

Annexure-1

**REVISED TECHNICAL SPECIFICATIONS
FOR
Rugged Control Cubicle
FOR
BHEL Corporate R&D Vikasnagar, Hyderabad**

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Scope of Supply and Technical Specifications for Rugged Control Cubicle

SCOPE :

- Supply of Custom built Rugged Control Cubicle along with assembly & Wiring as per following specifications -1 no.

Section-1

Two Layer Cubicle Specifications:

Sl.	Description	Details	Vendors Comments	READ AS
1.	Overall Size of the Cubicle	L X B X H (mm) ≤ 1390x1190x1380;		L X B X H (mm) $\hat{O}$ 1405 X 1185 X 1398
2.	Weight of Empty Cubicle	200 Kgs. (Not More than)		200 Kgs. (About)
3.	Design Methodology	Frame Based Design with support beams.		No Change
4.	Sheet metal covers all around over the frame	Suitable metal (Aluminum or GI or any other material) with necessary thickness to meet the Sl. No. 25. Compliance.		No Change
5.	Maintenance Envelop	Min. 0.5 M on sides and front		No Change
6.	Gap between Layers	30-40 mm		No Change
7.	Compartments to be designed for separating critical components	- 5 nos (Min.)		No Change
8.	Eye bolts	Eye bolts are to be provided for lifting (Min. 4 nos.)		No Change
9.	Window for Display	EMI/EMC compatible window for Display unit with more than 75% visibility.		No Change
10.	Fans for Cooling	4 Nos. as per section 4		No Change
11.	Assembly and Wiring	Cubicle Assembly and Wiring incl. Bus Bars as per Section 4		No Change
12.	General Instructions for Cubicle fabrication		Vendor to Confirm	
13.	Frame to Metal Plates Joining	With necessary overlap and shrouded with Countersunk screws.		No Change
14.	Accessibility from Front	User accessible switches, knobs, display etc. are on the front plate (fixed) as per details given in Section 3		No Change

15.	Cables and pipes	All cables and cooling water pipes entry and exit are from Bottom only. Position and number of openings will be provided during the detailed engineering design.		No Change
16.	3 D modeling	Complete BOM is to be represented in 3 D. 3D models for the component to be made If the same is not available from the manufacturer.		No Change
17.	Component Layout	Compartmental based construction for high power components, low power sensitive electronics and others. Mutually decided based on the Mil STD requirements.		No Change
18.	Shock Mounts	No Shock mounts are allowed inside the cubicle.		No Change
19.	Shock Analysis	Shock Analysis to be performed as per requirements specified in section – 4 before the manufacturing.		No Change
20.	Thermal Analysis	Thermal analysis to be carried based on the details provided in Sec. 3.		No Change
21.	Cubicle Chromatization	To be carried as per Std.IS 5/ IS 1874		No Change
22.	Painting	Painting to be carried as per Std. IS 5/ IS 1874		No Change
23.	Supports for Cabling	Suitable mechanical provisions are to be made based on the cable routing provided by BHEL.		No Change
24.	Material	Cubicle to be manufactured based on the Mil std requirements. Bimetallic issues to be kept in view.		No Change
25.	Apertures	All Apertures are to be made to the precise component requirement with suitable gaskets.		No Change
26.	Reference Standard for Compliance	MILStd-461-E , IP 54 and JS-55555		No Change

Note: Supplier shall quote lump sum for all the charges and not to quote separately for design, assembly, painting etc.

Section- 2

Instructions for Cubicle fabrication:-

- **Preliminary Cubicle Design (3 D Model) is to be submitted to BHEL for necessary design finalization and validation. Newly Added**
- 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-54.
- Control panel shall be fabricated out of suitably thick metal plates, properly supported using angles and channels.
- The Panel shall be fully compartmentalized with fixed door on the front only.
- Cable entry is only from bottom. (Suitable removable gland plates shall be provided by BHEL). Suitable supporting arrangement between the gland plate and terminals in the middle are to be provided.
- Front door of the cubicle shall be fully removable type and not hinged.
- Separate and adequate space shall be provided for accommodating display, indicating lamps, control contractors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker busbar connections.
- Engraving: - Engraving of names for front panel display and indication shall be provided. Details will be provided by BHEL during design finalization. Tally plates of anodized aluminum alloy to be provided for the components.
- Painting: - Painting of the control panels to be carried out by supplier as per IS 5/IS 1874 standard. Surface preparation and painting procedure is as per Annexure 1. Paint will be provided by BHEL.
- Assembly & Component mounting: - Assembly and mounting of the components in the panels is in the scope of the supplier. The components along with the layout for mounting will be provided by BHEL
- Lifting Arrangement: - Eye Bolts (Removable) to be provided for lifting and slinging arrangements.
- The panels shall be made with the relevant standards and shall meet strictly all the requirements specified.
- Supplier shall provide the technical support during the EMI/EMC and Environmental testing. And will modify/replace the parts of panels wherever and whenever required to comply with the specified requirements.

Section-3					
List Components to be provided by BHEL for mounting on Rugged Control Cubicle					
S.N	ITEM	Rating	Approx. Size (mm)	App. Wt (Kg)	Qty
1.	Input Circuit Breaker (DC)	1000VDC ,1600 A	296*302*418	45	1 No.
2.	EMI/EMC Input Filter	25 to 1500A @55 ðC Max 1200V DC	300*200*150	14.5	1 No.
3.	DC Power supply	170-320Vdc input +5,+15,+24Vdc output	300*300*250	15	1 Set
4.	Control hardware supply MCB	150 W	10*10*5	0.5	1 No.
5.	3 Phase IGBT Stack	170-320V DC/1900A	1090*596*366	162	1 No.
6.	Pre charge Contactor	6 A	10*10*5	0.5	1 No.
7.	Pre charge resistor	150ß , 450 W	10mm , 5 mm Dia Cyl	0.1	1 No.
8.	Hall effect current Sensors	2000/400 mA	170*135*60	1.5	4 No.
9.	Hall effect voltage sensor	1000V/ 50 mA	137.8*64.3*63	0.29	3 No.
10.	DSP based Hardware	24 VDC / 5 Amps.	300*300*150	10	1 No.
11.	Space heater Contactor	6 A	10*10*5	0.5	1 No.
12.	Space Heater	1200 W, 240V, 1q	10mm , 5 mm Dia Cyl		1 No.
13.	Diode				1 No.
14.	Current transformers		170*135*60	1.5	3 No.
15.	Display Unit	140*100*20		1	1 No.
16.	CBCT	420mm * 170 mm Rectangular	420*170*10	10	1 No.
17.	Earth fault relay	90-270V AC input supply	22.5*110*73.5		1 No.
18.	LED	RED LED (24V DC)	37mm dia.		4 No.
19.	LED	Green LED(24V DC)	37mm dia.		10 No.
20.	Push Button	24V DC supply operated	40mmdia.		3 No.
21.	Selector switch	24V DC supply operated	80mmdia.		2 No.
22.	Emergency switch	24V DC supply operated	40mmdia.		1 No.
23.	Speed resolver		100 mm dia.		1 No.
24.	Output contactor of blower	Minimum 4kW rating	10*10*5	0.5	1 No.
25.	Terminal block				1 Set
26.	Cable glands	Power cable glands			1 Set
27.	Cable glands	Control cable glands			1 Set
28.	Brake Chopper	400VAC, 1000A	300x100x50	2	1 Set
29.	Resistance Box	400VAC,75KW	1390x690x350	75	1 Set
30.	Common Mode Filter	420mm * 170 mm Rectangular	420*170*10	10	1 No.
31.	Any other component including EMI/EMC Filters etc.				1 Lot
	Total Approx.		~0.65 m³	~300 kg	

Note : Sl. 28 to 30 are newly added

Section 4

Cubicle Assembly and Wiring Guidelines:

- Halogen free FRLS grade multiple strands cable with overall shielding and individual wire shielding shall be used for internal wiring.
- Shielding will be copper with silver coating
- All cables are to be used with appropriate colors.
- Required cable clamps are to be provided as per cable routing.
- Internal cabling arrangement shall comply with MIL grade requirements.
- The busbars shall be air insulated and made up of high conductivity Aluminium. All busbars shall be fully screened by means of PVC sleeves in their own and the same shall be arranged in accordance with IS-375
- The busbars shall be properly segregated, suitably braced with insulated supports (DMC/FRP/SMC) placed at appropriate intervals to withstand the electromagnetic stresses during short circuit. Minimum electrical clearances shall be maintained between phase, neutral, body and DC/AC Supplies as per standards.
- Copper conductor/bus bars to be used for high power connections.
- Earthing bus bars to be provided inside the panel. External Earthing terminals to be provided.
- Wiring diagram to be provided in soft and hard copy.
- Cross Over and overlap of different wiring like Control, Power AC/DC to be avoided. If it is necessary, the same to be shielded properly.
- The following items as per the requirement and detailed layout to be provided as a part of the Cubicle Wiring:-

<u>Sl. No.</u>	<u>Description</u>
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| 1. | Mil Grade circular Interconnecting Connectors |
| 2. | Terminal Blocks |
| 3. | Suitable 24V Fans for air circulations with honeycomb mesh |
| 4. | 4 core, 16 core & 24 core signal Cable |
| 5. | 4 Core control power supply cable of 10 Amps |
| 6. | Bus bars /Power cable shielded to carry 3000 Amps for power connections. |
| 7. | Lugs for crimping and termination for control and power wiring |
| 8. | Ferrules as per wiring scheme. |
| 9. | RS 232 Cable with mil grade D type connectors on either side |
| 10. | RS 485 Cable with mil grade D type connectors on either side |
| 11. | Any additional item required for interconnection and wiring |

Section-5

Shock Analysis:

- The Cubicle to be designed to withstand a shock of 58g.
- The shock analysis is to be undertaken either in ANSYS or I-DEAS software.
- The normal mode analysis is to be carried out by Block – Lanczos method.
- The fixed points of the equipment (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.
- Generation of solid/ surface model of the equipment and consequent development of finite element model after discussion with BHEL
- The shock loads likely to be experienced will be provided by the designer prior to commencing the shock analysis.
- 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.

Vibration Analysis:

- Cubicle shall be designed to withstand following vibration level.

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 in the straight line joining the values as specified:

- a) At 25 Hz - 55 dB
- b) At 8 kHz – 85 dB

- Cubicle should be capable of trouble free operation under the influence of external vibration at the frequencies from 0 to 5 Hz with the amplitude of 1.0 mm and at the frequencies 20 to 30 Hz with an acceleration of 1 g (9.81 m/sec^2)

Section 6

Documentation:

- Complete Cubicle Design in 2D (AutoCAD) & 3D drawing (preferably in NX) to be provided.
- All drawings should contain the foot print, weight and CG of the equipment.
- The 3D modeling drawings are to be submitted in hard copy as well as soft copy..
- All models are to be provided with provision for editing.
- Complete shock analysis report is to be submitted in hard copy as well as soft copy forms.
- Complete Shock analysis related computer files (source/components/mesh) are to be provided.