

REQUEST FOR QUOTATION

	BHARAT HEAVY ELECTRICALS LIMITED Electronics Division PB No. 2606, Mysore Road Bangalore - 560026 INDIA	RFQ NUMBER: PSS0000197 RFQ DATE : 13.06.2017	Due Date/Day: 05.07.2017 WED Time : 13:00 HRS Tender Box : Reception Area Opening Venue: NEW ENGG. BLDG
MMI:PU:RF:003			
(address for communication) :		(for all correspondence) Purchase Executive : SIVASHANKARI P Phone : 25146134 Fax : 00918028520135 E-mail: fsesdmm@bheledn.co.in	

1. Separate offer in English language addressed to the Purchase Executive shall be made for this RFQ in three parts.
 Three Part Bid : Offer shall be made in three parts as detailed below:
 "Pre-Qualification Bid (Part I Bid)" : Documents related to PQC to be placed in a sealed cover super scribed with RFQ No., Due Date and "Pre-qualification Bid (Part I Bid)".
 "Techno-commercial Bid (Part II Bid)" : Techno-commercial Bid to be placed in a separate envelope super scribed with RFQ No., Due Date and "Techno-commercial Bid (Part II Bid)". This bid should contain all commercial terms i.e. delivery terms, payment terms, applicable taxes/duties etc.
 "Price Bid (Part III Bid)" : Price of the offered item to be placed in a separate sealed envelope super scribed with RFQ No & Due Date.
 All the three sealed envelopes shall be placed in another sealed envelope super scribed with RFQ No & Due Date.
 Pre-qualification bid will be opened on due date. Techno-commercial bid (part II) will be opened for the vendors who are qualified in the pre-qualification bid.
2. Reference Documents: PS-460-0166 Rev00 is to be completely read, understood and should be acceptable to bidder.
3. Pre-qualification criteria is attached herewith.
4. Terms & Conditions shall be as per Doc Ref Doc no: BHEL: EDN: GCC - SHOP: Rev00, Instructions to bidders as per Doc no: BHEL: EDN: ITB - SHOP: Rev00, and Annexures.
5. Price basis shall be firm; Price Variation Clause is NOT acceptable.
6. Tender opening Time is 01:30 PM on the tender due date, Place: Tender opening room @ BHEL-ESD, Electronic city, Bangalore.
7. Please drop your offer before due date & time in the tender box named "Wednesday" kept at the reception of BHEL-ESD, Electronic city, Bangalore.
8. Items should be delivered to

BHEL-ESD,
 PLOT NO 98,
 ELEGTRONIC CITY PHASE 1,
 HOSUR ROAD,
 BANGALORE-560100,
 KARNATAKA.

Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
1	DS0830004250 ACB 7500A, 430V Doc No.- PS4600166 Rev - 00 Certificate Of Conformance ACB 7500A, 430V Naval qualified as per PS-460-0166	1	NO	1	15.11.2017

Total Number of Items - 1

1.

TWO PART BID - SUBMIT TECHNICAL AND PRICE BID IN SEPARATE SEALED COVERS

NOTES :

- 1.This RFQ is Governed by :
 - a)INSTRUCTIONS TO BIDDERS/SELLERS(Doc No :BHEL:EDN:ITB-SHOP) available at **www.bheledn.com (RFQ-PO Terms & Conditions)**
 - b)GENERAL CONDITIONS OF CONTRACT FOR PURCHASE(Doc no :BHEL:EDN:GCC-SHOP) available at **www.bheledn.com (RFQ-PO Terms & Conditions)**
 - c)Any other specific Terms and Conditions mentioned.
2. Bidders / Representatives who would like to be present during opening of offers are required to furnish authorization letter for the same.

For and On behalf of BHEL.

SIVASHANKARI P
 Contrl Eqpmnt - ESD

1 OF 2

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				PRE QUALIFICATION CRITERIA DEFENCE ENGINEERING		PQ-460-001	
						Rev No. 00	
						Page 01 of 01	
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company.		PQC for 430 V, 7500A, 3 pole, drawout to front type ACB					
		1. Pre-qualification criteria (PQC):					
		1.1The Bidder shall be an Original Equipment Manufacturer (OEM) and shall have capabilities with respect to manufacturing and routine testing facilities for the similar or higher rating Air circuit Breakers (ACB).					
		1.2The bidder shall furnish the detailed approach for meeting type test requirements as per purchase specification (PS-460-0166 Rev00).Approved (NABL) test labs, where test will be carried out, shall be mentioned.					
		1.3The bidder should furnish Overall General Arrangement (OGA) Drawings (AutoCAD) for verifying ACB dimensions.					
		1.4The average annual financial turnover of the bidder in the preceding three financial years as on March 31st 2017 shall be at least INR 10 crores.					
		1.5The bidder must have supplied and successfully commissioned the ACBs of rating 4000A or above in past.					
		2. Document submission :					
		2.1The bidder shall submit supporting documents to comply with point 1.1 regarding manufacturing and routine testing capabilities of said ACB. If necessary, BHEL may visit the works.					
		2.2Type test methodology and approved test labs names where type tests shall be performed shall be furnished.					
		2.3OGA (AutoCAD) shall be furnished to verify that limiting dimensions will be met.					
		2.4Self-certified document in respect of financial turnover in compliance of Sl. No. 1.4 above.					
		2.5Document to support the supply and successful commissioning/operation of 4000A or above ACB.					
		Offers without above necessary documents shall be liable for rejection.					
		3. Reference documents: PS-460-0166 Rev00, is to be completely read, understood and should be acceptable to bidder. Compliance to same shall be provided.					
Ref. Doc		Revisions :			Prepared :	Approved :	Date:
		Refer to record of revisions :			Avnish Tayal	B Mallaiah	06-06-2017

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ADDITIONAL TERMS AND CONDITIONS

(RFQ NO. PSS0000197)

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5. Price basis shall be firm; Price Variation Clause is NOT acceptable.
6. DELIVERY : 24 weeks from date of Purchase Order.
7. Tender opening Time is 01:30 PM on the tender due date, Place: Tender opening room @ BHEL-ESD, Electronic city, Bangalore.

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KARNATAKA.**



PURCHASE SPECIFICATION

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PURCHASE SPECIFICATION OF Air Circuit Breaker, 7500A, 430 V

REVISION 00

APPROVED

PREPARED

ISSUED

DATE

24-02-17



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REVISION HISTORY SHEET FOR PURCHASE SPECIFICATION

REV NO	DATE	NATURE OF CHANGE	REASON FOR CHANGE	PREPARED BY	APPROVED BY
00	24/02/2017	First Issue	--	AT	PB

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1. Scope

This Purchase Specification covers the requirements with regard to supply of Air Circuit Breaker (7500A, 430V, 3 ph, 50Hz, 3 Pole). It also covers associated controls, protections.

2. Purpose.

Air Circuit Breaker (7500A, 430V, 3 ph, 50Hz, 3 Pole) is intended for providing 430V, 50 Hz, 3ph supply from 3.5MW Turbo Alternator (TA) to the consumers through generation and distribution system. Hence it will serve the purpose of Generator Circuit Breaker. The breaker would be fitted in breaker panel (BHEL scope) which will be part of Local Control Panel (LCP)(BHEL scope) of Turbo-alternator(BHEL scope).

3. System Requirements.

The breaker is required to connect 430V, 50 Hz, 3 ph supply from 3.5MW TA to switchboard. The breaker shall be controlled locally from LCP of TA and remotely from Electrical Control system (LCS). The detailed requirements of the Breaker are enumerated in the succeeding paragraphs.

4. Air Circuit Breaker Specifications.

ACB shall comply to IEC 60947-2/3, IEC 61363 in general. The technical specifications of the Breaker are detailed in the Table below:

Table 1

Sl.No.	Parameter	Description of 7500A
1	Type	Air Circuit Breaker, 'draw-out to the front
2	Rating Current (A) at 40°C	7500A
3	Rated Operational Voltage(V), 50Hz	430 V
4	Rated insulation voltage(V),50Hz IEC 60947 Part 11	1000 V
5	No. of poles	3
6	Rated ultimate short circuit breaking capacity (kA rms) at 430V	100kA at 430V
7	Rated service short circuit breaking capacity (kA rms) at 430V	100kA at 430V



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8	Rated short time withstand capacity 50Hz (kA rms) (1 sec)	100kA
9	Rated making capacity 50Hz(kA peak)at 430V	210kA
10	Rated impulse withstand voltage of main circuit	12kV
11	Rated impulse withstand voltage of aux. circuit	4kV
12	Typical opening time	40 msec
13	Typical closing time	60 msec
14	Utilization category	B
15	Suitability for isolation	Yes
16	Draw out	Yes
17	Manual	Yes
18	Electrical	Yes
19	Electrical & Mechanical life (Operating Cycles)	10000
20	Limiting - Height X Width X Depth in mm	600 X 1190 X 640
21	Electrical life without maintenance	5000
22	Power loss comparison(Watt Loss/Ph (Watt))	375

5. Overloads

After taking into consideration necessary derating, ACB will withstand following overloads:

- 7600 A for 60 seconds
- 9000 A for 30 seconds

The temperature rise under overload modes is not specified but will need to be estimated / measured on completion of the design / testing. After occurrence of overloads, The Air Circuit Breaker should be capable of operation under rated loads and further overload modes during the specified service life of the ACB.



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6. Construction

- a. Air Circuit Breakers (ACBs) should have facility for emergency manual operation and should be suitable for electrical supply characteristics as available at customer site. Wiring utilised in the circuit breakers should be low halogen type. All ACBs are to be of withdrawal type on front side. Facility should be provided to disengage it from fixed bus bars connection with locking arrangement in service, isolated & maintenance position.
- b. ACB should be of robust construction and capable of being handled by operator using appropriate handling gear under most adverse conditions.
- c. The space around the breakers is to be designed to allow the free passage of cooling air and be free of unnecessary obstruction. Flash barrier above arc chutes must not impede the flow of air through the section.
- d. It should be possible to change main and auxiliary contacts of the breakers in withdrawn position.
- e. It should be possible to calibrate/test, the protections with portable/built in test equipment.
- f. For handling the ACBs in confined spaces, it should be possible to attach lifting tackles. ACB is to be fitted with clearly defined lifting points.
- g. The mechanical interlocks are to be provided to ensure that main contacts are in open condition before the ACB connects to or disconnects from the fixed (bus bars) connections.
- h. Provision should be made for adequate supporting and locking of each ACB in fully withdrawn position for maintenance.
- i. ACBs are to be of withdrawal type designed as a self-contained unit, eg. Including a housing or cassette. Means are to be provided to disengage it from the fixed (bus bar) connections and to lock it in the following positions within the cassette:-
 - i. 'Service'- Connected to bus bars and fully operational.
 - ii. 'Isolated' Test Position' - disconnected from bus bars but operational.
 - iii. 'Maintenance'- fully disconnected and withdrawn. Position locks are to engage automatically as the ACB is moved in either direction, and be unlocked manually.
- j. The ACB is to be fitted with a counter to record the number of close-open operations. The counter is to be 5 digits self-resetting to zero after 99999.
- k. ACBs will conform to NES 530 and BS 4752. Prior approval of customer is to be taken for deviations sought if any. Following additional requirements are to be met:-

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i. Operating conditions, Environmental Specifications and EMI/EMC specifications will be as per purchase specification.

ii. Fire characteristics : Low halogen and fire retardant type.

l. The ACBs should have the facility for manual close/trip.

m. The ACBs should have electrical ON/OFF facility from local and remote.

7. Protection

a. The following protections are to be provided on the ACBs.

i. Overload protection

ii. Short circuit protection

iii. Earth fault protection

b. Interlocks against re-closing of the circuit breakers after a short circuit, by means of their over current release is to be provided.

c. Local (mechanical and by means of Push-button) and remote (electrical, by feed of impulse voltage of 24V/110 V DC) unlocking of circuit breakers disabled after short-circuit release has been operated will be catered for.

8. Dimensions

ACBs are to be designed for minimum weight consistent with adequate strength and minimum volume taking into account temperature rise. Dimensions of ACBs are not to exceed following value.

(Height X Width X Depth)- 600 mm X 1190 mm X 640 mm (max. depth 700mm with terminals)

9. Interfaces with External Systems

a. **Interface between TA-B Breaker and LCP:** The Breaker shall require a control facility from the LCP. The breakers should have provision for electrical control of command and status monitoring from LCP. 110 V DC for closing coil, trip coil and gear motor will be provided. LCP will have necessary interlocks for closing and tripping of breaker. 10 NO/NC auxiliary contacts for interlocks and indications may be provided with the ACB. ACB will have suitable terminals for command and feedbacks signal cables. ACB should preferably have 2 trip coils. LCS will further interface to Breaker through LCP.

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- b. **Interface between Breaker and TA:** The Breaker shall receive the 430V, 50Hz, 3Ph supply.
- c. **Interface between TA-B Breaker and Switchboard:** The Breakers shall provide the 430V, 50Hz, 3Ph supply.

10. Alarm/Warning

Following Alarms/warning indications are to be provided on the front panel:

- Overload protection.
- Short circuit protection.
- Earth fault protection.
- Insulation etc

11. Status Indication, Remote Control

The following indications are to be provided on the front panel and as PFC for remote purposes

- Breaker ON
- Breaker tripped.
- Ready to close

12. Synchronization of AC sources.

The breaker is installed in LCP of TA. The breakers when installed in LCP of TA will have the ability for synchronous making from local position (LCP) as well as remote from Electrical Control System (LCS).

13. General Design Features.

The complexity of the equipment in terms of requirements for routine maintenance such as adjustments of preset controls, lubrication etc., is to be kept at bare minimum.

14. Control Supply

The Control supply for closing coil, trip coil, and gear motor shall be provided from the LCP at 110V DC. Supplier will indicate the total power required for this purpose while submitting the offer.

15. Temperature rise

The ambient air temperature surrounding the circuit breaker (CB) shall be determined by the heat dissipated within the breaker panel (1300(W) X 1000(D) X 1500(H) IP23) and airflow

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through it, there is no force cooling envisaged for the breaker panel. However suitable louvers shall be provided in the panel. Breaker heat loss, associated busbar/cables loss shall contribute to temp rise inside the panel. The ambient temperature outside breaker panel is 40°C and inside temperature shall depend on heat losses. The breaker should work satisfactorily under these conditions. The maximum temperature rise for component parts of Circuit Breaker (CB) is as per IEC 60947-2, and IEC 62271-100. The maximum temperatures of breaker components specified for operation as per standard shall not be exceeded. In this regard DEF-STAN 02-530 is relevant. The Supplier should submit supporting calculation to prove compliance in this regard.

16. Modular Construction

All the ACBs shall be installed to permit interchangeability of similar modules and ease of access during inspection, maintenance, installation and repair of various modules

17. System Fault Level

Asymmetrical	160 KA at 430 V AC
Symmetrical	60 KA at 430 V AC

18. Creepages and Clearance Distances.

Creepage and clearance distances are to be as per NES 609 except for bus bars where they are to be as follows:

- Creepage: Not less than 40 mm to earth and between phases or poles.
- Clearance: Not less than 19 mm to earth and between phases or poles.

19. Internal Cabling.

The cables should be Low Fire hazard type with Zero Halogen and low smoke. Cable selection standard is to meet EMI/EMC specifications of screening.

20. Talley Plates

Suitable tally plates for Air Circuit Breakers to be provided to identify components, and circuits etc

21. Diagram Plate

An engraved diagram plate for ACBs to be fixed to inner side of the front panel.



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22. Applicable Standards.

Sl.No.	Tests	As per spec
1	Design and fabrication of Circuit Breaker	NES 530 & BS 4752
2	Creepage & Clearance	NES 609
3	For instrumentation	NES 604
4	Short circuit	BS 5486 : Part 1
5	Through fault	BS 5486 : Part 1
6	Operation of protection devices	As per Purchase spec
7	EMI! EMC Test Specifications.	DND!SDG!24!EMC-1
8	Shock test & Environmental test of all subassemblies	JSS 55555-2000
9	For high strength steel	GOST 5521 and NES 791
10	Internal cables	MIL-C-24640
11	Material specifications	NES 507
12	Selection of Breakers	NES 532 and IEC 363
13	Water ingress	NES 1004
14	Voltage withstand	NES 511
15	Insulation resistance	NES 511
16	Temperature rise	NES 511
17	Mill volt drop	NES 511
18	Functional tests	As per this purchase spec
19	Emission Test	As per purchase spec
20	Reliability and maintainability engineering	DEF STAN 00-40 & 0041
21	For component selection and derating	NAVSEA specification 0967-LP-597-1011
22	Fire Characteristic Test & Toxicity Test	NCD 1409, 1410 and 1411
23	Documentation	JSS-0251 and HQATVP Exploitation Document Specifications

Wherever available, equivalent Indian Standards may be used after obtaining written approval.

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ENVIRONMENTAL CONDITIONS

23. Shock, Noise and Vibration Aspects

The ACBs will be rigidly mounted and should meet the specifications as specified in succeeding paragraphs.

24. Shock

Equipment is to be designed to be capable of withstanding shock and vibration of a high order. If the equipment weighs less than 200 Kgs, the same is tested for shock with stand ability in the K-200 shock testing machine. When, the equipment weighs more than 200 Kgs, Shock analysis is to be carried out. In order to provide an estimate of shock with stand ability the following section amplifies the shock strength related aspects. Subsequent section provides a guideline to shock analysis.

25. Shock Strength

The requirement of shock strength are as follows:

- The equipment when installed rigidly on shock mounting should have adequate strength and be capable of trouble free operation at shock loads in the form of a single wave of a sinusoidal pulse.
- The strength and operational capability of the equipment of the mass up to 200 kg are to be verified only in the K-200 machine. The shock values will be specified based on foot prints, weight and CG of equipment which will need to be supplied by vendor. For equipment mass greater than 200 Kg, the breaker manufacturer shall provide supporting calculations to qualify his design to the shock values. Approval will be accorded after the equipment meets shock requirements.
- Design guideline for shock equivalent to that experience on a K-200 machine is as given below:

Weight in Kgs	Vertical				Longitudinal				Horizontal			
	A1	T1	A2	T2	A1	T1	A2	T2	A1	T1	A2	T2
0-60	180	3	83.5	6.5	220	2.5	59.5	9	280	3	94	9.0
60-140	170	2	36	9.5	245	2.5	54	11.5	300	2	34	17.5
140-200	130	2.5	35	9	280	2.5	90.5	7.5	280	2	34	16.5



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26. Requirement of Shock Analysis of Equipment

- a. **Shock analysis of the equipment** is to be carried out to ensure the proper functioning of the equipment under the shock loading. The shock loads likely to be experienced by the equipment are as follows:
54 g with 34 msec pulse full sine wave
- b. The shock analysis may be performed either by equivalent static load approach or transient dynamic analysis approach. The shock analysis is to be undertaken either in ANSYS or I-DEAS software. For equivalent static load approach, maximum shock amplitude is to be applied as inertia load and the response of the equipment is to be obtained. The stresses and deflections under the shock loading should not exceed the allowable limit. For transient dynamic analysis, the shock pulse indicated in the statement of requirement is to be applied as ground excitation. Generally, linear analysis is to be carried out if there is no non-linearity involved in the model. However, if the model has got inherent non-linearity, non-linear transient analysis has to be carried out.
- c. Apart from the above analysis, the designer/manufacture shall carry out the normal mode dynamic analysis of the equipment to estimate the natural frequency of the equipment. The normal mode analysis is to be carried out by Block - Lanczos method.
- d. The shock mount need not be modelled in the analysis as the shock amplitude specified in the spec is above the shock mount. Therefore, the fixed points of the equipments (the shock mount locations) is to be modelled as translational restraint which means that all three translational degrees of freedom will be fixed and all three rotational degrees of freedom will be free.
- e. Generation of solid surface model of the equipment and consequent development of finite element model will vary from equipment to equipment depending on the shape, size, dimensions and functioning of the equipment. Therefore, it is not possible to generalize the method of preparing the finite element model. The manufacturer shall discuss with BHEL/end user before undertaking the analysis regarding above aspects. The shock analysis report is to be submitted in hard copy. Manufacturer shall submit the full solid / surface model and the finite element in CD to BHEL/end user

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COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY		27. Vibration Levels. Vibration levels in 1/3 Octave band frequency range from 25 Hz to 8 KHz with a reference to 1 x 10.5 m/sec when measured above shock absorbers should not exceed the straight line joining the values as specified:				
		At 25 Hz 55 dB				
		At 8 KHz 85 dB				
		28. Vibration Resistance. The equipment should be capable of trouble free operation under the influence of propellers/simulated external vibrations at the frequencies up to 5 Hz with amplitude of 1.0 mm and at the frequencies 20 to 30 Hz with an acceleration of 1 g (9.81 m/sq sec).				
		29. Air Borne Noise Average level of sound pressure measured in the test bed in accordance with ISO 3744 on conformed surface at a measuring distance of one meter, in dB(A) with respect to reference threshold level of 2 x 10.5 N/m² should not exceed 60 dBA.				
		30. Emission Compliance RoHS compliant.				
		31. Fire Characteristic Test & Toxicity compliance As per NCO 1409, 1410 and 1411.				
		32. Ambient Air Temperatures and Humidity Specifications.				
		a. Main and Auxiliary Machinery Spaces				
			Temperature	Relative Humidity	Period	
	Temperatures at machinery spaces	35 to 40° C	95 ±3%	Continuous		
	b. Main and Auxiliary Machinery Spaces					
	The minimum temperature of 5°C during normal/refit/laid up conditions and maximum of 50°C for a short time duration are to be envisaged.					
	As a rule, long time operation of auxiliary machinery must be ensured at ambient temperature upto 40 deg C (outside breaker panel, inside temp will depend on heat loss and air flow) and humidity upto 98%. Maximum temperature of 50 deg C is envisaged for short time duration.					



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33. Ship Motion

Satisfactory and reliable operation of equipment is to be ensured at rated power under following conditions:

- a. Constant Heel = +/- 15⁰
- Temporary Heel = +/- 30⁰ (03 minutes)
- Constant Trim = +/- 15⁰
- Temporary trim = +/- 30⁰ (03 minutes)
- b. Roll = upto +/- 45⁰ (period of 06 to 09 seconds)
- c. Pitch = upto +/- 15⁰ (period not less than 05 seconds)
- d. Conditions at (a), (b) and (c) above need not be assumed to occur concurrently.

34. EMI and EMC.

All electrical equipment should provide satisfactory operation in the presence of electromagnetic emissions prevalent in the vicinity of the equipment. This may be ensured by provision of suitable filtering capacitors and other filters. Inter-connecting cables must be properly terminated. Signal and control cables should have screens and should be braided. The equipment is required to undergo tests as per DND/SDG/24/EMC-1 specifications (mentioned in table below). The limit values of conducted emission, radiated emission, conducted susceptibility shall be as per MIL standards 461/462. The equipment will undergo RS06 test (The equipment under test shall not exhibit any malfunction, degradation of performance as listed in specifications when subjected to DC magnetic field of 1200 Alm) in addition to other applicable tests. In case test facility is not available, then the testing may be carried out by means of analysis from a competent organisation which will be approved by the customer. The summary of the tests is given below at Table-1.

Table 2

S.No	Requirement	Type of test	Description	Frequency range
(1)	CE-101	Cond. Emissions	Power Leads	25 Hz – 10 KHz
(2)	CE-102	Cond. Emissions	Power Leads	10 KHz – 10 MHz
(3)	CS-101	Cond. Susceptability	Power Leads	25 Hz – 150 KHz
(4)	CS-114	Cond. Susceptability	Bulk Cable	10 KHz– 200MHz



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			Injection	
(5)	CS-115	Cond. Susceptability	Ground - Bulk Cable Injection	Impulse Excitation
(6)	RE101	Rad. Emissions	Magnetic Field (Cables & equipt)	25 Hz – 100 KHz
(7)	RE102	Rad. Emissions	Electric Field	10 KHz – 18 GHz
(8)	RS-101	Rad. Susceptability	AC Magnetic Field	25 Hz – 100 KHz
(9)	RS-103	Rad. Susceptability	Electric Field	2 MHz – 40 GHz
(10)	RS-06	Rad. Susceptability	DC Magnetic Field	1200 A/m

Testing Requirements

35. Test protocol and Testing procedures

- As per this specifications, the equipment is to undergo Routine Tests and Acceptance Tests. For acceptance/type tests, tests reports or detailed analysis to be furnished.
- Proposed list of tests and test procedure at works and outside works are to be indicated in the test protocol, which are to be forwarded for approval with standards / specifications along with technical offer.

36. Testing of ACBs.

The functional tests shall be conducted in accordance with the approved test protocol. The test protocol shall include but not limited to the tests as indicated in the specification. Any other additional tests, as may be considered appropriate to qualify the equipment in accordance with user requirements shall be included in the test protocol. All functional tests will be carried out at manufacturer's premises (details will be worked out in the test protocol). The suitable infrastructure for undertaking the trials needs to be provided by the manufacturer.

The ACB is to be subjected to following tests and test report is to be furnished

a. Mechanical tests.

- Opening & closing of main contacts
- Contact pressure
- Operation of all mechanical interlinks



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(iv) Draw-in & draw-out mechanism along with cradle strength.

(v) Mechanical endurance test.

b. Electrical test.

(i) mV Drop test.

(ii) Temperature rise test.

(iii) HV test

(iv) Test of electrical opening and closing of main contacts with spring charge motor.

(v) Auxiliary contact operations.

(vi) Electrical Endurance Test.

(vii) 100kA short circuit test.

37. Routine Tests

The equipment shall be subjected to following routine tests:

Sl.No	Description	Remarks
1.	Dimension & Weight Checks	As per specs & test protocol
2.	Functional Test	
3.	Insulation Resistance Test (cold and hot)	
4.	Temperature Rise Test	As per specs & test protocol
5.	High Voltage withstand ability Test	As per specs & test protocol
6.	Self-Generated Noise & Vibration Test	As per specs & test protocol
7.	Earth Bonding Test	
8.	Efficiency Test	As per specs & test protocol
9.	Endurance Test	

Acceptance/Type tests



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38. Environmental Tests.

Following type tests are to be conducted on the equipment at DQAE (N) laboratories in accordance with JSS 55555. In case test facility is not available, then the testing may be carried out by means of analysis from a competent organisation which will be approved by the customer

- | | |
|--------------------------|--|
| a. Vibration Resistance | Physical testing at laboratory/ analysis. |
| b. High Temperature Test | Physical testing at laboratory/ analysis. |
| c. Damp Heat Test | Physical testing at laboratory/ analysis. |
| d. Low temperature Test | Physical testing at laboratory/ analysis. |
| e. Mould Growth test | on sample materials, facility available at CQAE Bangalore. |
| f. Salt corrosion test | on sample materials, facility available at CQAE Bangalore. |

39. EMI/EMC tests

To be done as per clause 36 of this specification.

40. Shock test

Test/analysis to be done as per clause 26 of this specification.

41. Manufacturing Standards

Standards used for development and manufacturing of equipment/system and its components are to be indicated and extract of the standards relevant to the equipment is also to be provided as a part of OEM documentation.

42. Spares and Tools

Following spares and tools as per the lists mutually finalised at the time of ordering should be provided:

- Testing, tuning and commissioning tools, test equipment and spares.
- One-year exploitation spares including special type test equipment and tools.
- List of Base and depot spares for five years exploitation.

43. Life Time Product Support

The supplier will undertake to provide long term product for the entire equipment including bought out items for a minimum period of 25 years.

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44. Training

Supplier should be committed to provide training to the personnel of the customer on the operation and maintenance aspects on site/customers premise or at supplier premise as per mutually agreed terms.

45. Guarantee.

The complete equipment is to be guaranteed against all manufacturing defects for a period of 12 months after commissioning on board.

46. Compliance Statement.

Point by point compliance statement of the purchase specification is to be forwarded by the supplier along with technical proposal. Deviations, if any, shall be clearly brought out along with proper justification/analysis.

47. Service Life

- a. Till overhaul : 10 years
- b. Full Life : 25 years
- c. Period of defect free operation without maintenance: 2500 hrs
- d. Period of storage (for the purpose of preservation) unless specified otherwise in the contract, before installation: 5 years. (Supplier may indicate specific preservation requirements if any for storage beyond 5 years).

GENERAL ASPECTS

48. Tolerances & surface finish on equipment feet

Tolerances and surface finish for equipment feet are to be as follows:

Tolerances on length, width and height of feet	IT 14/2
Tolerances on distance between centres of feet	IT 14/2
Max gap between a feet and horizontal surface	0.1 mm
Surface finish of the mating surface of the feet	Ra 1.6-3.6
Surface finish of internal surface of holes	Ra 1.6
Tolerance on diameter of hole	H14

49. Earth Protection

External earthing terminals to be provided.

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50. Lifting Arrangements.

Eye bolts (removable) to be provided for lifting and slinging arrangement.

51. Reliability, Availability & Maintainability

The design of the circuit breakers should cater for high degree of reliability (specified in the succeeding sub paragraphs) in terms of satisfactory performance at the supply voltage, frequency, current and environmental conditions and functional requirements specified in the SORs. Detailed study report/data in this regard is to be forwarded at the time of techno-commercial offer/technical design.

a. Equipment Availability.

- (i) The equipment should not have any down time due to preventive maintenance activities during the operational period
- (ii) The probability that the equipment will be available (i.e., not undergoing corrective maintenance) at any instant during the operational period is to be not less than 99.85%.
- (iii) The downtime due to preventive maintenance activities during the operational period is not to exceed 02 hours (On line maintenance only during 2500 hours operational time).
- (iv) Sufficient onboard spares are to be scaled such that the risk of stock-out would be less than 10%.

b. Equipment Reliability

- (i) The probability that the equipment will be continuously reliable (i.e., not requiring repair/corrective maintenance), at any instance during the operational period should not be less than 0.99.
- (ii) In respect of failures, which are not repairable at sea, the probability that the equipment will survive the maximum operational period at the stated usage without failure is to be greater than 99.9%.
- (iii) In respect of failures, which are repairable at sea during the operational period, the probability that the equipment will survive a period of 2200 hrs continuous operation during one operational sortie, without such a failure is to be greater than 99%

c. Equipment Maintainability.

- (i) The median active time (50 percentile) to restore or repair the equipment after failure using specified procedures and resources is not to be greater than 30 minutes.

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- (ii) The maximum (95 percentile) active repair time is not to be great than 180 minutes

d. Failure Analysis.

A comprehensive study on failure data of various components of the product is to be carried out. The Mean Time between Failure (MTBF) should emerge from the above analysis. Analysis should also be able to identify and recommend the range and scale of the critical spares.

52. Period of Storage before Installation.

3 years (when storage period exceeds 3 years, maintenance procedures to be specified by OEM).

53. Binding Data.

The following data is to enable preparation of installation drawings. These data are defined as "Binding Data" and are to be provided within one week of placement of order and are as follows:

- Foot print details with dimensions
- Detailed dimensional profile drawing with three views indicating maintenance space requirement
- Weight and CG
- Heat load
- Cable entry and maintenance space
- Terminal connection details (prior to testing)

54. Documents.

As per Appendix 'A'.

55. Preservation Packing Painting / Finishing.

The unit should be suitably water proof packed using suitable preservatives for transportation and sent to BHEL ESD Bangalore.

56. Installation and Setting to Work Procedure.

The supplier shall provide necessary support for the installation of breaker in breaker panel including supplying necessary documents/drawings, recommendations/validation of busbar sizes/connections etc.

The following are to be supplied for installation and setting to work:

- Installation Procedure.
- Preservation and de-preservation along with list of necessary equipment/system.
- Equipment/infrastructure required for installation, commissioning on-board.



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- d. The supplier should participate in commissioning / testing and tuning of the equipment on-board.

57. Environmental Stress Screening (ESS)

- a. ESS is done on electronic equipment at module level. ESS is the tailored application of electrical and environmental stresses, to electronics parts modules and units to identify and eliminate defective abnormal or marginal parts and manufacturing defects. Production screen is normally conducted on 100% of the manufactured items. The intent of ESS is to simulate infant mortality failures via accelerated aging without causing damage or inducing wear out to the product under development manufacture.
- b. All production version PCBs and electronic modules shall be tested for ESS at approved ETDC laboratories, equipped with facilities to undertake these tests or DMDE approved test agencies, as per the guidelines indicated in DQA (N) document No.OQAN/EL/QAP-ESS/2012/238 dated 14 Mar 2012 (Guidelines for Environmental Stress Screening for Electronic Equipment for Indian Navy).
- c. The ESS tests consists of:-
- Random Vibration (20 Hz to 2000 Hz)
 - Thermal shock
- d. Units rendered defective during ESS shall be replaced and re-tested.
- e. The plans/details of conducting ESS shall be furnished in ATP to be forwarded by the firm for approval.

58. Warranty.

The equipment supplied shall carry a warranty for a period of 18 months from the date of despatch or 12 months from the date of commissioning at, whichever is earlier.

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		Appendix A. LIST OF DOCUMENTS					
COPY RIGHT AND CONFIDENTIAL THIS INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY	Necessary documentation and drawings as elaborated in the succeeding paragraphs are to be supplied as hard copies and a soft copy on CD. The quality, contents and format of the documents shall conform to the JSS-0251-01 and Exploitation document specification of HQATVP. The technical documentation of 7500A AC Air Circuit Breaker should form part of the equipment supply and shall consist of following: - Part 1 - Technical Description (including Album of Drawings) - Part 2 - Operating Instructions (including Combat Exploitation document) - Part 3 - Maintenance Instructions (including Maintenance schedule & Service log /certificate). - Part 4 - Repair Technical Documentation (RTD) - Part 5 - Catalogue of Spare Parts, Tools and Accessories - Other Documents (Watch Keepers Instructions, Data books, Lists, Diagrams and all test reports etc.)						
	Scope of Individual Documents. The brief scope of each part document of the set is enumerated in the succeeding paragraphs: a. Technical Description Technical Description is to contain comprehensive descriptive information necessary to understand the design, construction principles and functions of the system / equipment, so as to ensure full utilization of its technical and operational capability. The depth of information is to be sufficient, firstly for the operator to exploit the system/equipment including minor "repair by replacement" and secondly, for the maintainer to carry out maintenance, both preventive and corrective, and enable him to independently identify and localize defects and undertake early rectification; thereby enhancing the OPS availability of the equipment / system even while ensuring technically correct exploitation. Technical description is to cover all details namely, mechanical, electromechanical, electrical, electronic etc. Software architecture, interface and						
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design description must also be included in the technical description, if applicable. Sufficient and appropriate illustrations are to be used to supplement the text, including functional block diagrams, lubrication plan, exploded/perspective diagrams, circuit diagrams etc. In case the equipment or system is such that its technical Description contain a large number of drawings/illustration, they are to be collated/formatted in an Album of Drawings as a sub part (part 1.1) of the technical Description. For ease of reference appropriate cross references must be included both in the text and in the album.

b. Operating Instructions

Operating Instructions must contain the information required for the correct operation of the equipment, or system and sustaining it in a high state of readiness for operation. The depth of information must be sufficient to operate the system or equipment safely and with maximum efficiency under normal, special or emergency conditions. It must encompass pre start checks, setting up, starting and running adjustments, functional tests, etc. The information must be sufficient to also carry out routine and online checks and simple fault diagnosis based on the "built in test equipment" (BITE) and rectification based on the philosophy of "repair by replacement". Equipment and systems which are software based and have a GUI based MMI, must also include a section on "Computer Operations and Software Usage. In addition to the above, the operating instructions must contain, preferably in summary form, information to enable planning staff to evaluate the potential of the system or equipment and to evaluate the requirements for OP logistic support. Attention of planning staff must also to be drawn to any special precautions necessary during operation or maintenance or equipment to avoid a development of a condition dangerous to the personnel, equipment/system, platform or the environment. Combat Exploitation Document if applicable to a particular system or equipment must be included in this Section/Part. However, due to the sensitive nature of the information this may be formatted as a separate document, albeit a sub set (part 2.1) of the operating instructions.

c. Maintenance Instructions including Service Log and Certificate

The Maintenance Instructions document must contain exhaustive maintenance procedures and instructions to ensure availability and readiness of the equipment for its designated function. It must include preventive and corrective maintenance, service instructions encompassing pre & post operation maintenance, preservation during long and short layoff, lubrication schedule, maintenance schedule, both by time (daily, weekly etc.) and/or by running hours (50 hr, 100 hr, etc.), flowchart and table of likely faults and fault diagnosis etc. The list of test equipment, and



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test rigs/jigs etc. required to undertake maintenance must be given, with appropriate illustrations. Based on the Maintenance Instructions of a particular system or equipment, and also the ops cum refit cycle of the platform, a "Maintenance Schedule" is generated. This is normally in a tabular form giving the periodic routines and associated details, of the system/equipment. The equipment "Log and Certificate" also forms part of the Maintenance Instructions. However due to the independent nature and frequent usage, the Maintenance Schedule and Log and Certificate, are formatted as separate documents as sub parts 3.1 and 3.2 of the Maintenance Schedule.

d. Repair Technical Documentation (RTDs).

This part contains instructions for the base repair including dismantling, reconditioning alignment etc. of the system / equipment. These are referred to as Repair Technical Document or RTDs. Though a constituent of "the five part concept", this document may be prepared separately and independent of the exploitation documents. However to have a complete and comprehensive set of documents on a particular topic, it is assigned a part number i.e. Part 4. In case prepared separately it is to be ensured that between the Maintenance Instructions (Part 3 and RTDs) the entire scope of maintenance and refitU repair, required for the life time of the platform, are covered. The information must be sufficient to also carry out routine and online checks and simple fault diagnosis based on the "built in test equipment" (BITE) and rectification based on the philosophy of "repair by replacement".

e. Catalogue of Spare Parts, Tools and Accessories

Catalogue of Spare Parts, tools and Accessories is a document which specifies the nomenclature, purpose, quality and place of storage of spare parts, tools and accessories which are requirement for exploitations and repair/maintenance of the equipment or system. It consists of a comprehensive part list which lists out all replaceable parts number. Identification of each part is done by means of exploded view, photographs, or line diagrams, etc. As considered appropriate. In addition to the spare parts, a list of special tools, accessories test equipment, jigs, gauges etc. along with their description and exact purpose is tabulated. The list indicates if a particular spare is to be carried onboard or is available at the base or depot. The number of spares to be carried/stocked at the base/depot is also indicated.

f. Other Documents

Since documentation is for the use of the customer/end user and the variety and complexity of equipment/systems is vast, there may be certain other documents required to be generated like



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training charts, check off lists, watch keeper instructions, special logbooks etc. Supplier may suggest the same along with offer.

If ACB uses any software, then following additional documents would be required for long term exploitation of the systems:

g. Software Requirement Specifications (SRS).

This document should give the details of functional and system requirement, which are implemented by the software.

h. Software Design Specifications (SDS) including Algorithm

This document should give the details of how the software is designed. This will include

- (i) Software architecture
- (ii) Software description module wise
- (iii) Data and control flow diagrams etc.
- (iv) Flow charts

i. Software Test Methodology.

This document will contain all details about how the software should be tested on board. Tests for each functional aspect will be included and test data to be used and results expected will also be indicated. In addition certificates of tests done by the designer / 3rd party auditors are to be included in the certificate and log of the equipment / system.

j. Interface Requirement Specifications

This document will give details of all software interfaces that are required for the system to communicate with another system or a subsystem within the system. This will include aspects such as communication protocols, message structure, inter-process communication, mail boxes etc.

k. Software Test Plan

This will give a detailed plan for onboard software testing, such as module level testing, process level testing, integrating system testing, software audit etc. The usage of the simulators / imitators are also to be included. This will provide to the customer the ability to test and accept the system including its software initially and subsequently during its life cycle.

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