 Max. continuous voltage KV :
- 2.6 Rated frequency Hz :
- 2.7 No. of poles No :
- 2.8 Rated currents
- a. Continuous (at site condition, 50 deg. Ambient & within cubicle) amp. :
- b. Short time current for 3 sec. :
- 2.9 Max. temperature rise over 50 deg.C ambient deg.C :
- 2.10 Rated operating duty :
- Short circuit currents load currents mechanical operations
- 2.11 Interrupting capacity at rated voltage and operating duty
- a. Symmetrical :
- b. Asymmetrical :

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 3 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



2.12 Transient Recovery voltage :

- a. Rate of rise
- b. Peak voltage

2.13 At 100% interrupting  
capacity

- a. Opening time max. ms :
- b. Arcing time Max. ms :
- c. Total tripping time (max) ms

2.14 Total closing time (max) ms

2.15 Number of breaks per pole :

Total length of breaks per pole mm

Total length of contact travel mm

2.16 Rate of contact travel :

- a. At tripping m/sec :
- b. At closing m/sec :

2.17 No. of breaker operations  
permissible without requiring  
inspection replacement of  
contacts and other main  
parts.

- a. At 100% rated current :
- b. At 100% rated  
interrupting current :

2.18 Type of contacts

2.19 Material of contacts

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 4 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



2.20 Minimum clearance in air mm

- a. Between poles :
- b. Between live parts and ground :

2.21 Operating Mechanism

- a. Type :
- b. No. of breaker operations stored :
- c. Trip free or fixed trip ? :
- d. Anti pumping features provided ? :
- c. 2 x 100% Hydraulic pumps/ compressors provided ? :

2.22 Closing coil

- a. Voltage :
- b. Permissible voltage variation :
- c. Closing coil current at rated voltage :

2.23 Tripping coil

- a. Quantity :
- b. Voltage :
- c. Permissible voltage variation
- d. Tripping coil current at rated voltage

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 5 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



2.24 Breaker / Cubicle  
accessories

Accessories such as control  
switch, indication lamps,  
relay furnished as specified

2.25 Breaker provided with the  
following

- a. Mechanical safety interlock :
- b. Emergency manual trip :
- c. Mechanical ON-OFF indicator
- d. Operation counter
- e. Gas pressure guage

2.26 Auxiliary switch with 6 no. +  
6 no. contacts

2.27 Cell / Auxiliary switch

- a. Are switch contacts convertible type ? :
- b. Contact rating at :
  - i) Rated & making current
  - ii) Interrupting current (inductive)
  - iii) P.F for A.C & L/R for D.C interruption

2.28 Net weight of the breaker Kg

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 6 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 2.29 Impact load for foundation design (to include dead load plus impact values on opening at maximum interrupting rating) Kg
- 2.30 Volume of SF6 Gas
- 2.31 Overall dimension (LxBxH) mm
- 2.32 Type test report on identical breaker enclosed Yes/No
- 2.33 a. SF6 gas monitoring device as per specification provided :
- b. Normal pressure
- c. Gas pressure with limits of tolerance at which the circuit breaker operates correctly
- d. Principle of operation for gas monitoring device
- e. Total volume of gas per pole at –C
- f. Current breaking capacity with SF6 inside at atmospheric pressure
- g. Leakage of gas per year per pole
- h. Number of operations after which SF6 gas replacement is necessary

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 7 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- i) At 100% rated current
- ii) At 100% rated interrupting current

- i. Maximum induced over voltage when switching off low inductive loads and features provided to limit the same
- j. Recommended interval between routine maintenance and procedure for same (attach sheets if required)

3.0 CURRENT TRANSFORMER

3.1 Make

3.2 Type

3.3 Reference standard

3.4 CT ratios as per drawing

3.5 Rated frequency

3.6 CT for differential protection

- a. Class
- b. Secondary resistance at 75 deg.C
- c. Knee point voltage
- d. Excitation current at VK/2

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 8 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 3.7 CT for metering & relaying
- 3.8 Short circuit withstand
  - a. Short time current for 3 sec. KA rms
  - b. Dynamic current Kap
- 3.9 Class of insulation
- 3.10 Temp. rise over 50 deg.C ambient Deg.C
- 3.11 Basic insulation level KV peak
- 3.12 CT magnetization curve furnished
- 4.0 VOLTAGE TRANSFORMER
  - 4.1 Make
  - 4.2 Type
  - 4.3 Reference standard
  - 4.4 Voltage ratio
  - 4.5 Rated frequency
  - 4.6 Accuracy class
  - 4.7 VA burden
  - 4.8 Over voltage factor
    - a. Continuous
    - b. 30 seconds
  - 4.9 Class of insulation

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 9 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 4.10 Temp. rise over 50 deg.C    Deg.C  
      ambient
- 4.11 Winding connection
  - a. Primary
  - b. Secondary
- 5.0 Fuses
  - a. Continuous ratings –  
      HV/LV
  - b. Symmetrical fault rating  
      – HV/LV
- 6.0 Earth switch
  - Type
  - Current rating
- 7.0 Disconnecter
  - Type
  - Current rating
- 8.0 Surge Arrestors
  - Type
  - Capacitor value
- 9.0 Surge Capacitor
  - Type
  - Capacitor value
- 10.0 SECONDARY WIRING
- 10.1 Type and insulation

ISSUE  
R0

SPEC NO. TCE. 5403A-C-540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 10 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 10.2 Voltage grade
- 10.3 Conductor material
- 10.4 Conductor size (minimum)
  - a. Potential circuit
  - b. Control circuit
  - c. Current circuit
- 10.5 Wires identified at both ends with markers
- 11.0 GROUND BUS
  - 11.1 Ground bus furnished
  - 11.2 Material
  - 11.3 Size
- 12.0 NAME PLATE
  - 12.1 Material
  - 12.2 Thickness
  - 12.3 Size for a) Panel
    - b) Equipment/devices
- 13.0 AC/DC Supply
  - 13.1 Isolating switches fuse unit for incoming supply
    - a. A.C – type & rating
    - b. D.C – type & rating
  - 13.2 Isolating switches fuse unit at each cubicle
    - a. A.C – type & rating

ISSUE  
R0

SPEC NO. TCE. 5403A-C-540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 11 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



b. D.C – type & rating

14.0 TROPICAL PROTECTION

- a. Any special treatment for tropical protection ?
- b. Screens are of corrosion resistant materials ?



15.0 PAINTING

Finish of switchgear

- a. Inside
- b. Out side

16.0 ACCESSORIES

Accessories furnished

17.0 TESTS

Routing tests to be performed on switchgear

- a.
- b.
- c.
- d.

Type tests to be performed

- a.
- b.
- c.

ISSUE  
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SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



**2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.**

VOLUME – IV  
SECTION: D3.3  
SHEET 12 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



Drawings / Data furnished

ISSUE  
R0

**BHAVNAGAR ENERGY CORPORATION LIMITED**

**2X250 MW CFBC LIGNITE BASED TPP**

**VOLUME III**

**TECHNICAL SPECIFICATION**

**FOR**

**GENERATOR CIRCUIT BREAKER**

**SPECIFICATION NO.: PE-TS-356-510-E001 (REV. 00)**



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

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 1 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



**DATA SHEET-B**  
To be furnished by Bidder

- 1.0 GCB CUBICLE
- 1.1 Make :
- 1.2 Type
- 1.3 Reference standard :
- 1.4 Voltage (Nom./ Max) kV :
- 1.5 Phase / frequency No. / Hz :
- 1.6 Short circuit rating
  - a. Peak withstand KAp :
  - b. Short-time for 3 sec KA rms :
- 1.7 Insulation level
  - a. Impulse voltage withstand KVp :
  - b. One minute power frequency withstand voltage KVp :
- 1.8 Construction :
- 1.9 Degree of protection :
- 1.10 Sheet metal used :
- 1.11 Minimum thickness of sheet metal used mm :
- 1.12 Switchgear completely assemble wired and tested at factory :

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 2 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 2.0 CIRCUIT BREAKER
- 2.1 Make :
- 2.2 Type :
- 2.3 Reference standard :
- 2.4 Rated voltage KV :
- 2.5 Max. continuous voltage KV :
- 2.6 Rated frequency Hz :
- 2.7 No. of poles No :
- 2.8 Rated currents
- a. Continuous (at site condition, 50 deg. Ambient & within cubicle) amp. :
- b. Short time current for 3 sec. :
- 2.9 Max. temperature rise over 50 deg.C ambient deg.C :
- 2.10 Rated operating duty :
- Short circuit currents load currents mechanical operations
- 2.11 Interrupting capacity at rated voltage and operating duty
- a. Symmetrical :
- b. Asymmetrical :

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 3 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 2.12 Transient Recovery voltage :
- a. Rate of rise
  - b. Peak voltage
- 2.13 At 100% interrupting capacity
- a. Opening time max. ms :
  - b. Arcing time Max. ms :
  - c. Total tripping time (max) ms
- 2.14 Total closing time (max) ms
- 2.15 Number of breaks per pole :
- Total length of breaks per pole mm
  - Total length of contact travel mm
- 2.16 Rate of contact travel :
- a. At tripping m/sec :
  - b. At closing m/sec :
- 2.17 No. of breaker operations permissible without requiring inspection replacement of contacts and other main parts.
- a. At 100% rated current :
  - b. At 100% rated interrupting current :
- 2.18 Type of contacts
- 2.19 Material of contacts

ISSUE  
R0

SPEC NO. TCE. 5403A-C-540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 4 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



2.20 Minimum clearance in air mm

- a. Between poles :
- b. Between live parts and ground :

2.21 Operating Mechanism

- a. Type :
- b. No. of breaker operations stored :
- c. Trip free or fixed trip ? :
- d. Anti pumping features provided ? :
- c. 2 x 100% Hydraulic pumps/ compressors provided ? :

2.22 Closing coil

- a. Voltage :
- b. Permissible voltage variation :
- c. Closing coil current at rated voltage :

2.23 Tripping coil

- a. Quantity :
- b. Voltage :
- c. Permissible voltage variation
- d. Tripping coil current at rated voltage

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 5 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



2.24 Breaker / Cubicle  
accessories

Accessories such as control  
switch, indication lamps,  
relay furnished as specified

2.25 Breaker provided with the  
following

- a. Mechanical safety interlock :
- b. Emergency manual trip :
- c. Mechanical ON-OFF indicator
- d. Operation counter
- e. Gas pressure guage

2.26 Auxiliary switch with 6 no. +  
6 no. contacts

2.27 Cell / Auxiliary switch

- a. Are switch contacts convertible type ? :
- b. Contact rating at :
  - i) Rated & making current
  - ii) Interrupting current (inductive)
  - iii) P.F for A.C & L/R for D.C interruption

2.28 Net weight of the breaker Kg

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 6 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 2.29 Impact load for foundation design (to include dead load plus impact values on opening at maximum interrupting rating) Kg
- 2.30 Volume of SF6 Gas
- 2.31 Overall dimension (LxBxH) mm
- 2.32 Type test report on identical breaker enclosed Yes/No
- 2.33 a. SF6 gas monitoring device as per specification provided :
- b. Normal pressure
- c. Gas pressure with limits of tolerance at which the circuit breaker operates correctly
- d. Principle of operation for gas monitoring device
- e. Total volume of gas per pole at –C
- f. Current breaking capacity with SF6 inside at atmospheric pressure
- g. Leakage of gas per year per pole
- h. Number of operations after which SF6 gas replacement is necessary

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 7 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- i) At 100% rated current
- ii) At 100% rated interrupting current

- i. Maximum induced over voltage when switching off low inductive loads and features provided to limit the same
- j. Recommended interval between routine maintenance and procedure for same (attach sheets if required)

3.0 CURRENT TRANSFORMER

3.1 Make

3.2 Type

3.3 Reference standard

3.4 CT ratios as per drawing

3.5 Rated frequency

3.6 CT for differential protection

- a. Class
- b. Secondary resistance at 75 deg.C
- c. Knee point voltage
- d. Excitation current at VK/2

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 8 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 3.7 CT for metering & relaying
- 3.8 Short circuit withstand
  - a. Short time current for 3 sec. KA rms
  - b. Dynamic current Kap
- 3.9 Class of insulation
- 3.10 Temp. rise over 50 deg.C ambient Deg.C
- 3.11 Basic insulation level KV peak
- 3.12 CT magnetization curve furnished
- 4.0 VOLTAGE TRANSFORMER
  - 4.1 Make
  - 4.2 Type
  - 4.3 Reference standard
  - 4.4 Voltage ratio
  - 4.5 Rated frequency
  - 4.6 Accuracy class
  - 4.7 VA burden
  - 4.8 Over voltage factor
    - a. Continuous
    - b. 30 seconds
  - 4.9 Class of insulation

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 9 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 4.10 Temp. rise over 50 deg.C    Deg.C  
      ambient
- 4.11 Winding connection
  - a. Primary
  - b. Secondary
- 5.0 Fuses
  - a. Continuous ratings –  
      HV/LV
  - b. Symmetrical fault rating  
      – HV/LV
- 6.0 Earth switch
  - Type
  - Current rating
- 7.0 Disconnecter
  - Type
  - Current rating
- 8.0 Surge Arrestors
  - Type
  - Capacitor value
- 9.0 Surge Capacitor
  - Type
  - Capacitor value
- 10.0 SECONDARY WIRING
- 10.1 Type and insulation

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 10 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



- 10.2 Voltage grade
- 10.3 Conductor material
- 10.4 Conductor size (minimum)
  - a. Potential circuit
  - b. Control circuit
  - c. Current circuit
- 10.5 Wires identified at both ends with markers
- 11.0 GROUND BUS
  - 11.1 Ground bus furnished
  - 11.2 Material
  - 11.3 Size
- 12.0 NAME PLATE
  - 12.1 Material
  - 12.2 Thickness
  - 12.3 Size for a) Panel
    - b) Equipment/devices
- 13.0 AC/DC Supply
  - 13.1 Isolating switches fuse unit for incoming supply
    - a. A.C – type & rating
    - b. D.C – type & rating
  - 13.2 Isolating switches fuse unit at each cubicle
    - a. A.C – type & rating

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.

VOLUME – IV  
SECTION: D3.3  
SHEET 11 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



b. D.C – type & rating

14.0 TROPICAL PROTECTION

- a. Any special treatment for tropical protection ?
- b. Screens are of corrosion resistant materials ?



15.0 PAINTING

Finish of switchgear

- a. Inside
- b. Out side

16.0 ACCESSORIES

Accessories furnished

17.0 TESTS

Routing tests to be performed on switchgear

- a.
- b.
- c.
- d.

Type tests to be performed

- a.
- b.
- c.

ISSUE  
R0

SPEC NO. TCE. 5403A-C-  
540-002-TURBINE



**2 X 250 (+20% MAXIMUM) MW LIGNITE BASED TPP AT  
PADVA, BHAVNAGAR DIST.**

VOLUME – IV  
SECTION: D3.3  
SHEET 12 OF 12

TITLE

**GENERATOR CIRCUIT BREAKER**



Drawings / Data furnished

ISSUE  
R0