



# BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS GROUP  
ENGINEERING MANAGEMENT, NEW DELHI

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	02	Name	SK	DKM	RS
Type of Document	<b>TECHNICAL SPECIFICATION</b>		Sign	-sd-	-sd-
Title	<b>400KV AND 132KV SF6 CIRCUIT BREAKERS</b>		Date	03.05.12	03.05.12
			Group	TBEM	
			W.O. No	81009	
CUSTOMER	<b>THE SINGARENI COLLIERIES COMPANY LTD.</b>				
CONSULTANT	<b>NATIONAL THERMAL POWER CORPORATION LTD.</b>				
PROJECT	<b>400 KV AND 132 KV SWITCHYARD FOR SINGARENI THERMAL POWER PROJECT 2X600MW AT ADILABAD, AP</b>				

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02	22.08.13	<i>Sd</i>	<i>Amended</i>	<i>Ramesh</i>	Requirement of Type Tests on 400kV Circuit Breaker has been revised as optional.
01	29.10.12	-sd-	-sd-	-sdr	List of Type tests to be conducted on 132kV Circuit Breaker included at cl.1.4.1.2 of Section-1
Rev No.	Date	Altered	Checked	Approved	<b>REVISION DETAILS</b>

## SECTION 1

### **SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.**

#### **1.0 SCOPE**

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 400kV and 132kV SF6 Circuit Breakers complete with accessories as listed in clause 1.2 & 1.3 below.

This section covers the specific technical requirements of SF6 Circuit Breakers. In case of any discrepancies between the requirements mentioned in this section and those specified in the following sections of this specification, the specifications given herein shall prevail and shall be treated as binding requirements.

#### **1.1** The equipment is required for the following project.

CUSTOMER: THE SINGARENI COLLIERIES COMPANY LTD.

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Refer Section - 3 for Project Details and General Specifications.

#### **1.2 TECHNICAL PARTICULARS**

Minimum creepage for Insulators (@ 25 mm /kV) - 10500 mm  
Minimum Zinc coating on Support Structure - 610 grams/ sq meter

Rest as per the following NTPC Specifications attached herewith:

- (i) For 400kV SF6 Circuit Breakers refer SCCL (2X600MW) BTG package, Technical Specification: Section-VI, Part-B, Technical Specifications, Sub Section-B-17, SWITCHYARD-CIRCUIT BREAKER, and Page 1 to 13.
- (ii) For 132kV SF6 Circuit Breakers refer Technical Specification :132KV START UP POWER FOR SCCL 2X600 MW TPS AT ADILABAD PROJECT , SPEC. NO TBEM-81009-132KV START UP POWER SPECIFICATION,CHAPTER-E1: CIRCUIT BREAKER, Page E1-1 to 12.

#### **1.3 QUANTITIES**

##### **1.3.1 Main Equipment:**

Sl.No.	Description	Quantity (in Nos.)
1	420 KV, 3150 A, 50 kA for 1 sec , SF6 Circuit Breakers without PIR, Pneumatic/Electrically Spring Charged/Electro-Hydraulic mechanism with single and three phase high speed auto reclosing and with Support Structure	7
2	420 KV, 2000 A, 50 kA for 1 sec , SF6 Circuit Breakers without PIR, Pneumatic/Electrically Spring Charged/Electro-Hydraulic mechanism with single and three phase high speed auto reclosing and with Support Structure	7
3	145KV, 1600 A, 31.5 kA for 1 sec , SF6 Circuit Breakers without PIR, Spring/Pneumatic mechanism without auto reclosing and with Support Structure	2

Sl.No.	Description	Quantity (in Nos.)
4	145KV, 1250 A, 31.5 kA for 1 sec , SF6 Circuit Breakers without PIR, Spring/Pneumatic mechanism with single and three phase high speed auto reclosing and with Support Structure	2
5	145KV, 1250 A, 31.5 kA for 1 sec , SF6 Circuit Breakers without PIR, Spring/Pneumatic mechanism without auto reclosing and with Support Structure	1

Each Circuit Breaker (400kV and 132kV) shall be supplied with following accessories as required for the satisfactory operation of the breaker.

- i) Support Structure
- ii) Interpole cabling, pipes, cable tray of associated size, etc.
- iii) Gas filling adaptor.
- iv) Foundation bolts.
- v) Any other accessory/device required for the satisfactory operation of the breaker.

### **1.3.2 Mandatory Maintenance Equipment for 420kV Circuit Breaker:**

Sl No.	Description	Quantity (in Nos.)
1	SF6 Gas Filling and Evacuating Device (Portable)	1
2	SF6 Gas Recycling and Purifying plant(300liters)	1
3	SF6 Gas Leak Detector	1

### **1.3.3 Mandatory Spares:**

#### **1.3.3.1 Mandatory Spares for 420 KV, 3150 A, 50 kA for 1 sec , SF6 Circuit Breakers:**

Sl. No.	Item Description	Unit	Quantity (in Nos.)
1	Relays, power contactors, switch-fuses for electrical control circuit (one set consisting of one no. each of all types for one circuit breaker)	set	1
2	Set of gaskets, ring & seals	set	1
3	Molecular filter for circuit breaker	set	1
4	Tripping and closing coil (one set consisting of one no. each of all types)	set	3
5	Spring charging motors	no.	1

### **1.4 Type tests**

Bidder shall submit valid type test reports of the tests carried out. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test (s) should have been either conducted at an independent laboratory or should have been witnessed by a client. These test reports shall be vetted by SSCL/NTPC/BHEL at contract stage. If any test report(s) is not acceptable by customer during contract execution stage, same has to be conducted by bidder without any commercial and delivery implication.

### **1.5 OPTIONAL TYPE TEST REQUIREMENTS FOR 400KV CIRCUIT BREAKERS.**

**Type test charges will be optional. These charges shall be valid for the entire tenure of the contract. BHEL reserves the right to delete the optional type tests at time of contract.**

The contractor shall carry out the type tests as listed below on the **400kV Circuit Breaker** to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately and the same shall be considered for the evaluation of the bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.

**List of type tests on 420kV Circuit Breakers:**

Sl No.	Type test On 420kV Circuit Breaker
1	Dielectric Tests
2	Radio Interference Test
3	Corona Test
4	Temperature Rise Test
5	Short Time withstand current and peak withstand current tests
6	Mechanical operation Test at ambient temp. (M1)
7	Short Circuit Test making and breaking test
8	Capacitive current switching test line charging current breaking test(C2)
9	Verification of degree of protection of boxes
10	Static terminal load tests <b>(Submission of calculations only , no charges are required)</b>
11	Short Line Fault Tests
12	Out of Phase making & breaking test
13	Switching of Shunt Reactor(50-80 MVAR)

- 1.51 The type test shall be carried out in presence of employer's representative for which minimum 15 days notice shall be given by contractor .The contractor shall obtain the employer's approval for the type test procedure before conducting the type test. The type test procedure clearly specify the test set up, instruments to be used, procedure, acceptance norms, recording of different parameters interval of recording ,precautions to be taken etc. for the type tests (s) to be carried out.
- 1.5.2 In case contractor has already conducted such specified type test(s), he may submit during detailed engineering the type test reports to the owner for waiver of conductance of such type test(s).These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test (s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type tests (s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
- 1.5.3 All acceptance and routine tests as per the specification and relevant standard shall be carried out. Charges for these shall be deemed to be included in the equipment price.
- 1.5.4 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of SCCL, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

**1.6 Supervision of Erection, Commissioning & Site Testing:**

Sl. no.	Description	Unit	Quantity (in Nos.)
1.	Supervision of Erection ,Testing & Commissioning of all 420kV Breakers with special tools and test instruments* in Bidder scope	1 lot	14
2.	Supervision of Erection, Testing & Commissioning of all 145kV Breakers with special tools and test instruments* in Bidder scope	1 lot	5

Note: 1 lot= 1 Circuit Breaker

The Supervision of testing and commissioning shall be inclusive of the following:

- i. Testing equipments required for testing.
- ii. To and Fro fares from Bidder's headquarter to BHEL site.
- iii. Accommodation and conveyance at site.
- iv. Any other incidental charges.

No other charges shall be paid by BHEL.

### **1.7 PROVENNESS OF CIRCUIT BREAKERS**

Bidders must meet the Provenness Criteria for 400kV and 132kV Circuit Breakers stipulated in ATTACHMENT-3A28 (2 sheets) attached herewith at Section-5 as Annexure. The Provenness data must be furnished with the offer.

#### Notes:-

- I. '\*' - The following instruments/kits shall be brought out at site by Bidder/supplier:
  - (a) Time Interval meter (Timing kit)
  - (b) Gas leak Detector

The following instruments/kits shall be provided by BHEL at site:

- (a) Circuit Breaker Analyzer- (Make- SCOPE T&M HISAC 2406) - Adaptor/Transducer for above Analyzer suitable for your Breaker shall be in scope of bidder.
- (b) DCRM
- (c) Dew Point Meter
- (d) Megger
- (e) Multimeter

Bidder must have considered in their offer the following equipments:

- (i) 1 set of adopter/transducer for analyser for 420kV SF6 Circuit Breaker.
- (ii) 1 set of adopter/transducer for analyser for 145kV SF6 Circuit Breaker.
- (iii) 1 set of Gas filling adaptor for 420kV SF6 Circuit Breaker.
- (iv) 1 set of Gas filling adaptor for 145kV SF6 Circuit Breaker.

# 400 KV CIRCUIT BREAKER

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	<b>CIRCUIT BREAKER</b>				
1.00.00	<p><b>GENERAL</b></p> <p>Circuit Breakers shall be outdoor type, comprising three identical single pole units, complete in all respects with all fittings and wiring. The circuit breakers and accessories shall conform to IEC-62271-100 or equivalent Indian standard.</p>				
2.00.00	<p><b>DUTY REQUIREMENTS</b></p>				
2.01.00	<p>Circuit breaker shall be totally restrike free under all duty conditions and shall be capable of performing their duties without opening resistor. The circuit breaker shall meet the duty requirement of any type of fault or fault location and shall be suitable for line charging and dropping when used on 400 kV effectively grounded or ungrounded systems and perform make and break operations as per the stipulated duty cycles satisfactorily. The circuit breaker shall meet the requirements of C2/M1 type of duty as per IEC.</p>				
2.02.00	<p>The circuit breaker shall be capable for breaking the steady &amp; transient magnetising current corresponding to 400kV/132KV transformers up to 500 MVA rating. It shall also be capable of breaking line charging currents as per IEC with a voltage factor of 1.4.</p>				
2.03.00	<p>The rated transient recovery voltage for terminal fault and short line faults shall be as per IEC.</p>				
2.04.00	<p>The circuit breakers shall be reasonably quiet in operation. Noise level in excess of 140 dB measured at base of the breaker would be unacceptable. Bidder shall indicate the noise level of breaker at distance of 50 to 150 m from base of the breaker.</p>				
2.05.00	<p>The Bidder may note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, pneumatic/hydraulic pressure and arc extinguishing medium pressure, etc. While furnishing the proof of the total break time of complete circuit breaker, the Bidder may specifically bring out the effect of non-simultaneity within a pole and between poles and show how it is covered in the guaranteed total break time.</p>				
2.06.00	<p>While furnishing particulars regarding the D.C. component of the circuit breaker, the Bidder shall note that IEC requires that this value should correspond to the guaranteed minimum opening time under any condition of operation.</p>				
2.07.00	<p>The critical current which gives the longest arc duration at lock out pressure of extinguishing medium and the duration shall be indicated.</p>				
2.08.00	<p>All the duty requirements specified above shall be provided with the support of adequate test reports to be furnished along with the bid.</p>				
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center; vertical-align: top;"> <p>SINGARENI THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE</p> </td> <td style="width: 33%; text-align: center; vertical-align: top;"> <p>TECHNICAL SPECIFICATIONS SECTION - VI PART-B</p> </td> <td style="width: 33%; text-align: center; vertical-align: top;"> <p>SUB-SECTION-B-17 SWITCHYARD - CIRCUIT BREAKER</p> </td> <td style="width: 33%; text-align: center; vertical-align: top;"> <p>PAGE 1 OF 13</p> </td> </tr> </table>		<p>SINGARENI THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION - VI PART-B</p>	<p>SUB-SECTION-B-17 SWITCHYARD - CIRCUIT BREAKER</p>	<p>PAGE 1 OF 13</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.00.00	<b>CONSTRUCTIONAL FEATURES</b>		
3.01.00	<p>All making and breaking contacts shall be sealed and free from atmospheric effect. In the event of leakage of extinguishing medium to a value, which cannot withstand the dielectric stresses specified in the open position, the contacts shall preferably self close. Main contacts shall be first to close and the last to open and shall be easily accessible for inspection and replacement. If there are no separately mounted arcing contacts, then the main contacts shall be easily accessible for inspection and replacement. Main contacts shall have ample area and contact pressure for carrying the rated current under all conditions. All current carrying contact surfaces shall be silver plated. The thickness of silver plating shall not be less than 25 microns. The interrupter sectional drawing showing the following conditions shall be furnished for information with the bid:</p> <ul style="list-style-type: none"> <li>a) Close position</li> <li>b) Arc initiation position</li> <li>c) Full arcing position</li> <li>d) Arc extinction position</li> <li>e) Open position.</li> </ul>		
3.02.00	All the three poles of the breaker shall be linked together either electrically/pneumatically or electro hydraulically.		
3.03.00	Circuit breakers shall be provided with two (2) independent trip coils, suitable for trip circuit supervision. The trip circuit supervision relay would also be provided. Necessary terminals shall be provided in the central control cabinet of the circuit breaker.		
4.00.00	<b>SULPHUR HEXAFLORIDE (SF6) GAS CIRCUIT BREAKER</b>		
4.01.00	Circuit breakers shall be single pressure type.		
4.02.00	Design and construction of the circuit breaker shall be such that there is minimum possibility of gas leakage and entry of moisture. There should not be any condensation of SF6 gas on insulated surfaces of the circuit breaker.		
4.03.00	In the interrupter assembly, there shall be absorbing product box to eliminate SF6 decomposition products and moisture. The details and operating experience with such filters shall be brought out in additional information schedule.		
4.04.00	Each pole shall form an enclosure filled with SF6 gas independent of two other poles. Common monitoring of SF6 gas can be provided for the three poles of circuit breaker having a common drive. The interconnecting pipes in this case shall be such that the SF6 gas from one pole could be removed for maintenance purposes.		
4.05.00	Material used in the construction of circuit breakers shall be such as fully compatible with SF6.		
4.06.00	The SF6 gas density monitor shall be adequately temperature compensated to model the density changes due to variations in ambient temperature within the body of circuit breaker as a whole. It shall be possible to dismantle the monitor without removal of gas.		
SINGARENI THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-17 SWITCHYARD - CIRCUIT BREAKER	PAGE 2 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.07.00	Sufficient SF6 gas shall be supplied to fill all the circuit breakers installed plus an additional 20% of the quantity as spare.		
5.00.00	<b>OPERATING MECHANISM</b>		
5.00.01	Circuit breaker shall be operated by pneumatic mechanism or electrically spring charged mechanism or electro-hydraulic mechanism or a combination of these.		
5.00.02	The operating mechanism shall be anti-pumping and trip free (as per IEC definition) electrically and either mechanically or pneumatically under every method of closing. The mechanism of the breaker shall be such that the position of the breaker is maintained even after the leakage of operating media and/or gas.		
5.00.03	The operating mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operation of the power operated closing devices. A mechanical indicator shall be provided to show open and close positions of breaker. It shall be located in a position where it will be visible to a man standing on the ground with the mechanism housing door closed. An operation counter shall also be provided.		
5.00.04	Closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip coils shall operate correctly under all operating conditions of the circuit breaker upto the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage. If additional elements are introduced in the trip coil circuit their successful operation for similar applications of outdoor breaker shall be clearly brought out in the bid.		
5.00.05	Working parts of the mechanism shall be of corrosion resisting material. Bearings requiring grease, shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker.		
5.00.06	Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coil. Provision shall also be made for local electrical control. 'Local / remote' selector switch and close & trip push buttons shall be provided in the breaker central control cabinet. Remote located push buttons and indicating lamps shall also be provided.		
5.00.07	Operating mechanism and all accessories shall be in local control cabinet. A central control cabinet for the three poles of the breaker shall be provided along with supply of necessary tubing, cables, etc.		
5.00.08	Provisions shall be made on breakers for attaching an operation analyser to perform speed tests after installation at site to record contact travel against time and measure opening time.		
5.00.09	The Bidder shall furnish curve supported by test data indicating the opening time under close-open operation with combined variation of trip coil and operating media along with the bid.		
SINGAREM THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-17 SWITCHYARD – CIRCUIT BREAKER	PAGE 3 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.01.00	<b>Pneumatically Operated Mechanism</b>		
5.01.01	Bidder shall offer unit compressor with each circuit breaker. The unit compressor are to be located outdoor near the breaker(s).		
5.01.02	The breaker local air receivers shall comply with the requirement specified, and shall have sufficient capacity for two 'CO'operations of the breaker at the lowest pressure for reclose duty without refilling.		
5.01.03	Independently adjustable pressure switches with potential free ungrounded contacts to actuate lockout device shall be provided. This lock out device with provision for remote alarm indication shall be incorporated in the circuit breaker to prevent operation whenever the pressure of the operating medium is below that required for satisfactory operation at the specified rating. The scheme should permit operation of all block and alarm relays as soon as the pressure transient present during the rapid pressure drop has been damped and a reliable pressure measurement can be made. Such facilities shall be provided for following conditions :		
	<ul style="list-style-type: none"> <li>a) Trip lockout pressure - 2 nos.</li> <li>b) Close lockout pressure - 1 no.</li> <li>c) Extreme low pressure - 1 no.</li> <li>d) Auto reclose lock out pressure - 1 no.</li> </ul>		
5.01.04	The compressed air mechanism shall be capable of operating the circuit breaker under all duty conditions with the air pressure immediately before operation between 85% and 110% of the rated supply pressures. The make/break time at this supply pressure shall not exceed the specified make/ break time within any value of trip coil supply voltage as specified.		
5.02.00	<b>Spring Operated Mechanism</b>		
5.02.01	Spring operated mechanism shall be complete with motor, opening spring & closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit. Opening spring shall be supplied with limit switch for automatic charging and other necessary accessories.		
5.02.02	As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty. After failure of power supply to the motor, one close-open operation shall be possible with the energy contained in the operating mechanism.		
5.02.03	Breaker operation shall be independent of the motor, which shall be used solely for compressing the closing spring.		
5.02.04	Motor shall comply with the requirements specified in Chapter-B-25. Motor ratings shall be such that it requires not more than 30 seconds for fully charging the closing spring.		
SINGARENI THERMAL POWER PROJECT (2X660 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-17 SWITCHYARD - CIRCUIT BREAKER	PAGE 4 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.02.05	Closing action of the circuit breaker shall compress the opening spring ready for tripping.		
5.02.06	When closing springs are discharged, after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.		
5.02.07	The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.		
5.03.00	<b>Hydraulically Operated Mechanism</b>		
5.03.01	Hydraulically operated mechanism shall comprise operating unit with power cylinder, valves, and low pressure reservoir, motor, etc.		
5.03.02	The hydraulic oil used shall be fully compatible for the specified temperature range.		
5.03.03	The oil pressure controlling the oil pump and pressure in the high pressure reservoir shall have adequate number of spare contacts for continuous monitoring of low pressure, high pressure, etc., in control room. The necessary remote equipment shall also be provided.		
5.03.04	The mechanism shall be suitable for at least two close open operations after failure of ac supply to the motor starting at pressure equal to lowest pressure of auto-reclose duty.		
5.03.05	The hydraulically operated mechanism shall be capable of operating the circuit breaker correctly and performing the duty cycle specified under all conditions with the pressure of hydraulic operated fluid in the operating mechanism at the lowest permissible pressure before make up. The operating time at the lowest pressure for a particular operation shall not exceed the guaranteed operating time within any value of trip coil-supply voltage as specified.		
5.03.06	Trip lockout shall be provided to prevent operations of the circuit breaker below the minimum specified hydraulic pressure. Alarm contacts for loss of nitrogen shall be provided and wired suitably upto the central control cabinet.		
5.03.07	All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage at a minimum of 1.5 times maximum working pressure.		
5.04.00	<b>FITTINGS AND ACCESSORIES</b>		
5.04.01	Following is partial list of some of the major fittings and accessories to be furnished as integral part of the breakers. Number and exact location of these parts shall be indicated in the bid.  <b>Control unit / Central control cabinet</b> in accordance with Chapter-B-25 complete with: <ul style="list-style-type: none"> <li>a) Double compression type cable glands, lugs, ferrules, etc.</li> <li>b) Local/remote changeover switch</li> </ul>		
SINGAREM THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-17 SWITCHYARD - CIRCUIT BREAKER	PAGE 5 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS				
	<ul style="list-style-type: none"> <li>c) Operation counter</li> <li>d) Fuses, as required</li> <li>e) Antipumping relay/contactor</li> <li>f) Rating and diagram plate in accordance with IEC including year of manufacture, etc.</li> <li>g) Gauges for SF6 gas pressure, pneumatic/hydraulic pressure.</li> <li>h) Gas density monitor with alarm and lockout contacts</li> </ul>				
6.00.00	<b>Fittings and Accessories</b>				
6.01.00	<p><b>Hollow insulator columns</b></p> <p>The insulators shall conform to requirements stipulated in Chapter-B-25. All routine tests shall be conducted on the insulators as per relevant IEC. In addition the following routine tests shall also be conducted on hollow column insulators :</p>				
	<ul style="list-style-type: none"> <li>a) Ultrasonic test</li> <li>b) Pressure test</li> <li>c) Bending load test in 4 directions at 50% specified bending load.</li> <li>d) Bending load test in 4 directions at 100% specified Bending load as a sample test.</li> <li>e) Burst pressure test as a sample test.</li> </ul>				
6.02.00	<p><b>Support Structures</b></p> <p>The minimum height of equipment supports shall be 2.55 meters. The height of center line of conductor shall be as given elsewhere in the specification.</p>				
6.03.00	<b>Terminal connectors</b> shall conform to requirements stipulated in Chapter B-25.				
6.04.00	<b>Additional fittings for Pneumatic Circuit Breaker</b>				
	<ul style="list-style-type: none"> <li>a) Unit compressed air system.</li> <li>b) Breaker local air receivers</li> <li>c) Pressure gauge, spring-loaded safety valve and pressure switch with adjustable contacts</li> <li>d) Pressure switch to initiate an alarm if the pressure in the auxiliary reservoir falls below a preset level for longer than it is normally necessary to refill the reservoir.</li> <li>e) Stop, non-return and other control valves, piping and all accessories upto breaker mechanism housing.</li> </ul>				
6.05.00	<p><b>Unit Compressed Air System</b></p> <p>The unit compressed air system for each breaker shall be provided with compressed air piping, piping accessories, control and non-return valves, filters, coolers of adequate capacity, pressure reducing valves(if any), isolating valves, drain ports, etc.</p>				
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center; vertical-align: top;"> SINGARENI THERMAL POWER PROJECT  (2X660 MW)  BOILER TURBINE GENERATOR PACKAGE </td> <td style="width: 33%; text-align: center; vertical-align: top;"> TECHNICAL SPECIFICATIONS  SECTION - VI  PART-B </td> <td style="width: 33%; text-align: center; vertical-align: top;"> SUB-SECTION-B-17  SWITCHYARD –  CIRCUIT BREAKER </td> <td style="width: 33%; text-align: center; vertical-align: top;"> PAGE  6 OF 13 </td> </tr> </table>		SINGARENI THERMAL POWER PROJECT (2X660 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-17 SWITCHYARD – CIRCUIT BREAKER	PAGE 6 OF 13
SINGARENI THERMAL POWER PROJECT (2X660 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-17 SWITCHYARD – CIRCUIT BREAKER	PAGE 6 OF 13		

CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.05.01	<p><b>Air Compressor:</b></p> <p>a) The air compressor shall be driven by automatically controlled motor. It shall be of air cooled type complete with preferably oil-less cylinder lubrication. The compressors or pumps shall be mounted within the operating mechanism housing or a separate weather-proof and dust-proof housing. The motors shall conform to requirements of Chapter-B-25.</p> <p>b) The compressor size shall be such that it is capable of performing following operations satisfactorily :</p> <p>i) Total running time of compressor not exceeding 45 minutes per day, considering 2% leakage and 2 CO-operations.</p> <p>ii) Air charging time not exceeding 20 minutes after one CO operation of the breaker.</p> <p>c) The compressor shall be provided with automatic adjustable unloading device, if necessary, during starting. Each compressor shall be equipped with a time totaliser.</p> <p>d) In accordance with the requirements stipulated under Part-I, the compressors and its accessories shall conform to the type tests and shall be subject to routine tests as per applicable standards.</p>		
6.05.02	<p><b>Intercooler and After cooler :</b></p> <p>Intercooler between compressor stage and after cooler at discharge of H.P. cylinder shall be included in Contractor's scope. They shall be of air cooled type and shall be designed as per ASME Code of IEMA Standards. The design pressure on the air side of cooler shall be 1.25 times the working pressure. A corrosion allowance of 3mm shall be included for all steel parts.</p>		
6.05.03	<p><b>Air Receivers :</b></p> <p>a) The capacity of receivers shall be sufficient for two (2) CO operations of the breaker.</p> <p>b) Air receiver shall be designed in accordance with the latest edition of the ASME Code for Pressure Vessel - Section VIII of BS:5179. A corrosion allowance of 3.0 mm shall be provided for shell and dished ends. Receivers shall be hot dip galvanized.</p> <p>c) Accessories such as suitable sized safety valve to relieve full compressor discharge at a set pressure equal to 1.1 times the maximum operating pressure, dial type pressure gauge with isolating and drain valve and test connection shall be provided.</p> <p>d) <b>Quality of Air :</b></p> <p>Compressed air used shall be dry and free of dust particles. Arrangement for conditioning the compressed air shall be provided as an integral part of air compressor system. The quality of air shall be compatible with the parts used in the system. All necessary components required to make it compatible shall be included.</p>		
SINGAREN THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-17 SWITCHYARD - CIRCUIT BREAKER	PAGE 7 OF 13

CLAUSE NO.	TECHNICAL REQUIREMENTS
6.06.00	<p><b>Controls and Control Equipment :</b></p> <p>a) The compressor control shall be of automatic start stop type initiated by pressure switches on the receiver. Supplementary manual control shall also be provided.</p> <p>b) All control equipment shall be housed in a totally enclosed cabinet. Pressure gauges and other indicating devices, control switches shall be mounted on the control cabinet.</p> <p>c) Facility to annunciate failure of power supply to the compressor control shall also be provided.</p>
6.07.00	<p><b>Compressed Air Piping, Valves and Fittings:</b></p> <p>a) The flow capacity of all valves shall be at least 20% greater than the compressor capacity.</p> <p>b) The high pressure system shall be such that after one 0 - 0.3 Sec - CO operation, the breaker shall be capable of performing one CO operation within 3 minutes.</p> <p>c) All compressed air piping shall be bright annealed, seamless phosphorous Deoxidized Non-Arsenical Copper alloy or stainless steel pipe (C-106 of BS: 2871).</p> <p>d) All joints and connections in the piping system shall be brazed or flared as necessary.</p> <p>e) Compressed air piping system shall be supplied in clean, sealed and packed condition. Before installation, the pipes shall be again cleaned properly to remove dust, brazing particles, etc.</p>
6.08.00	<p><b>Mandatory Maintenance Equipment :</b></p> <p>The Contractor shall include in his proposal maintenance equipment in accordance with requirements attached at annexure-I of this chapter.</p>
7.00.00	<b>TESTS</b>
7.01.00	<p><b>TYPE TESTS TO BE CONDUCTED</b></p> <p>The following type tests shall be conducted on Circuit breakers in accordance with the requirements stipulated under Chapter-B-16</p> <p>a) Dielectric test</p> <p>b) Radio Interference voltage test</p> <p>c) Corona Test</p> <p>d) Temperature rise tests (For each current rating)</p> <p>e) Short-time withstand current and peak withstand current test</p> <p>f) Mechanical operation test at ambient temperature (M1)</p> <p>g) Short circuit current making and braking test</p> <p>h) Capacitive current switching tests: line charging current breaking tests (C2)</p> <p>i) Verification of degree of protection of boxes</p> <p>j) Static terminal load tests</p>

SINGAREM THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-17 SWITCHYARD - CIRCUIT BREAKER	PAGE 8 OF 13
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	k) Short-line fault tests  l) Out-of-phase making and breaking test m) Switching of shunt reactor (50-80MVAR)				
7.02.00	<b>Routine Tests</b>  Routine tests as per IEC-62271-100 on the complete breaker/ pole alongwith its own operating mechanism and pole column shall be performed on all circuit breakers.				
7.03.00	<b>Site Tests</b>  All routine tests except power frequency voltage dry withstand test on breaker shall be repeated on the completely assembled breaker at site.				
8.00.00	<b>PARAMETERS</b>				
8.01.00	<b>General</b>				
	a) Type of circuit breaker                      Outdoor SF6, single pressure, live tank type  b) Rated frequency                                      50 Hz  c) Number of poles                                      Three (3)  d) Rated operating duty cycle                      O - 0.3 sec. - CO - 3min. - CO  e) Reclosing    Single and three phase high speed auto reclosing (as required)  f) Total closing time                                      Not more than 150 ms.  g) Trip and closing coil voltage                      220V DC  h) Auxiliary contacts                                      Total 10 NO and 10 NC contacts per pole. The contacts shall have continuous rating of 10A and breaking capacity of 2A with circuit time constant of minimum 20 millisecond at 220V DC.  i) Noise level    Maximum 140dB at 50m distance from base of circuit breaker  j) Rated terminal load                                      Adequate to withstand 100kg static load as well as wind, seismic and short circuit forces without impairing reliability or current carrying capacity.  k) Temperature rise over                                      As per IEC62271-100				
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center; padding: 5px;">           SINGAREN THERMAL POWER PROJECT            (2X600 MW)            BOILER TURBINE GENERATOR PACKAGE         </td> <td style="width: 33%; text-align: center; padding: 5px;">           TECHNICAL SPECIFICATIONS            SECTION - VI            PART-B         </td> <td style="width: 33%; text-align: center; padding: 5px;">           SUB-SECTION-B-17            SWITCHYARD -            CIRCUIT BREAKER         </td> <td style="width: 33%; text-align: center; padding: 5px;">           PAGE            9 OF 13         </td> </tr> </table>		SINGAREN THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-17 SWITCHYARD - CIRCUIT BREAKER	PAGE 9 OF 13
SINGAREN THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-17 SWITCHYARD - CIRCUIT BREAKER	PAGE 9 OF 13		

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	Ambient l) Type of operating mechanism m) Rated ambient temperature n) System neutral earthing o) Seismic acceleration p) Support structure height	Pneumatic/spring/hydraulic/or a combination of these 50 degree Centigrade Effectively earthed 0.3 g horizontal Adequate so that lowest part of support insulator of equipment is minimum 2550 mm from ground or plinth level.
8.02.00	<b>400kV Class Circuit Breakers</b> a) Rated voltage b) Rated continuous current current capacity c) Rated line charging breaking Current (voltage factor of 1.4) d) Rated small inductive current Breaking capacity e) First pole to clear factor f) Symmetrical interrupting Capability g) Rated short circuit making current h) i) Short line current carrying Capability for one second ii) Out of phase breaking current Capacity i) Rated break time i) 40 ms under test duties 2,3 & 4 at rated values ii) 45 ms under test duties 1 to 5 and short line fault test duties and combined variation of trip coil voltage, operating pressure and quenching media pressure, etc.	420 kV rms Minimum 2000/3150 A at rated ambient temperature 600A at 90° C leading power factor with maximum permissible switching overvoltage of 2.3 pu. Corresponding to interrupting steady and transient magnetising current of 50 to 630 MVA transformers with overvoltage less than 2.3 pu 1.3 50kA, rms. 125 kAP 50 kA, rms. 12.5kA, rms.

CLAUSE NO.	TECHNICAL REQUIREMENTS	
j)	Rated one minute power frequency withstand voltage	i) 520 kV rms between live terminals and earth. ii) 610 kV rms across isolating distance.
k)	Rated lightning impulse withstand voltage	i) $\pm 1425$ kVp between live terminals and earth. ii) $\pm 1425$ kVp impulse on one terminal and 240 kVp power freq. voltage of opposite polarity on other terminal (across isolating distance).
l)	Rated switching impulse withstand voltage	i) $\pm 1050$ kVp between live terminals and earth. ii) $\pm 900$ kVp impulse on one terminal and 345 kVp power freq. voltage of opposite polarity on other terminal (across isolating distance).
m)	Max. Radio interference	1000 micro volts for freq. between 0.5 MHz and 2.0 MHz at voltage 266 kV rms.
n)	Phase to phase spacing	7000 mm
o)	Corona extinction voltage	Not less than 320 kV rms
p)	Pre-insertion resistor rating	400 ohms with minimum pre-insertion time of 8 millisecc. (wherever applicable)

## TECHNICAL REQUIREMENTS

ANNEXURE-I

### SPECIFICATION OF MANDATORY MAINTENANCE EQUIPMENT

(Refer cl. 6.08.00 of this section)

#### 1.0 SF6 Gas Handling Plants:-

##### a) SF6 gas filling and evacuating equipment(Portable) :

The capacity of this plant shall be such that it shall not take appreciable time for filling or evacuating of the complete 3 pole breaker. The required vacuum for complete evacuation shall be attained with the help of this plant.

##### b) SF6 gas filtering, drying, storage and recycling plant:

This shall include all the necessary devices for measurement of purity, moisture content, decomposition products etc. of SF6 gas. Mixing with air/oil/moisture during above process should be proved to be Nil during testing.

The plant shall be complete with accessories and fittings so that SF6 gas from the breaker can be directly filled in the plant storage reservoir.

In case purging of the equipment before filling with SF6 gas is desirable, then the required equipment for dry gases etc. shall be furnished as a part of the plant.

For heavy items within the plant, the lifting hooks shall be provided for lifting and moving with the overhead cranes.

The capacity of the plant shall be such as to handle and store 300 Litres of SF6 gas.

1.1 i. These SF6 gas handling plants shall be complete with all the necessary pipes, couplings flexible tubes and valves for coupling to the equipment.

ii. The design and construction of the plant, valves, couplings, connections shall be such that leakage of SF6 gas shall be minimum. Similarly valves, couplings and pipe work shall be so arranged that accidental loss of gas to the atmosphere shall be minimum.

1.2 SF6 gas decomposition analysing equipment and instruments should have capacity for performing the following functions:

- a) The moisture content measurement or alternatively dew point measurement.
- b) The air content measurement.
- c) Sensitivity should not be affected by dust, humidity, heat & wind etc.

NOTE: The equipments should have in-built calibration facility. The calibration/sensitivity check shall be demonstrated at breaker supplier's works/site/manufacturers works.

## TECHNICAL REQUIREMENTS

### 1.3 SF6 Gas leak detector:

The SF6 gas leak detector shall meet the following requirements:

- a) The detector shall be free from induced voltage effects.
- b) The sensing probe shall be such that it can reach all the points on the breaker where leakage is to be sensed.
- c) The accuracy of the equipment shall be at least 10 ppm.

### 1.4 Operational Analyser ( along with DCRM Kit ) :

The operational analyser shall meet the following requirements:

- a) Operational analyser shall be one complete system, which once installed should record all the parameters, as laid down in subsequent clauses.
- b) It shall have facility to record the breaker contact movement during opening, closing, auto reclosing and make-break operation, the speed of contacts at various stages of operation, travel of contacts, opening time, closing time and make break time, etc.
- c) The analyser shall have provisions for recording atleast 12 different functions of the circuit breaker. All necessary transducer (i.e three nos. for complete 3 phase speed and travel record of breaker), cables, pickups, attachments required for the breaker shall be supplied with the analyser. The cables supplied shall be sufficient enough for recordings at site on a completely assembled and erected breaker.
- d) The operational analyzer must have facility to measure Dynamic Contact Resistance of arcing contact and main contact with minimum 100 A DC current while closing / opening of circuit breaker. The necessary software ( window based) for analysis of the measured data shall also be supplied along with the kit excluding computer / laptop). This software shall be demonstrated at site during commissioning. The DCR test kit shall be suitable for simultaneous measurement of DCR of both the breaks of a pole of the circuit breaker.
- e) The analyser shall be suitable for operation outdoor and shall be suitably shielded against induced charges.
- f) The output of the analyser shall be on a plain paper or any paper having infinite shelf life and the output thus obtained shall have a long life and shall not require any special storage facility. Photographic paper is not acceptable.
- g) All the necessary catalogues, write up for operation and maintenance of the analyser shall be furnished alongwith each analyser and peripheral system.
- h) Demonstration at breaker manufacturer's premises for functional/operational check and compatibility with breaker.

# 132KV CIRCUIT BREAKER

<b>CHAPTER - E1 : CIRCUIT BREAKER</b>	
1.00.00	<b>GENERAL</b>  Circuit Breakers shall be outdoor type, comprising three identical single pole units, complete in all respects with all fittings and wiring. The circuit breakers and accessories shall conform to IEC- 62271-100 or equivalent Indian Standard.
2.00.00	<b>DUTY REQUIREMENTS</b>
2.01.00	Circuit breaker shall be C2/M1 class under all duty conditions and shall be capable of performing their duties without opening resistor. The circuit breaker shall meet the duty requirement of any type of fault or fault location and shall be suitable for line charging and dropping when used on 400/132 kV effectively grounded or ungrounded systems and perform make and break operations as per the stipulated duty cycles satisfactorily.
2.02.00	The circuit breaker shall be capable for breaking the steady & transient magnetizing current corresponding to 400/132 kV transformers up to 630 MVA rating. It shall also be capable of breaking line charging currents as per IEC- 62271-100 with a voltage factor of 1.4.
2.03.00	The rated transient recovery voltage for terminal fault and short line faults shall be as per IEC:62271-100.
2.04.00	The circuit breakers shall be reasonably quiet in operation. Noise level in excess of 140 dB measured at base of the breaker would be unacceptable. Bidder shall indicate the noise level of breaker at distance of 50 to 150 m from base of the breaker.
2.05.00	The Bidder may note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, pneumatic/hydraulic pressure and arc extinguishing medium pressure, etc. While furnishing the proof of the total break time of complete circuit breaker, the Bidder may specifically bring out the effect of non-simultaneity between same pole and poles and show how it is covered in the guaranteed total break time.
2.06.00	While furnishing particulars regarding the D.C. component of the circuit breaker, the Bidder shall note that IEC-62271-100 requires that this value should correspond to the guaranteed minimum opening time under any condition of operation.
2.07.00	The critical current which gives the longest arc duration at lock out pressure of extinguishing medium and the duration shall be indicated.
2.08.00	All the duty requirements specified above shall be provided with the support of adequate test reports to be furnished along with the bid.
3.00.00	<b>CONSTRUCTIONAL FEATURES</b>
3.01.00	All making and breaking contacts shall be sealed and free from atmospheric effect. In the event of leakage of extinguishing medium to a value, which cannot withstand the dielectric stresses specified in the open position, the contacts shall preferably self close. Main

	contacts shall be easily accessible for inspection and replacement. If there are no separately mounted arcing contacts, then the main contacts shall be easily accessible for inspection and replacement. Main contacts shall have ample area and contact pressure for carrying the rated current under all conditions. The interrupter sectional drawing showing the following conditions shall be furnished for information with the bid:
a)	Close position
b)	Arc initiation position
c)	Full arcing position
d)	Arc extinction position
e)	Open position.
3.02.00	All the three poles of the breaker shall be linked together either electrically/pneumatically or electro hydraulically.
3.03.00	Circuit breakers shall be provided with two (2) independent trip coils, suitable for trip circuit supervision. The trip circuit supervision relay would also be provided. Necessary terminals shall be provided in the central control cabinet of the circuit breaker.
4.00.00	<b>SULPHUR HEXAFLORIDE (SF6) GAS CIRCUIT BREAKER</b>
4.01.00	Circuit breakers shall be single pressure type.
4.02.00	Design and construction of the circuit breaker shall be such that there is minimum possibility of gas leakage and entry of moisture. There should not be any condensation of SF6 gas on insulated surfaces of the circuit breaker.
4.03.00	In the interrupter assembly, there shall be absorbing product box to eliminate SF6 decomposition products and moisture. The details and operating experience with such filters shall be brought out in additional information schedule.
4.04.00	Each pole shall form an enclosure filled with SF6 gas independent of two other poles. Common monitoring of SF6 gas can be provided for the three poles of circuit breaker having a common drive. The interconnecting pipes in this case shall be such that the SF6 gas from one pole could be removed for maintenance purposes.
4.05.00	Material used in the construction of circuit breakers shall be such as fully compatible with SF6.
4.06.00	The SF6 gas density monitor shall be adequately temperature compensated to model the density changes due to variations in ambient temperature within the body of circuit breaker as a whole. It shall be possible to dismantle the monitor without removal of gas.
4.07.00	Sufficient SF6 gas shall be supplied to fill all the circuit breakers installed plus an additional 20% of the quantity as spare.
5.00.00	<b>OPERATING MECHANISM</b>
5.00.01	Circuit breaker shall be operated by pneumatic mechanism or electrically spring charged mechanism or electro-hydraulic mechanism or a combination of these. It shall be gang operated in case of 3-phase reclosing operation as applicable.

5.00.02	The operating mechanism shall be anti-pumping and trip free (as per IEC definition) electrically and either mechanically or pneumatically under every method of closing. The mechanism of the breaker shall be such that the position of the breaker is maintained even after the leakage of operating media and/or gas.
5.00.03	The operating mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operation of the power operated closing devices. A mechanical indicator shall be provided to show open and close positions of breaker. It shall be located in a position where it will be visible to a man standing on the ground with the mechanism housing door closed. An operation counter shall also be provided.
5.00.04	Closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip coils shall operate correctly under all operating conditions of the circuit breaker upto the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage. If additional elements are introduced in the trip coil circuit their successful operation for similar applications of outdoor breaker shall be clearly brought out in the bid.
5.00.05	Working parts of the mechanism shall be of corrosion resisting material. Bearings requiring grease, shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker.
5.00.06	Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coil. Provision shall also be made for local electrical control. 'Local / remote' selector switch and close & trip push buttons shall be provided in the breaker central control cabinet. Remote located push buttons and indicating lamps shall also be provided.
5.00.07	Operating mechanism and all accessories shall be in local control cabinet. A central control cabinet for the three poles of the breaker shall be provided along with supply of necessary tubing, cables, etc.
5.00.08	Provisions shall be made on breakers for attaching an operation analyser to perform speed tests after installation at site to record contact travel against time and measure opening time.
5.00.09	The Bidder shall furnish curve supported by test data indicating the opening time under close-open operation with combined variation of trip coil and operating media along with the bid.
5.01.00	<b>Pneumatically Operated Mechanism</b>
5.01.01	Bidder shall offer unit compressor with each circuit breaker. The unit compressor are to be located outdoor near the breaker(s).
5.01.02	The breaker local air receivers shall comply with the requirement specified, and shall have sufficient capacity for two 'CO' operations of the breaker at the lowest pressure for reclose duty without refilling.

5.01.03	Independently adjustable pressure switches with potential free ungrounded contacts to actuate lockout device shall be provided. This lock out device with provision for remote alarm indication shall be incorporated in the circuit breaker to prevent operation whenever the pressure of the operating medium is below that required for satisfactory operation at the specified rating. The scheme should permit operation of all block and alarm relays as soon as the pressure transient present during the rapid pressure drop has been damped and a reliable pressure measurement can be made. Such facilities shall be provided for following conditions :
a)	Trip lockout pressure - 2 nos.
b)	Close lockout pressure - 1 no.
c)	Extreme low pressure - 1 no.
d)	Auto reclose lock out pressure - 1 no.
5.01.04	The compressed air mechanism shall be capable of operating the circuit breaker under all duty conditions with the air pressure immediately before operation between 85% and 110% of the rated supply pressures. The make/break time at this supply pressure shall not exceed the specified make/ break time within any value of trip coil supply voltage as specified.
5.02.00	<b>Spring Operated Mechanism</b>
5.02.01	Spring operated mechanism shall be complete with motor, opening spring & closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit. Opening spring shall be supplied with limit switch for automatic charging and other necessary accessories.
5.02.02	As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty. After failure of power supply to the motor, one close-open operation shall be possible with the energy contained in the operating mechanism.
5.02.03	Breaker operation shall be independent of the motor, which shall be used solely for compressing the closing spring.
5.02.04	Motor shall comply with the requirements specified in Chapter-E12. Motor ratings shall be such that it requires not more than 30 seconds for fully charging the closing spring.
5.02.05	Closing action of the circuit breaker shall compress the opening spring ready for tripping.
5.02.06	When closing springs are discharged, after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.
5.02.07	The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.
5.03.00	<b>Hydraulically Operated Mechanism</b>
5.03.01	Hydraulically operated mechanism shall comprise operating unit with power cylinder,

	valves, and low pressure reservoir, motor, etc.
5.03.02	The hydraulic oil used shall be fully compatible for the specified temperature range.
5.03.03	The oil pressure controlling the oil pump and pressure in the high pressure reservoir shall have adequate number of spare contacts for continuous monitoring of low pressure, high pressure, etc., in control room. The necessary remote equipment shall also be provided.
5.03.04	The mechanism shall be suitable for at least two close open operations after failure of ac supply to the motor starting at pressure equal to lowest pressure of auto-reclose duty.
5.03.05	The hydraulically operated mechanism shall be capable of operating the circuit breaker correctly and performing the duty cycle specified under all conditions with the pressure of hydraulic operated fluid in the operating mechanism at the lowest permissible pressure before make up. The operating time at the lowest pressure for a particular operation shall not exceed the guaranteed operating time within any value of trip coil-supply voltage as specified.
5.03.06	Trip lockout shall be provided to prevent operations of the circuit breaker below the minimum specified hydraulic pressure. Alarm contacts for loss of nitrogen shall be provided and wired suitably upto the central control cabinet.
5.03.07	All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage at a minimum of 1.5 times maximum working pressure.
5.04.00	<b>Fittings And Accessories</b>
5.04.01	Following is partial list of some of the major fittings and accessories to be furnished as integral part of the breakers. Number and exact location of these parts shall be indicated in the bid.  <b>Control unit / Central control cabinet</b> in accordance with Chapter-E12 complete with:  <ul style="list-style-type: none"> <li>a) Double compression type cable glands, lugs, ferrules, etc.</li> <li>b) Local/remote changeover switch</li> <li>c) Operation counter</li> <li>d) Fuses, as required</li> <li>e) Antipumping relay/contactor</li> <li>f) Rating and diagram plate in accordance with IEC including year of manufacture, etc.</li> <li>g) Gauges for SF6 gas pressure, pneumatic/hydraulic pressure.</li> <li>h) Gas density monitor with alarm and lockout contacts</li> </ul>
6.00.00	<b>FITTINGS AND ACCESSORIES</b>
6.01.00	<b>Hollow insulator columns</b>  The insulators shall conform to requirements stipulated in Chapter-E12. All routine tests shall be conducted on the insulators as per relevant IEC. In addition the following routine tests shall also be conducted on hollow column insulators :  <ul style="list-style-type: none"> <li>a) Ultrasonic test</li> </ul>

	<ul style="list-style-type: none"> <li>b) Pressure test</li> <li>c) Bending load test in 4 directions at 50% specified bending load.</li> <li>d) Bending load test in 4 directions at 100% specified Bending load as a sample test.</li> <li>e) Burst pressure test as a sample test.</li> </ul>
6.02.00	<p><b>Support Structures</b></p> <p>The minimum height of equipment supports shall be 2.55 meters. The height of center line of conductor shall be as given elsewhere in the specification.</p>
6.03.00	<p><b>Terminal connectors</b> shall conform to requirements stipulated in Chapter E12.</p>
6.04.00	<p><b>Additional fittings for Pneumatic Circuit Breaker</b></p> <ul style="list-style-type: none"> <li>a) Unit compressed air system.</li> <li>b) Breaker local air receivers</li> <li>c) Pressure gauge, spring-loaded safety valve and pressure switch with adjustable contacts Pressure switch to initiate an alarm if the pressure in the auxiliary reservoir falls below a preset level for longer than it is normally necessary to refill the reservoir.</li> <li>d) Stop, non-return and other control valves, piping and all accessories upto breaker mechanism housing.</li> <li>e)</li> </ul>
6.05.00	<p><b>Unit Compressed Air System</b></p> <p>The unit compressed air system for each breaker shall be provided with compressed air piping, piping accessories, control and non-return valves, filters, coolers of adequate capacity, pressure reducing valves(if any), isolating valves, drain ports, etc.</p>
6.05.01	<p><b>Air Compressor:</b></p> <ul style="list-style-type: none"> <li>a) The air compressor shall be driven by automatically controlled motor. It shall be of air cooled type complete with preferably oil-less cylinder lubrication. The compressors or pumps shall be mounted within the operating mechanism housing or a separate weather-proof and dust-proof housing. The motors shall conform to requirements of Chapter-E12.</li> <li>b) The compressor size shall be such that it is capable of performing following operations satisfactorily : <ul style="list-style-type: none"> <li>i) Total running time of compressor not exceeding 45 minutes per day, considering 2% leakage and 2 CO-operations.</li> <li>ii) Air charging time not exceeding 20 minutes after one CO operation of the breaker.</li> </ul> </li> <li>c) The compressor shall be provided with automatic adjustable unloading device, if necessary, during starting. Each compressor shall be equipped with a time totaliser.</li> <li>d) In accordance with the requirements stipulated under Part-I, the compressors and its accessories shall conform to the type tests and shall be subject to routine tests as per applicable standards.</li> </ul>
6.05.02	<p><b>Intercooler and After cooler :</b></p>

	<p>Intercooler between compressor stage and after cooler at discharge of H.P. cylinder shall be included in Contractor's scope. They shall be of air cooled type and shall be designed as per ASME Code of IEMA Standards. The design pressure on the air side of cooler shall be 1.25 times the working pressure. A corrosion allowance of 3mm shall be included for all steel parts.</p>
6.05.03	<p><b>Air Receivers :</b></p> <p>a) The capacity of receivers shall be sufficient for two (2) CO operations of the breaker.</p> <p>b) Air receiver shall be designed in accordance with the latest edition of the ASME Code for Pressure Vessel - Section VIII of BS:5179. A corrosion allowance of 3.0 mm shall be provided for shell and dished ends. Receivers shall be hot dip galvanized.</p> <p>c) Accessories such as suitable sized safety valve to relieve full compressor discharge at a set pressure equal to 1.1 times the maximum operating pressure, dial type pressure gauge with isolating and drain valve and test connection shall be provided.</p> <p>d) <b>Quality of Air :</b></p> <p>Compressed air used shall be dry and free of dust particles. Arrangement for conditioning the compressed air shall be provided as an integral part of air compressor system. The quality of air shall be compatible with the parts used in the system. All necessary components required to make it compatible shall be included.</p>
6.06.00	<p><b>Controls and Control Equipment :</b></p> <p>a) The compressor control shall be of automatic start stop type initiated by pressure switches on the receiver. Supplementary manual control shall also be provided.</p> <p>b) All control equipment shall be housed in a totally enclosed cabinet. Pressure gauges and other indicating devices, control switches shall be mounted on the control cabinet.</p> <p>c) Facility to annunciate failure of power supply to the compressor control shall also be provided.</p>
6.07.00	<p><b>Compressed Air Piping, Valves and Fittings:</b></p> <p>a) The flow capacity of all valves shall be at least 20% greater than the compressor capacity.</p> <p>b) The high pressure system shall be such that after one 0 - 0.3 Sec - CO operation, the breaker shall be capable of performing one CO operation within 3 minutes.</p> <p>c) All compressed air piping shall be bright annealed, seamless phosphorous Deoxidized Non-Arsenical Copper alloy or stainless steel pipe (C-106 of BS:2871).</p> <p>d) All joints and connections in the piping system shall be brazed or flared as necessary.</p> <p>e) Compressed air piping system shall be supplied in clean, sealed and packed condition. Before installation, the pipes shall be again cleaned properly to remove dust, brazing</p>

	particles, etc.														
7.00.00	<b>TESTS</b>														
7.01.00	In accordance with the requirements stipulated under clause 2.00.00 of Sub Section General, the circuit breakers along with its operating mechanism shall conform to type tests. List of type tests to be included by Bidder <ul style="list-style-type: none"> <li>a) Dielectric tests</li> <li>b) Radio interference voltage test</li> <li>c) Temperature Rise test</li> <li>d) Short time withstand current and peak withstand test</li> <li>e) Mechanical endurance and environment test</li> <li>f) Short circuit test duties</li> <li>g) Short line fault test</li> <li>h) Out of phase making and breaking test</li> <li>i) Line charging current breaking test</li> <li>j) IP:55 test on each type of box</li> <li>k) Thermal tests on pre-insertion resistors</li> </ul>														
7.02.00	<b>Routine Tests</b>  Routine tests as per IEC-62271-100 on the complete breaker/ pole alongwith its own operating mechanism and pole column shall be performed on all circuit breakers.														
7.03.00	<b>Site Tests</b>  All routine tests except power frequency voltage dry withstand test on breaker shall be repeated on the completely assembled breaker at site.														
8.00.00	<b>PARAMETERS</b>														
8.01.00	<b>General</b>														
	<table border="0"> <tr> <td>a) Type of circuit breaker</td> <td>Outdoor SF6, single pressure , Live tank type</td> </tr> <tr> <td>b) Rated frequency</td> <td>50 Hz</td> </tr> <tr> <td>c) Number of poles</td> <td>Three (3)</td> </tr> <tr> <td>d) Rated operating duty cycle</td> <td>O - 0.3 sec. - CO - 3min. - CO</td> </tr> <tr> <td>e) Rated short circuit breaking current at rated voltage</td> <td>31.5kA with percentage of DC component as per IEC56 corresponding to minimum opening time under operating conditions specified.</td> </tr> <tr> <td>f) Symmetrical interrupting Capability</td> <td>31.5 kArms</td> </tr> <tr> <td>g) Short time current carrying Capability</td> <td>31.5 kArms for One (1) second</td> </tr> </table>	a) Type of circuit breaker	Outdoor SF6, single pressure , Live tank type	b) Rated frequency	50 Hz	c) Number of poles	Three (3)	d) Rated operating duty cycle	O - 0.3 sec. - CO - 3min. - CO	e) Rated short circuit breaking current at rated voltage	31.5kA with percentage of DC component as per IEC56 corresponding to minimum opening time under operating conditions specified.	f) Symmetrical interrupting Capability	31.5 kArms	g) Short time current carrying Capability	31.5 kArms for One (1) second
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h)	Short circuit making current Capability	80 kAp
i)	Rated out-of-phase breaking	7.8 kA rms
j)	Rated line charging breaking Current (voltage factor of 1.4)	As per IEC
k)	Reclosing	Single and three phase high speed auto reclosing (as required)
l)	Total closing time	Not more than 150 ms.
m)	Maximum difference in the instants of closing/opening of contacts	a) As per standard b)
n)	Trip and closing coil voltage	220V DC
o)	Auxiliary contacts	As required plus 10NO and 10NC contacts per pole as spare. The contacts shall have continuous rating of 10A and breaking capacity of 2A with circuit time constant of minimum 20 millisecond at 220V dc.
p)	Noise level	Maximum 140dB at 50m distance from base of circuit breaker
q)	Rated terminal load	Adequate to withstand 100kg static load as well as wind, seismic and short circuit forces without impairing reliability or current carrying capacity.
r)	Temperature rise over Ambient	As per IEC:62271-100
s)	Type of operating mechanism	Pneumatic/spring/hydraulic/or a combination of these
t)	Minimum creepage distance	As indicated in Section – E0
u)	Rated ambient temperature	50 degree Centigrade
v)	System neutral earthing	Effectively earthed
w)	Seismic acceleration	0.3 g horizontal
x)	Support structure height	Adequate so that lowest part of support insulator of equipment is minimum 2550 mm from ground or plinth level.
8.02.00	<b>145 kV CIRCUIT BREAKERS :</b>	

a)	Rated voltage	145 kV, rms.
b)	Rated frequency	50 Hz
c)	No. of poles	3
d)	Type of circuit breaker	Outdoor SF6
e)	Seismic acceleration	0.3g Horizontal
f)	Rated continuous current at an ambient temperature of 50° C	1600/1250 A
g)	Symmetrical interrupting Capability	31.5 kA, rms.
h)	Rated short circuit making current	80 kAP
i)	a) Short time current carrying Capability for one second	31.5 kA, rms.
	b) Out of phase breaking current Capacity	7.8 kA, rms.
j)	Rated line charging breaking current At 90° leading power factor angle (A, rms.) (The breaker shall be able to interrupt the rated line charging current with a test voltage immediately before opening equal to the product of $U/\sqrt{3}$ and 1.4 as per IEC-62271-100).	As per IEC
k)	Rated small inductive current Switching capability with over-voltage less than 2.3 p.u.	0.5 to 10 A
	Interrupting capability of Transformer steady and transient magnetising current	upto 500 MVA
l)	First pole to clear factor	1.5
m)	Rated breaktime	60 ms
n)	Total breaktime	65 ms
o)	Total closing time	Not more than 150 ms
p)	Rated operating duty cycle	0-0.3 S-CO-3 min. -CO
q)	Rated Insulation levels :	
	i) Full wave impulse withstand voltage (1.2/50 micro sec.)	

	between line terminals and ground	$\pm 650$ kV peak
	between terminals with circuit breaker open	$\pm 650$ kV impulse on one terminal and other terminal earthed
ii)	One minute power frequency dry and wet withstand voltage	
	between line terminals and ground	275 kV rms
	between terminals with circuit breaker open	275 kV rms
r)	Max. radio interference voltage for Frequency between 0.5 MHz and 2 MHz at 92 kV rms (Micro volts) both in open and closed position	1000
s)	Min. creepage distance	
	i) Phase to ground	3625 mm
t)	Operating mechanism	Pneumatic/spring/hydraulic/or a combination of these
u)	Trip coil and closing coil voltage	220 V DC
v)	Auxiliary contacts	Each circuit breaker pole shall be provided with an auxiliary switch with a total of twenty (20) independent single pole reversible contacts, in addition to those used for the breaker control. The auxiliary switch shall be factory assembled with ten (10) normally open & ten (10) normally closed contacts (These contacts would be further utilised by the Contractor for interlocking purposes)
	Auxiliary switch shall also comply with requirements of Section AUX.	
	i) Rating of auxiliary contacts	10 A at 220V DC
	ii) Breaking capacity of aux. Contacts	2A DC with the circuit time constant not less than 20 ms.
w)	Noise level at base and upto 50 m distance from base of breaker	140 dB (Max.)
x)	Phase to phase spacing	3000 mm(other type tested spacing is also acceptable)
y)	Rated terminal load	As per IEC

		The breaker shall be designed to withstand the rated terminal load, wind load/earthquake load and short circuit forces. The short circuit forces to be considered for the design shall be based on 6 m long bus bars consisting of 7/8" IPS Al. Tubes ACSR conductor with specified phase to phase spacing.
z)	Temperature rise over an ambient Of 50° C.	As per IEC 62271-100
aa)	System neutral earthing	Effectively earthed
ab)	Transmission Line Lengths	Upto 150 Km.
ac)	Requirements for support structures:	
	i) The minimum clearance between the live parts and earth shall be 2.1 meters.	
	ii) The terminal pad shall be at a height such that the center line of the terminating conductor is 4.6 m from plinth level.	

## **SECTION 2**

### **GENERAL ELECTRICAL SPECIFICATIONS**

#### **2.1 GENERAL**

This section covers the general technical requirements of Circuit Breakers. In case of any discrepancies between the requirements mentioned in this section and those specified in the following sections of this specification, the specifications given herein shall prevail and shall be treated as binding requirements. Requirements of Section-1 shall take precedence over all sections.

#### **2.2 GENERAL TECHNICAL SPECIFICATIONS**

As per NTPC Technical Specifications enclosed as below:

- i) SCCL (2X600MW) BTG package, Technical Specification: Section-VI, Part-B, Technical Specifications, Sub Section-B-08, MOTORS, Page 1 to 9.
- ii) SCCL (2X600MW) BTG package, Technical Specification : Section-VI, Part-B, Technical Specifications, Sub Section-B-25, SWITCHYARD-AUXILIARY ITEMS, Page 1 to 10.

CLAUSE NO.	TECHNICAL REQUIREMENTS										
<b>1.00.00</b>	<b>GENERAL REQUIREMENTS</b>										
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.										
1.02.00	All equipments shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.										
1.03.00	Contractor shall provide fully compatible electrical system, equipments, accessories and services.										
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.										
1.05.00	<p>The auxiliary AC voltage supply arrangement shall have 11kV, 3.3 kV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition :</p> <table border="0" data-bbox="432 1025 957 1126"> <tr> <td data-bbox="432 1025 845 1059">(a) 11kV, 3.3 kV</td> <td data-bbox="869 1025 957 1059">+/- 6%</td> </tr> <tr> <td data-bbox="432 1093 845 1126">(b) 415/240V</td> <td data-bbox="869 1093 957 1126">+/- 10%</td> </tr> </table>			(a) 11kV, 3.3 kV	+/- 6%	(b) 415/240V	+/- 10%				
(a) 11kV, 3.3 kV	+/- 6%										
(b) 415/240V	+/- 10%										
1.06.00	<p>The voltage level for motors shall be as follows :-</p> <table border="0" data-bbox="432 1216 1388 1440"> <tr> <td data-bbox="432 1216 845 1249">a) Upto 0.2KW</td> <td data-bbox="869 1216 1388 1249">: Single phase 240V AC / 3 phase 415V AC</td> </tr> <tr> <td data-bbox="432 1283 845 1317">b) Above 0.2KW and upto 200KW</td> <td data-bbox="869 1283 1388 1317">: 3 phase 415V AC</td> </tr> <tr> <td data-bbox="432 1350 845 1384">c) Above 200KW and upto 1500 KW</td> <td data-bbox="869 1350 1388 1384">: 3.3 kV</td> </tr> <tr> <td data-bbox="432 1417 845 1451">d) Above 1500 KW</td> <td data-bbox="869 1417 1388 1451">: 11 kV</td> </tr> </table> <p>Voltage rating for special purpose motors viz. screw compressors and those with VFD shall be as per manufacturer standard.</p> <p>For CHP conveyor's motor above 160KW rating 3.3KV, three phase AC supply is to be used. However all the motors on the Stacker/ Reclaimer machine shall be on 415V AC only.</p>			a) Upto 0.2KW	: Single phase 240V AC / 3 phase 415V AC	b) Above 0.2KW and upto 200KW	: 3 phase 415V AC	c) Above 200KW and upto 1500 KW	: 3.3 kV	d) Above 1500 KW	: 11 kV
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c) Above 200KW and upto 1500 KW	: 3.3 kV										
d) Above 1500 KW	: 11 kV										
1.07.00	Fault level shall be limited to 40kA RMS for 1 second for 11kV & 3.3 kV system and 45 kA RMS 1 second for 415V system. 415V system shall be solidly grounded and 220 VDC system shall be isolated type.										
1.08.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.										
SINGARENI THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-08 MOTORS	PAGE 1 <del>025</del>								

CLAUSE NO.	TECHNICAL REQUIREMENTS																	
1.09.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.																	
1.10.00	<p>Degree of Protection</p> <p>Degree of protection for various enclosures as per IS:4691, IEC60034-05 shall be as follows :-</p> <table border="0"> <tr> <td>i) Indoor motors</td> <td>-</td> <td>IP 54</td> </tr> <tr> <td>ii) Outdoor motors</td> <td>-</td> <td>IP 55</td> </tr> <tr> <td>iii) Cable box-indoor area</td> <td>-</td> <td>IP 54</td> </tr> <tr> <td>iv) Cable box-Outdoor area</td> <td>-</td> <td>IP 55</td> </tr> </table>			i) Indoor motors	-	IP 54	ii) Outdoor motors	-	IP 55	iii) Cable box-indoor area	-	IP 54	iv) Cable box-Outdoor area	-	IP 55			
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2.00.00	<p><b>CODES AND STANDARDS</b></p> <table border="0"> <tr> <td>1) Three phase induction motors</td> <td>:</td> <td>IS:325, IEC:60034</td> </tr> <tr> <td>2) Single phase AC motors</td> <td>:</td> <td>IS:996, IEC:60034</td> </tr> <tr> <td>3) Crane duty motors</td> <td>:</td> <td>IS:3177, IEC:60034</td> </tr> <tr> <td>4) DC motors/generators</td> <td>:</td> <td>IS:4722</td> </tr> <tr> <td>5) Energy Efficient motors</td> <td>:</td> <td>IS 12615</td> </tr> </table>			1) Three phase induction motors	:	IS:325, IEC:60034	2) Single phase AC motors	:	IS:996, IEC:60034	3) Crane duty motors	:	IS:3177, IEC:60034	4) DC motors/generators	:	IS:4722	5) Energy Efficient motors	:	IS 12615
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5) Energy Efficient motors	:	IS 12615																
3.00.00	<b>TYPE</b>																	
3.01.00	<p><b>AC Motors:</b></p> <p>a) Squirrel cage induction motor suitable for direct-on-line starting.</p> <p>b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg.C ambient temperature), shall be Energy Efficient motors, Efficiency class-Eff 1, conforming to IS 12615.</p> <p>c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.</p>																	
3.02.00	DC Motors	Shunt wound.																
4.00.00	<p><b>RATING</b></p> <p>(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.</p> <p>(b) Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings</p>																	
SINGARENI THERMAL POWER PROJECT (2X600 MW) BOILER TURBINE GENERATOR PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-B-08 MOTORS	PAGE 2- <del>08</del>															

### SECTION- 3

#### PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS

#### 3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

#### 3.1 PROJECT INFORMATION:

	Particular	Details
a)	Customer	M/S Singareni Collieries Company Limited, Kothagudem(SCCL)
b)	Project Title	2 X 600 MW Singareni Thermal Power Project at Peagdapalli (V), Jaipur (M), Adilabad Dist, Andhra Pradesh
c)	Location	Pegadapalli village, Jaipur Mandal, Adilabad District, A.P.
d)	Distance from Nearest Town - Mancherial	14.6 KM
e)	Distance from State Highway	4.6 KM
f)	Distance from NH-16 (Nirmal-Chennur section)	500 Mtrs
g)	Nearest Airport & Distance	Shamshabad Airport, Hyderabad 250 KM
h)	Nearest Railway Station	Mancherial Railway station on Nagpur-Kazipet main railway line of South Central Railway 14.6KM
<b>SITE CONDITIONS</b>		
a)	Max. ambient air temp.	50°C
b)	Min. ambient air temp.	0°C
c)	Max. design ambient temp.	50°C
d)	Design reference RH	95 % (at 40degC)
e)	Site elevation	143 Mtr above MSL
f)	Pollution Severity	High Pollution level (25mm/kV)
g)	Seismic Zone	Zone-III
<b>WIND DATA</b>		
a)	Basic Wind speed	44m/sec
b)	The risk co-efficient (K1)	1.07
c)	Category of terrain	Category-2

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Note:

- (i) Notwithstanding the values of the above mentioned parameters, the design wind pressure so computed at any point shall not be taken less than 1500 N/SqM for all classes of structures, i.e. A,B and C, as defined in IS:875(part-3).
- (ii) Important meteorological data from nearest observatory at Ramagundam is placed at Annexure-I.

**3.1.1 SYSTEM PARAMETERS:**

Sl.No.	Parameters	400 kV	132 kV
1	Highest system voltage	420 kV rms	145 kVrms
2	Lightning Impulse voltage	±1425kVp	± 650kVp
3	Switching impulse voltage	±1050kVp	--
4	Power frequency withstand for 1 min (rms)	630 kV(rms)	275 kV(rms)
5	Max. fault level (1 sec.)	50 kA	31.5kA
6	Minimum creepage distance	10500 mm	3625mm

**3.1.2 AUXILIARY POWER:**

Normal Voltage	Variation in Voltage	Frequency in Hz	Phase/Wire	Neutral Connection
415 Volts	± 10%	50 ± 5%	¾ wire	Solidly earthed
240 Volts	± 10%	50 ± 5%	½ wire	Solidly earthed
220 Volts	190V to 240V	DC	---	Isolated 2 wire system

Combined variation of voltage and frequency shall be limited to ± 10%. Fault level of 415V system shall not be less than 45kA.

The minimum height of equipment supports shall be 2550mm. The various minimum heights of the switchyard shall be as given below from plinth level:

Voltage	Equipment /1 <sup>st</sup> Level	2 <sup>nd</sup> Level	3 <sup>rd</sup> Level
132kV	4600mm	8000mm	12000mm
400kV (1½breaker)	8000mm	16000mm	--

**3.2 INSTRUCTION TO BIDDERS:**

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification.

It is recognized that the bidders may have standardized on the use of certain components,

Technical Specification

materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section-Lighting System.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

### **3.3 RULES, REGULATIONS, CODES & STANDARDS**

**3.3.1** In addition to codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts systems and works covered under this specification shall comply with currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following -

- a) Bureau of Indian Standards (BIS)
- b) Indian Electricity Act
- c) Indian Electricity Rules
- d) Indian Explosives Act
- e) Indian Factories Act and State Factories Act
- f) Indian Boiler Regulations (IBR)
- g) Regulations of the Central Pollution Control Board, India
- h) Regulations of the Ministry of Environment & Forest (MoEF) , Govt. of India
- i) Pollution Control Regulations of Department of Environment, Govt. of India

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- j) State Pollution Control Board.
- k) Rules for Electrical Installation by Tariff Advisory Committee(TAC)
- l) Building and other construction workers(Regulation of Employment and Conditions of Services) Central Rules,1998
- m) Explosive Rules,1983
- n) Petroleum Act,1984
- o) Petroleum Rules,1984
- p) Gas Cylinder Rules,1981
- q) Static and Mobile Pressure Vessels(Unified) Rules,1981
- r) Workmen's Compensation Act,1923
- s) Workmen's Compensation Rule,1924
- t) SCCL Safety Rules for Construction and Erection
- u) SCCL Safety Policy
- v) Any other statutory codes/ standards/ regulations, as may be applicable.

**3.3.2** Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply.

- a) Bureau of Indian Standards(BIS)
- b) Japanese Industrial Standards (JIS)
- b) American National Standards Institute (ANSI)
- c) American Society of Testing and Materials ( ASTM)
- d) American Society of Mechanical Engineers (ASME)
- e) American Petroleum Institute (API)
- f) Standards of the Hydraulic Institute, USA
- g) International Organization for Standardization (ISO)
- h) Tubular Exchanger Manufacturers' Association (TEMA)
- i) American Welding Society (AWS)
- j) National Electrical Manufacturers Association (NEMA)
- k) National Fire Protection Association (NFPA)
- l) International Electro-Technical Commission (IEC)
- m) Expansion Joint Manufacturers Association (EJMA)
- n) Heat Exchange Institute ( HEI)

**3.3.3** Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, along with the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned under 5.01.00 and 5.02.00 together with the complete word to word translation of the standard that is normally not published in English.

**3.3.4** In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.

- 3.3.5** In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.

### **3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED**

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions. All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (not applicable for this project) short circuit etc for the equipment. The equipment shall also comply with the following:

- a) All equipments shall be suitable for hot line washing.
- b) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
- c) Piping, if any, between equipment control cabinet or operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.
- d) All equipment shall be supplied with necessary interpole cabling, and its cost shall be included in the cost of equipment.

### **3.5 ENGINEERING DATA**

#### **3.5.1 DRAWINGS**

- a) All drawings shall be made in Autocad Release -14 or latest Version.  
All drawings shall be plotted in ink. All dimensions and data shall be in SI metric units. All items of the equipment should be clearly identified by proper part numbers in the contract drawings. Such parts which are to be dispatched to site from works in dispatchable units and are re-assembled at site, should be marked by proper identification marks at works and indicated in the drawings and quantified. All the items of the shipping list should be identified in the drawing. The language for all inscriptions shall be English.
- b) All drawings submitted by the contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials clearances and spaces required between various portions of equipment.

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- c) Each drawing shall bear a title block at the right hand bottom corner with clear mention of the name of the Owner, the System designation, specifications title, specifications number the name of the Projects drawing number and the revisions. If standard catalogue pages are submitted the applicable items shall be indicated there. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be metric units. TITLE BLOCK TO BE FOLLOWED FOR THIS PROJECT IS GIVEN IN ANNEXURE-H.  
NTPC and BHEL drawing number shall be provided to successful bidder.
- d) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the Project. The review of these documents /data/ drawings by the Owner will cover only general conformance of the data/ drawings/documents to the specifications and contract, interfaces with the equipment provided by others and external connections of the dimensions which might affect plant layout. The review by the Owner should not be construed to be thorough review of all dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. The review and/or approval by the Owner shall not relieve the Contractor of any of his responsibilities and liabilities under the contract.
- e) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Owner.
- f) All manufacturing, fabrication and execution of the work in connection with the equipment/system, prior to the approval of the drawings shall be at Contractor's risk. The Contractor is not expected to make any change in the design of the equipment/system, once they are approved by the Owner. However, if some changes are necessitated in the design of the equipment/ system at a later date, the contractor may do so, but such change shall be promptly be brought to the notice of Owner indicating the reasons for the change and get the revised drawing approved again.
- h) Drawing shall include all installation and detailed piping drawings. All piping of 100 mm and larger diameter shall be routed in detail and smaller pipe shall be shown schematically or by isometric drawing.
- i) As Built Drawings - After final acceptance of individual equipment/ system by the Owner the contractor will update all original drawings and documents for the equipment /system to "As Built" conditions.
- j) Drawings must be checked by the contractor prior to submission to the Owner. In case drawings are found to be submitted without proper checking by the contractor, the same shall not be reviewed and returned to the contractor for re-submission.
- j) The contractor shall submit the drawings /data/ document for Owner's review and approval. The Owner shall review the drawings and return to the contractor authorizing either to proceed with manufacture or fabrication or marked to show changes desired. When changes are required, drawings shall be resubmitted promptly, with revisions clearly

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marked for the final review. Any delays arising out of the failure of the contractor to submit /rectify in time shall not be accepted as a reason for delay in the contract schedule.

### 3.5.2 APPROVAL PROCEDURE

The following procedure for submission and review/approval of the drawings, data, reports, information, etc. shall be followed by Contractor:

- a. All data/information furnished by Vendor in the form of drawings, documents, catalogues or in any other form for NTPC's information/interface and/or review and approval are referred by the general term "drawings".
- b. All drawings (including those of subvendors') shall bear at the right hand bottom corner the 'title block' with all relevant information duly filled in. The Contractor shall give this format to his subvendor along with his purchase order for subvendor's compliance. All drawings shall be in English language. All dimensions shall be in metric units.
- c. Since all Drawing/documents submission and approval shall only be in soft, i.e., pdf format, the Contractor shall submit initially (first submission) all the drawings in soft.
- d. SCCL / NTPC shall review and furnish their comments/approval within 12 working days from the date of receipt of soft copy (pdf) of drawings/documents. NTPC shall furnish their comments in soft copy and the same shall be sent thro NTPC SAP C folder for viewing/ downloading by BHEL and SCCL. Commented drawings/ documents in hard copy shall not be sent to BHEL.
- e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

- f. The Contractor shall ensure submission of revised documents/drawings along with compliance report duly incorporating SCCL/NTPC comments highlighting/clouding the correction made in the revised documents/drawings. Contractor shall resubmit the drawings approved under Category II and III within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.)

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- g. While submitting the revised drawing/documents, Contractor shall attach a sheet with the drawing/document stating clearly the point wise reply to NTPC comments on previous revision and their incorporation status in the submitted revision. Contractor shall not make any changes in the portions of the drawings/documents other than those commented. If changes are required to be made in the already approved portion, Contractor shall resubmit the drawing/document specifically identifying all the changes along with the reasons for each change so made, for NTPC's review and approval.
- h. If the Vendor does not agree with any specific comments, they shall furnish the explanation for the same to NTPC for consideration and acceptance. The same shall be then discussed and agreed mutually.
- i. Wherever, drawings/documents are approved in Category-II the work can be carried out on the basis of comments furnished on the drawing/document. However, the comments of NTPC will be taken care by the vendor, while submitting the revised drawing/document for formal approval in category-I. In case the contractor does not agree with any specific comments, he shall furnish the clarification for the same in writing for consideration, acceptance and formal approval under Category I. The contractor shall ensure that replies to comments of SCCL/NTPC are submitted along with the revised drawings.
- j. In case Contractor does not agree with any specific comment, he shall furnish the explanation for the same to Employer consideration. In all such cases Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.
- k. It is the responsibility of the Contractor to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.
- l. Contractor shall not make any changes in the portion of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawings identifying the changes (alongwith reasons for changes) for Employer's review and approval.
- m. Final distribution of copies of Category 1 approved drawings/documents shall be submitted by Contractor as per Annexure-G.
- n. Approval of drawings will not in any way relieve the Contractor of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

**3.6 DOCUMENTATION TO BE FURNISHED BY THE CONTRACTOR**

The number of prints, manuals, CD-ROM's and manuals to be furnished for various types of document is given in ANNEXURE-G. The documentation shall include but not limited to the following as applicable, in addition to the documents if specified in Sections 1 and 2.

### 3.6.1 DETAILED ENGINEERING

- i) Layout, General Arrangements, Elevations and Cross Section drawings of all equipment and facilities of the plant.
- ii) Flow diagram. Process & Instrumentation Diagrams
- iii) Technical data Sheets.
- iv) Detail design calculations for components, system, piping etc. wherever applicable including sizing calculations.
- v) Characteristic Curves/ Performance Correction Curves.
- vi) Power Supply Single Line Diagram, Block logic, Control Schematics, Electrical Schematics etc.
- vii) Protection System Diagrams and Relay Settings.
- viii) Cable Schedules and interconnection diagrams
- ix) Cable Routing Plan
- x) Instrumentation schedule, measuring point list, functional write ups, installation drawings for field mounted instruments, wiring and tubing diagrams of the panels and enclosures etc.. Drawings for open and closed loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.
- xi) Alarm and annunciation/ Sequence of Event (SOE) list and trip set points.
- xii) Sequence and protection interlock schemes.
- xiii) Type test reports
- xiv) Control system configuration diagrams and card circuit diagrams and maintenance details.
- xiv) Detailed software manuals and software listing.
- xv) Detailed flow chart for digital control system.
- xvi) Mimic diagram Layout
- xvii) Civil drawings consisting of foundation and structural work, civil calculation sheets including structural analysis and design.
- xviii) Model study reports wherever applicable
- xix) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

### 3.6.2 ERECTION DRAWINGS

- a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.
- b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

### 3.6.3 INSTRUCTION MANUAL

- a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating

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Employer's comments and complete in all respect shall be submitted at least thirty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, operation and maintenance procedures, etc. separately for each component/equipment alongwith log record format.

- b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall being corporated and the updated final instruction manuals shall be submitted.
- c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer 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 and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.
- d. 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 will all relevant pamphlets, drawings and list of parts with procedures for ordering spares. Maintenance instructions shall include charts showing lubrication, checking, testing and replacement procedure 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 breakdown. A collection of the manufacturer's standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

### 3.7 MATERIAL /WORKMANSHIP

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each

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component shall be designed to be consistent with its duty and suitable factors of safety subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

### **3.8 LIMIT OF CONTRACT**

All the equipment, materials and services furnished by the manufacturer shall be complete in every respect with all mountings, fitting, fixtures and standard accessories normally provided with such equipment, and needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in technical specification and unless included in the list of exclusions. The manufacturer shall supply at no extra cost to Employer any additional material/service not covered specifically but which are found to be required for fulfillment of the scope of work under specification.

### **3.9 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE**

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipment located in non-air-conditioned areas shall also be of same type.

### **3.10 SPACE HEATERS**

The heaters shall be suitable for continuous operation at 240 V as supply voltage. On –off switch and fuse shall be provided.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal

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heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

### 3.11 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistance varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

### 3.12 VENTILATION OPENING

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

### 3.13 DEGREE OF PROTECTION

The enclosure of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

- a) Installed out door: IP- 55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area: IP-52
- d) Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41.
- e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS: 13947 (Part -I) / IEC-947 (Part-I) / IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

### 3.14 RATING PLATES, NAME PLATES AND LABELS

- 3.14.1 The equipment nameplate should preferably be of stainless steel. In case of aluminium, it should be at least 2mm thick.. The inscription on the nameplate shall be engraved and no punching shall be accepted except for equipment serial number and year of manufacture. These nameplates shall be black with white engraved lettering.
- 3.14.2 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.

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- 3.14.3 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.
- 3.14.4 Name plates of cubicles and panels may be made of non-rusting metal or 3 ply lamicaid.
- 3.14.5 Each switch shall have a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.

### 3.15 GROUND TERMINAL

Each equipment shall be provided with two grounding pads, each with two holes for M12 bolts and spring washers suitable for connection to 75mm x 12mm galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment.

### 3.16 BOLTS, NUTS AND WASHERS

Bolts, nuts and plain washers of size M12 and above shall be hot-dip galvanized, while sizes below M12 shall be electro-galvanized or stainless steel. All spring washers shall be electro-galvanized mild steel suitable for at least service condition -3 as per IS-1573.

In general, screw threads shall be standard metric threads. The use of other thread form will be used only after prior approval. The Contractor shall furnish locking devices for threaded fasteners, which will lock them in such a manner so as to prevent them from coming loose in transport and in service.

### 3.17 GALVANIZING

The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the steel by dry process. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking and peeling off, etc.

Unless otherwise specified in Section 1 or 2, the minimum weight of the zinc coating shall be as follows –

It shall be 610 gm/sq.m and minimum thickness of coating shall be 85 microns for all items thicker than 6 mm. The average coating thickness shall be 95 microns. For items less than 6 mm, requirements of coating thickness shall be as per clause 4.1 of IS 4759,1984. For surfaces which will be embedded in concrete, the zinc coating shall be 900 gm/sq.m minimum. Galvanizing of each member shall be carried out in one complete immersion.

After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment.

All bolts, nuts, lock nuts, washers, etc. shall be hot dip galvanized. Nuts, however, may be tapped, but not to cause appreciable racking of the nuts on the bolts.

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Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Measure shall be taken to avoid formation of white corrosion products on zinc surfaces during transport and storage. Application of zinc rich paint at site shall not be allowed.

Purity of zinc used for galvanizing shall be 99.95% as per IS 209, 1992. Sodium dichromate treatment may be provided, subject to approval of the Owner, to avoid formation of white rust after hot dip galvanization.

Presence of any defect noticed on inspection shall render the material liable to rejection. The Contractor shall supply all samples and equipment and carry out the tests without any extra cost.

Galvanized steel shall be subjected to six one-minute dips in copper sulphate solution as per IS 2633. Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests shall essentially be performed.

- i) Coating thickness as per IS 2633 :1986
- ii) Uniformity of zinc as per IS 2633 :1986
- iii) Adhesion test as per IS 2629 :1985
- iv) Mass of zinc coating as per IS 6745 :1972

### 3.18 PAINTING

The sheet steel to be painted shall be pretreated in tanks in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint on panels shall be applied. Electrostatic painting shall also be acceptable. Finishing paint on outside of the panels shall be as required otherwise by the Employer. The inside of the panels shall be glossy white. Each coat of finishing shall be properly stoved. The paint thickness shall not be less than 50 microns. Finished parts shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

### 3.19 QUALITY ASSURANCE PROGRAMME

3.19.1 The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his subcontractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS- 14001.

A quality assurance programme of the contractor shall generally cover the following:

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- i. His organisation structure for the management and implementation of the proposed quality assurance programme
- ii. Quality System Manual
- iii. Design Control System
- iv. Documentation Data Control System
- v. Qualification data for Bidder's key Personnel.
- vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- vii. System for shop manufacturing and site erection controls including process, fabrication and assembly.
- viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
- ix. Inspection and test procedure both for manufacture and field activities.
- x. Control of calibration and testing of measuring testing equipments.
- xi. System for Quality Audits.
- xii. System for identification and appraisal of inspection status.
- xiii. System for authorising release of manufactured product to the Employer.
- xiv. System for handling storage and delivery.
- xv. System for maintenance of records, and
- xvi. Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats No.QS-01-QAI-P-09/F1-R1 and QS-01-QAI-P-09/F2-R1 enclosed as Annexure- E and Annexure-F respectively.

### 3.19.2 GENERAL REQUIREMENTS - QUALITY ASSURANCE

3.19.2.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-01/F3 enclosed as Annexure- D.

3.19.2.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of

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materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. CD or E-mail for review.

- 3.19.2.3** Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control Organisation, during various stages of site activities from receipt of materials/equipment at site.
- 3.19.2.4** The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans alongwith Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer alongwith technical justification for approval and dispositioning.
- 3.19.2.5** No material shall be despatched from the manufacturer's works before the same is accepted subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch issuance of MDCC.
- 3.19.2.6** All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 3.19.2.7** All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorized representative for approval prior to carrying out the welding/brazing.
- 3.19.2.8** Contractor shall list out all major items /equipments / components to be manufactured in house as well as precured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment, etc., list of

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which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on the enclosed format No.QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. alongwith his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period to any procurement. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

- 3.19.2.9** For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organization, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders/contracts for such bought out items/components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.
- 3.19.2.10** Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their subcontractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 3.19.2.11** The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
- 3.19.2.12** Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not

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comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

**3.19.2.13** For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

**3.19.2.14** Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorized representative.

**3.19.2.15 ENVIRONMENTAL STRESS SCREENING**

All solid state electronic systems/equipment shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor/sub-contractor should meet the following.

1) The Contractor/Sub-contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor/Sub-contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

Or

In case the Contractor /Sub-contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, Most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

a. Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours , the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices and kept under energised conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

In case any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

b. Burn in Test Cycle

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The Burn in Test Cycle shall be 120hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

Technical Specification

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

During the Burn in Test the cubicle doors shall be closed(or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10degC above the ambient temperature.

The Contractor/Sub-contractor shall carry out routine test on 100% item at contractor/sub-contractor's works. The quantum of check/test for routine & acceptance test by employer shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

### 3.19.3 QUALITY ASSURANCE DOCUMENTS

3.19.3.1 The Contractor shall be required to submit QA Documentation as indicated in Annexure-G.

3.19.3.2 Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

3.19.3.3 Typical contents of Quality Assurance Document are as below:-

- i) Quality Plan,
- ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) Factory test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- iv) Manufacturer/works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- v) Non-destructive examination results /reports including radiography interpretation reports.  
Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- vi) Heat Treatment Certificate/Record (Time- temperature Chart)
- vii) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure)Verification sketches, if used and methods used to verify that the inspection and testing points in the Quality Plan were performed satisfactorily
- viii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
- ix) Certificate of Conformance (COC) wherever applicable.
- x) MDCC

Technical Specification

- 3.19.3.4 Similarly, the contractor shall be required to submit Quality Assurance Documents ( in line with above) pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system as indicated in Annexure-G.
- 3.19.3.5 Due to the large variety of equipment items, it is always possible to adapt the content of the quality document to better match the particularities of any equipment. This shall be done in agreement with the Supplier and the Inspector.  
The Quality Document file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. Each quality document shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.
- 3.19.3.6 Before dispatch/commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.
- i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory. The Inspector shall stamp, the quality document (or applicable section) for release.
  - ii) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
  - iii) If a decision is made to ship equipment, whereas all outstanding actions cannot be readily cleared for the release of the quality document by the time as per contract documents ( or finalization of the applicable section of the quality document within one month as per corresponding shipment date). The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status (signed by the Supplier Representative) to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The final quality document will be compiled and issued at the final assembly place of equipment before shipment.

### 3.19.4 TRANSMISSION OF QUALITY DOCUMENTS

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.