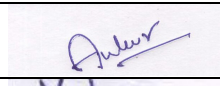
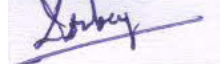





Bharat Heavy Electricals Limited, Bhopal
Control Equipment Engineering Division

SPECIFICATION OF CUBICLE FOR ACFC INVERTER

Project : CUBICLE FOR DEFENCE APPLICATION
Document number : PS 407233
Revision : 02
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HISTORY OF REVISIONS

Issue	Description
00	Concept release, original version
01	Mould Growth and Corrosion salt test added in the list of Acceptance test.
02	Structure material added at CI 2.0 sl no 5



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1.0 Introduction

Supplier has to design, develop, manufacture, test & supply the Cubicle as per the requirements called in this specification. This cubicle will be used in Defence Application.

2.0 Technical Requirements

The equipment supplied against this specification shall meet the following general requirements:

S.No	Description	Details
1	Overall Size of the Cubicle	1300 mm (Height) X 750 mm (width) X 450 mm (depth) 3D model of the structure of cubicle shall be provided by BHEL which is shock and vibration compliant. However, the outer covers are to be designed by the vendor in order to meet EMI/EMC of MIL Std. 461E. The complete model thus evolved will be approved by BHEL before manufacturing.
2	Weight of Cubicle	500 Kgs. (Maximum)
3	Reference Standard for Compliance	MILStd-461-E , IP 23 and JSS-55555
4	Design Methodology	Frame Based Design with support beams, it shall be rugged to meet shock requirement.
5	Sheet metal covers all around over the frame	Structure shall be made by Steel as per BHEL specification no AA10108. Covers can be made of any Suitable metal Aluminium or GI or any other material with necessary thickness to meet EMI/EMC given in Clause 8. Panel Door: Aluminium - Zinc Sheet with 2mm thickness Panel Frame: Aluminium - Zinc Sheet / GI Sheet with 2.5 mm thickness Side Covers: Aluminium - Zinc Sheet with 1.6 mm thickness. Top Sheet: Aluminium - Zinc Sheet with 2 mm thickness Gland Plate: Aluminium - Zinc Sheet with 2.5



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		mm thickness Base Frame: GI Sheet with 2.5 mm thick. Any deviation on above shall be discussed and cleared by BHEL.
6	Cubicle Chromatization	To be carried as per Std.IS 5/ IS 1874
7	Painting	Painting to be carried as per Std. IS 5/ IS 1874 on the outer sheet only.
8	Internal Side of Cubicle	Aluminium - Zinc Sheet finish (No Painting)
9	Accessibility from Front	There are no items to be mounted on front door. Front door shall be in two parts.
10	Component Layout	The components shall be placed generally as per layout given in 3D Model. However, the stack is in final stage of design, which will be given during design stage.
11	Frame to Metal Plates Joining	With necessary overlap and shrouded with headless screws.
12	Maintenance Envelop	500mm front side and 50mm on left and right side.
13	Constructional Guidelines	a) Cubicle shall be metal-enclosed, free-standing compartmentalized, modular type suitable for indoor installation. The panel shall be dust and vermin proof and the enclosure shall provide a degree of protection of not less than IP-23. b) Control panel shall be frame based design fabricated using angles and channels. c) The Panel shall have fixed door on all the sides with ventilation as given in the 3D model. d) Cable entry is only from bottom. Suitable supporting arrangement between the gland plate and terminals in the middle are to be provided. e) Openings shall be such that items are accessible for testing and maintenance and generally mounted as per 3D model. However EMI/EMC protections, proper gasketing, provision of EMI Glass and dirty box (if required) is in the scope of vendor.
14	Cables (Power and Control Cables)	All power and control cables entry and exit are from Bottom only. Position and number of



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		openings will be provided during the detailed engineering design.
15	Supports for Cabling	Suitable mechanical provisions are to be made based on the cable routing provided by BHEL.
16	Material	Structure material shall be as per BHEL standard BHEL spec AA10108. Cubicle to be manufactured based on the Mil std. requirements. Bimetallic issues to be kept in view. Any superior material shall be mutually discussed and cleared.
17	Window for Meters	EMI/EMC compatible windows.
18	Apertures	All Apertures are to be made to the precise component requirement with suitable EMI gaskets.
19	Louvers	Honeycomb mesh is to be provided.
20	Gasket	EMI Conductive Gasket to be used.
21	Shock Mounts	No Shock mounts are allowed inside the cubicle.
22	Shock Analysis	Shock Analysis is carried out on the structure by BHEL therefore no shock analysis is in the scope of vendor. However, the complete model with all covers shall be submitted to BHEL for complete compliance checking.
23	Thermal Analysis	Complete 3D model with door design, provided by vendor shall be subjected to Thermal Analysis by BHEL. Changes if any shall be incorporated.
24	Environmental Conditions	a) Ambient Temperature: -10 to 55 °C b) Humidity: 98%, Continuous condensing c) Atmosphere : The Cubicle shall be designed to work in humid, salt laden and corrosive atmosphere and shall meet JSS55555 requirements.
25	EMI/EMC	All required precautions is to be taken during design and manufacturing of Cubicle to meet EMI/EMC given in Clause 8. Honeycomb filters of appropriate design to be provided on all openings. Gaskets will be suitable for IP and IMI/EMC protection.

3.0 Scope of Work



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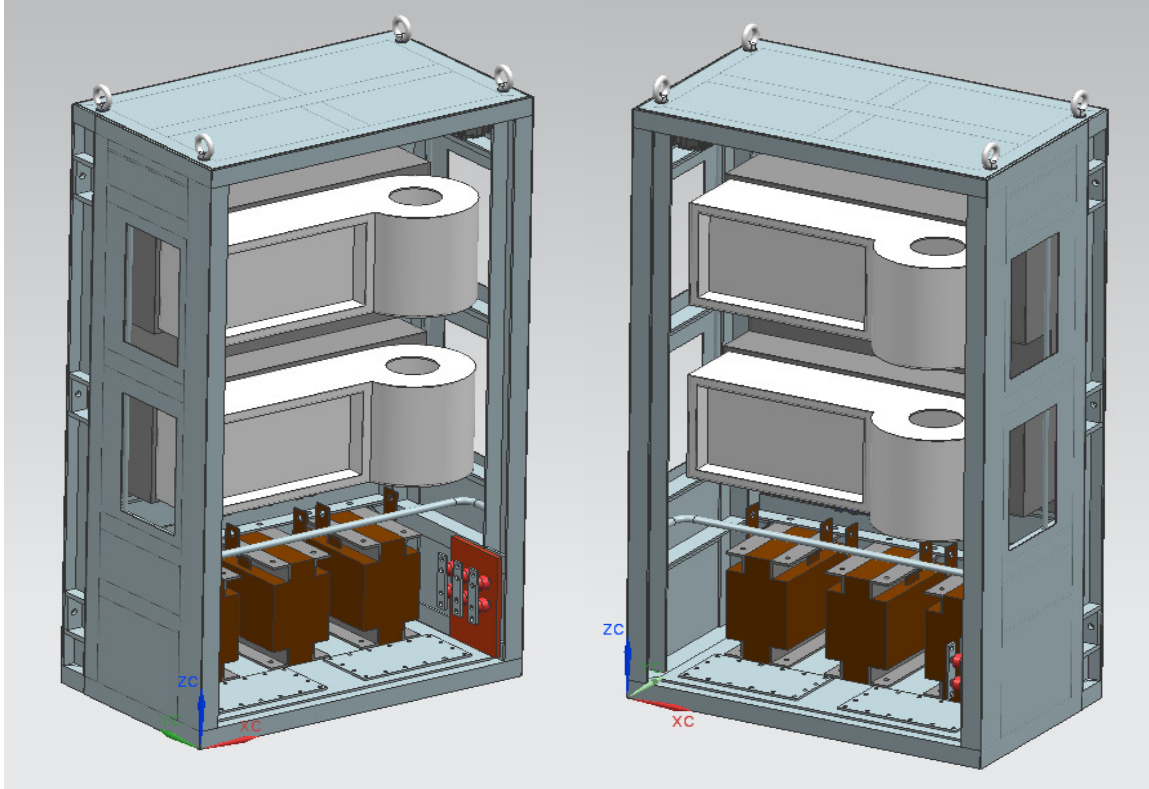
The scope of work includes Manufacture of a EMI/EMC compliant Rugged cubicle for Navy application. The Structure design shall be provided by BHEL which is analysed for shock and vibration compliance. The structure design shall be provided in the form of UG-NX 3D model. Vendor has to design EMI/EMC covers and front panel on the structure. The air inlet and outlet are also given in 3 D model. Mounting arrangement for items to be mounted inside the cubicle are provided in line with 3D model provided however the items are not in the scope of vendor. Items provided on the front panel are in the scope of vendor. These items are listed in the specification. The 3D model in UG NX complete with covers, gaskets, hinges, fans (if any) etc shall be submitted to BHEL for approval before manufacturing.

4.0 List of Components to be mounted in the Cubicle

All the below items are in BHEL scope.

S.No	Item	Qty
1	Current Transducer	3
2	Inductor	3
3	IGBT Stack consisting of Front End Converter and 3-Phase Inverter	1
4	Voltage Transducer	4
5	Cable glands	1 set
6	BUSBARS	1 set

General arrangement of Equipment in 3D Model of Cubicle



5.0 Shock and Vibration Analysis

- a) The Cubicle is designed to withstand a shock of 66g for 27ms.
- b) Cubicle is designed to withstand following vibration levels

Vibration levels in 1/3 Octave band frequency range from 25 Hz to 8 KHz with a reference to $1 \times 10^{-5} \text{ m/sec}^2$ when measured above shock absorbers should not exceed the straight line joining the values as specified: -

- (a) At 25 Hz -- 75 dB
- (b) At 8 KHz -- 100 dB

The equipment should be able to withstand vibration levels as specified below, with equipment rigidly installed (without shock mounts): -

- (a) 01 Hz to 5 Hz – Acceleration of 0.1g
- (b) 05 Hz to 50 Hz – Acceleration of 2.0 g



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6.0 Mould Growth Test

This test is to determine the resistance of equipment against mould growth. Refer Test No.21, Page no.4-87 of Defence Standard JSS 55555: 2012 Rev03. This is to be carried out on sample materials used for manufacturing of cubicle.

7.0 Corrosion (Salt) Test

This test is to determine the suitability of equipment for use and/or storage in salt laden atmosphere. This test is intended mainly for evaluating the quality and uniformity of protective coatings. Refer Test No.9, Procedure 1, Page no.4-44 of Defence Standard JSS 55555: 2012 Rev03. This is to be carried out on sample materials used for manufacturing of cubicle.

8.0 EMI/EMC Test

Equipment should provide satisfactory operation in the presence of electromagnetic emissions prevalent in the vicinity of the equipment. The cubicle is required to undergo tests as per below table. The tests shall be carried out after complete assembly of items and wiring. Carrying out the test is the responsibility of BHEL, however expert from Vendor will join the test if called for. Any modification required for passing the test shall be carried out by vendor at testing location or at suitable place decided mutually free of charge.

REQUIREMENT	TYPE OF TEST	DESCRIPTION	FREQUENCY RANGE
CE-101	Conducted Emissions	Power Leads	25 Hz – 10 KHz
CE-102	Conducted Emissions	Power Leads	10 KHz – 10 MHz
CS-101	Conducted Susceptibility	Power Leads	25 Hz – 150 KHz
CS-114	Conducted Susceptibility	Bulk Cable Injection	10 KHz – 200 MHz
CS-115	Conducted Susceptibility	Ground - Bulk Cable Injection	Impulse Excitation
RE101	Radiated Emissions	Magnetic Field (Cables &	25 Hz – 100 KHz



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REQUIREMENT	TYPE OF TEST	DESCRIPTION	FREQUENCY RANGE
		equipment)	
RE102	Radiated Emissions	Electric Field	10 KHz – 18 GHz
RS-101	Radiated Susceptibility	AC Magnetic Field	25 Hz – 100 KHz
RS-103	Radiated Susceptibility	Electric Field	2 MHz – 18 GHz
RS-06	Radiated Susceptibility	DC Magnetic Field	1200 A/m

For more details, refer MIL-STD 461E

9.0 Check on material characteristics

Test certificate of the original material supplier is to be submitted against this test. The supplier has to test the Element material for the desired compositions or else has to supply test certificate of the supplier for the same supported by relevant copies of original purchase documents.

10.0 Acceptance Test

Following tests shall be conducted on the Cubicle for acceptance:

S.No	Test Description	Remarks
1	Visual Inspection/Dimensional Check	
2	Check on Material Characteristics	
3	Original Purchase document of items mentioned in Clause 5 of this specification	
4	Proper fitment of items on the front door	
5	Proper fitment of Fan(if any)	
6	IP23 Test	
7	Mould Growth test	
8	Corrosion salt test	

11.0 Drawings & Approvals

The complete assembly drawing and 3D model of the Cubicle shall be submitted to BHEL for approval and only after written approval, manufacturing action shall be taken. Approval of



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documents from BHEL does not absolve supplier from the responsibility of desired performance of the equipment supplied by them. Since this is the development item, alterations in design are expected due to very stringent testing requirements of system. Those changes are to be incorporated at BHEL Bhopal or at place where testing is going on by the vendor free of cost.

12.0 Warranty

The supplied equipment shall be guaranteed for the period of 12 months after commissioning at customer place or 18 months after supply whichever is earlier. The supplier shall replace/ repair all failed equipment during warranty at his own expenses.

13.0 Inspection

Supplier to offer equipment for inspection by BHEL after submitting internal test report and giving an advance notice of minimum 7 days. BHEL may choose to waive off the inspection.