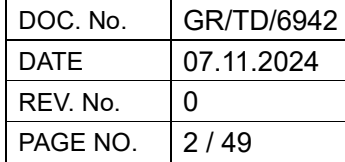
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**Procurement Technical Specification
of Electrical Panels for**

**BANGALORE METRO RAIL PROJECT
(5RS-DM)- PHASE-2,2A,2B (318 cars)**

Approved	07.11.2024	P.ARUNPRASAD	
Reviewed	07.11.2024	V.SARANYA	
Prepared	07.11.2024	BRINDHA M D	
	Date	Name	Signature

[illegible]




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1 Introduction

1.1 General

This document describes Procurement Technical Specification (PTS) of Electrical Panels to be supplied for cars under the 'BANGALORE METRO RAIL PROJECT (5RS-DM) - PHASE-2, 2A & 2B (318 cars) contract.

The Electrical Panels shall comply in all respects with 'BMRCL 5RS-DM' Employer's Requirements General Specification (ERGS) and Employer's Requirements Technical Specification (ERTS).

BMRC 5RS-DM - 318 cars contract is of 6-Car train-sets to be operated on the following 3 lines/corridor,

SI No.	Lines/Corridor	Distance (km)	Number of 6-car Train sets (Cars)	Grade of Automation	Signaling system
1	Line-6 (Kalena Agrahara – IIMB-Nagavara)	21.5 km	TS#16 (96 cars)	GoA2/GoA4	CBTC
2	Phase 2A (Central silk board junction – K.R. Puram)	19.8 km	TS#21 (126 cars)	GoA2/GoA4	CBTC
3	Phase 2B (K.R.Puram – Kempegowda International airport)	38.4 km	TS#16 (96 cars)	GoA2/GoA4	CBTC

The trains may have to be operated in GoA2 modes with Driver/attendant during initial phase of the project and shall finally be upgraded to GoA4 (UTO) mode.

Subcontractor shall be responsible for all works required in this PTS with regard to Design, Development, manufacture, supply, testing, training, delivery and commissioning.

The configuration of train formation is as follows.


DMC – TC – MC – MC – TC – DMC - 6 car train formation

DMC: Driving Motor Car,
MC: Motor Car,
TC: Trailer Car

* : Front Automatic Coupler (FAC)
– : Semi-Permanent Coupler (SPC)



All DMC, MC and TC supplied under this contract shall be totally interchangeable with all other

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DMC, MC and TC respectively, supplied under this contract, without modification.

Each DMC shall be provided with Automatic couplers without electric head, at the front end of the train. The other end of DMC and either ends of TC & MC shall be equipped with semi-permanent couplers.

BEML shall carry out all required works and activities as contractor for 'BMRCL 5RS-DM' project while the subcontractor shall be responsible for all works required in this PTS with regard to Design, Development, manufacture, supply, factory acceptance, testing and commissioning of Electrical Panels and shall be responsible for supporting the BEML activities as contractor for 'BMRCL 5RS-DM' Project.

The scope of work shall include all items of work which may be required to meet the performance requirements, trouble free and efficient operation of trains and meeting the best international practices even if not specifically mentioned in the tender specifications as specified in ERTS 1.1.7

As per ERTS 1.1.3 The scope of supply shall also include:

- i. To provide final drawings and other any documents required for review and acceptance by the Project Manager.
- ii. To provide supporting information including samples for design development items such as mock-ups, studies and reports.
- iii. Preparation of documents for obtaining approvals by Employer from the appropriate statutory authorities.

1.2 Climatic and environmental Conditions (ERTS clause 2.1)

The BMRCL cars shall operate reliably and safely under Bangalore climatic and Environmental conditions as per ERTS 2.1 shown in the following Table-1. Accordingly, the Electrical Panels shall be designed to operate with satisfactory performance under the following climatic and environmental conditions.

Description	Limiting Values
Maximum ambient temperature (Refer note1 below)	42°C
Minimum temperature	8°C
Humidity (Refer note 2 below)	92% saturation during rainy season
Rainfall	Rain occurs generally from May to October. Average annual rainfall is approximately 1065mm. Maximum rainfall in any 24h period is 178mm.
Atmosphere during hot season	Extremely dusty including bird feathers
Maximum wind Speed	125 km/h
SO ₂ level in atmosphere	6.7— 80 mg/ m ³
NO _x level in atmosphere	16 - 80 micro g/m ³
Respiratory Suspended Particles Matter in atmosphere (RSPM)	49 - 120 micro g/m ³


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Total Suspended Particles Matter in atmosphere (TSPM)	111 - 360 micro g/m ³		
Altitude	1000 m		
Conditions in stations	All underground stations will be fully airconditioned. Above ground stations will have air-conditioning for certain designated rooms only.		

Table-1

Note:

1. The temperature of the metal surfaces of the vehicles when exposed directly to the sun, for long periods of time, may be assumed to rise to 60°C.
2. Any moisture condensation shall not lead to any malfunction or failure.

1.3 Environmental Conditions in Tunnel:

i) Tunnel ventilation is achieved primarily by the movement of vehicles inside the tunnel under normal working conditions. The relief of the piston effect generated by the train is achieved by means of draft relief shafts. Tunnel ventilation fans installed at each end of each station will be used to provide supplementary ventilation at times of high temperature, and under congested traffic or emergency conditions. These fans will provide reversible airflow and will intake from, and exhaust to the outside through ventilation shafts. The maximum design temperature inside the tunnel is expected to be 46°C under normal as well as congested conditions.


ii) Under emergency conditions of tunnel fire, the tunnel ventilation system will be used for smoke extraction by operating tunnel fans in push-pull mode. The allowable maximum temperature inside the tunnel during such smoke extraction will be below 60°C.

iii) Track-way exhaust systems will be provided to extract a portion of train-generated heat while the train is within the bounds of a station. During normal conditions, under platform exhaust as well as over-track-way exhaust fans will operate. In addition, control of these fans shall be possible during congested and emergency conditions for the purpose of aiding tunnel ventilation and providing additional smoke removal capability for the station and tunnel. During emergency fire conditions within a station, the station air handling system will be operated to supplement smoke removal.

iv) Tunnel walls may be wet and seepage water will normally be present in the invert. Rolling Stock supplied must therefore be capable of withstanding the effects of seepage and continue to operate in such wet and humid conditions.

1.4 Line Characteristics

- i)
 - a) Length of Line-6 from Kalena Agrahara to Nagavara is 21.5 Km
 - b) Length of Phase 2A (Central silk board junction – K.R.Puram) is 19.8 km
 - c) Length of Phase 2B (K.R.Puram – Kempegowda International airport) is 38.4 km.
- ii) Station name, number, location, inter distance, platform location, line profile, gradient and curves radius are given in Appendix- E of ERTS document.
- iii) Presently, trains of East-West Corridor and North-South Corridor of Phase-I are being maintained in Baiyappanahalli and Peenya depot respectively. In future, the trains which will

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operate on East-West Corridor shall be maintained at Whitefield and Challaghatta depots (new depots). Baiyappanahalli depot will provide the maintenance facilities for trains operating on Phase 2A line and trains operating on Phase 2B line shall be maintained at Airport Depot (new depot). Trains which will operate on Line-6 shall be maintained at Kothanur depot (new depot).

1.5 Track Structure Parameters (ERTS clause 2.3)

The Track Structure Parameters for At-grade, Elevated and Underground Corridors are shown in Table-2.

Description	Elevated and At-grade Corridor		Underground
	Ballasted	Ballasted less (DFF)	Ballasted less (DFF)
Track Laying Gauge	1435 mm		
Rail Type (Main line)	UIC 60 Head hardened (1080)		
Rail Type (Depot)	UIC 60 (880)		
Rail profile	60E1 (UIC 60) 880 grades	60E1 (UIC 60) 1080 grade HH	60E1 (UIC 60) 1080 grade HH
Indication of Rail	1 in 20	1 in 20	1 in 20
Rail Seat spacing, Main line	650 mm \pm 10 mm	650 mm \pm 10 mm	700mm \pm 10m
Sleeper Spacing (Depot)	650mm \pm 20mm	650mm \pm 20mm	650mm \pm 20mm
Ballast Cushion Depth (Depot)	250mm	250mm	250mm
Standard Rail length	13m and 18m	13m and 18m	13m and 18m
Rail panel lengths	Long welded rails	Long welded rails	Long welded rails
Minimum Radius of curvature	Depot – 100m	120m with grade compensation	200m with grade compensation
Minimum Turn Out Radius (Main Line)	1 in 7, R-140		
Minimum Turn Out Radius (Depot)	1 in 7, R-140		
Max. Cant Permissible	125 mm	125 mm	125 mm
Max. Cant Deficiency Permissible	100 mm	100 mm	100 mm
Max. permissible Cant Gradient	1 in 440	1 in 440	1 in 440
Turn-out Speed: Turnout (Main line) (1 in 9) R-300	45 km/h	45 km/h	45 km/h
Turn-out Speed: Turn-out (Main line) 1 in 7,	25 km/h	25 km/h	25 km/h
Turn-out Speed: Scissors (Main line)	25 km/h	25 km/h	25 km/h
Turn-out Speed: In Depots	25 km/h	25 km/h	25 km/h
Maximum Gradient (Main Line)	4% (compensated)	4% (compensated)	4% (compensated)


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Minimum vertical curve radius crest	1500m	1500m	1500m	
Widening of track Gauge on curves	Upto 9 mm for curves sharper than 500m radius			
Structural gauge and passing clearance in straight	Refer to appendix E of this document for typical sections			
Tunnel Profile	Drawings showing section of cut and cover and bored tunnel in the Underground sections and details of various equipment/Electrical Panels etc. located therein are mentioned in are enclosed in Appendix E of ERTS document			
Line profile	The drawings showing the line profiles of all corridors are enclosed in Appendix E of ERTS document.			

Table-2


Note: For detailed Track Tolerance details refer ERTS section 2.3.2 & Table 2.3 and principle details Platform Interfaces refer ERTS section 2.3.3 & Table 2.4

1.6 Current Collection System (ERTS clause 2.5)

System particulars	For all sections and depots
Supply Voltage System	750V DC.
Type of Current collection	Through Third Rail (Inverted Rail) in all sections.
Current Collector	Through current collector shoes mounted on the driving motor cars and motor cars
Minimum height from rail level to Current collecting surface of the conductor rail	As per para 4.1.1 (a) of chapter 4 of SOD (December 2015)
Maximum height from rail level to Current collecting surface of the conductor rail	As per para 4.1.1 (b) of chapter 4 of SOD (December 2015)
Minimum distance of Centre line of the Conductor rail and track centre	As per para 4.1.2 (a) of chapter 4 of SOD (December 2015)
Maximum distance of Centre line of the Conductor rail and track centre	As per para 4.1.2 (b) of chapter 4 of SOD (December 2015)
Nominal Voltage	750 V DC
Minimum Voltage	500 V DC
Maximum Voltage	900 V DC
Occasional maximum voltage	950V D.C
Occasional maximum voltage during regenerative braking	1000 V D.C
Voltage for guaranteed performance	725 V DC.

Table-3

Typical third rail schematic, gauge and dimensions are given in Appendix E of ERTS.

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2. Definitions and Abbreviations

The following definitions and abbreviations are applicable to the PTS.

2.1 Definitions

The following definitions and abbreviations are applicable to the PTS.

“BMRCL” means the Employer for the Mass Rapid Transport System (MRTS) for Bangalore

“BMRCL’s Representative” mean such persons appointed by BMRCL to act as engineers for the purpose of the MRTS.

“BEML” means the Customer to procure the Electrical Panels for BMRCL 5RS-DM contract.

“Subcontractor” means the subcontractor of Electrical Panels to BEML for 5RS-DM BMRCL Project.

“ERGS” means Employer’s Requirements-General Specification of 5RS-DM BMRCL contract for BMRCL Metro Project

“ERTS” means Employer’s Requirements-Technical Specification of 5RS-DM BMRCL contract for BMRCL Metro Project

“PTS” means BEML’s Procurement Technical Specification.

“GTC” General Terms & Conditions of BEML for the procurement of the Propulsion system

“Engineer / Project Manager / BMRCL’s Representative ” means any person nominated or appointed from time to time by the employer to act as the Engineer / Project Manager for the purpose of the contract and notified as such in writing to the contractor.

“Engineer's / Project Manager’s Representative” means any assistant of the Engineer / Project Manager appointed from time to time by the Engineer.

2.2 Abbreviations

ATC: Automatic Train Control

BMRCL: Bangalore Metro Rail Corporation Limited

EMC: Electro-Magnetic Compatibility

EMI: Electro-Magnetic Interference

FAI: First Article Inspection

ERTS: Employer's Requirement Technical Specification


ERGS: Employer's Requirement General Specification

GCC: General Condition of Contract

GTC: General Terms and Conditions.

LRU: Least Replaceable Unit

MDBF: Mean Distance Between Failures

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MDBCf: Mean Distance Between Component Failures

MDBSF: Mean Distance Between Service Failures

MTTR: Mean Time To Repair

PIS: Passenger Information System

PTS: Procurement Technical Specification

SCC: Special Condition of Contract

SOD: Schedule of Dimension

TCMS: Train Control and -Management System

N/A: Not Applicable

TBD: To Be Determined

PDR: Preliminary Design

FDR: Final Design

GoA: Grade of Automation

UTO: Unattended Train Operation

For further abbreviations, please refer to ERTS APPENDIX C (ERTS 23)

3. Precedence of Documents

The PTS shall be read in conjunction with the General Terms and Conditions (GTC) of tender, ERGS, ERTS.

To the extent that any provision of the PTS is inconsistent with any provision of the Commercial Specification, the provisions of the General Terms and Conditions (GTC) shall prevail.


To the extent that any provision of GTC is inconsistent with any provisions of the GS and TS, the provisions of GTC shall prevail.

In the event of any conflict between requirements of particular parts of this PTS, the Subcontractor shall seek clarification from BEML.

Order of precedence	Document Title
1	BMRL 5RS-DM_ERTS
2	BMRL 5RS-DM_ERGS
3	GTC
4	PTS

This PTS shall in no way relieve the subcontractor from any requirements specified in the ERTS and ERGS.

The complete requirements are those found in the above documents. It shall be the subcontractor's responsibility to ensure that equipment, documentation and services furnished against this PTS are in full compliance with all the above documents.

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Also, in the event of any conflict among the requirements of particular parts of the PTS, ERTS and ERGS, the subcontractor shall seek clarification with BEML prior to making a contract. After making a contract, the subcontractor shall comply with BEML's Interpretation for any discrepancies.

4. Qualifying Criteria for subcontractor and Vendor approval

4.1 Proven Design


The proposed Electrical Panels by the sub-contractor against this PTS shall satisfy the "Proven Design" clause 5.1.2 of ERTS.

Proposed Electrical Panels shall have been in use and have established their satisfactory performance and reliability on at least three mass rapid transit systems in commercial / revenue service over a period of three years or more (in each MRTS) either outside the country of origin in three different countries or in MRTS in India. Electrical Panels used in existing Rolling Stock in MRTS in India do not get automatically qualified for use unless specifically approved by the Project Manager for this project. If required by the Project Manager, Subcontractor shall provide certificate of satisfactory performance for a period of three years or more from the Metro operators.

The subcontractor shall manufacture and supply the Electrical Panels only from such manufacturing units that have supplied the Electrical Panels that fulfill the proven design requirements as above. (Refer ERTS clause 5.1.2).

4.2 Qualifying Criteria (ERTS Clause 5.1.2)

- (i) The subcontractor shall meet the qualification criteria as per ERTS 5.1 Proven design.
- (ii) The subcontractor should be an OEM and should have carried out design and manufacturing of sub-assemblies and those sub-assemblies proposed for Electrical Panels shall be state-of-art & of proven design and have been in use and have established their satisfactory performance and reliability on at least three mass rapid transit systems in revenue service over a period of three years or more (in each MRTS) either outside the country of origin in three different countries or in an MRTS in India. Proposed Electrical Panels should have been in service during the preceding three years or more in respect of Electrical Panels in similar metro system. To this effect, the subcontractor shall submit purchase order copies and satisfactory performance reports from the customers / Metro Corporations along with the technical offer.
- (iii) Electrical Panels used in existing rolling stock of an MRTS in India do not get automatically qualified for use unless specifically approved by the Engineer for this project. If required by the Engineer, subcontractor shall provide certificate of satisfactory performance for a period of three years or more from the Metro operators. Where similar sub-systems of a different rating are already proven in service as per the above criteria then the design shall be based on such sub-systems.
- (iv) Electrical Panels shall be procured from the approved vendors and sourced from only such manufacturing units that have supplied the sub-systems that fulfill the proven design requirements as above. The contract envisages commencement of manufacturing only after completion of pre-final design. Accordingly, the number of years in revenue service and operation for the above requirements shall be calculated as on the contracted Key Date No. 3.1 corresponding to 'Pre-Final Design Completion'.

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- (v) The subcontractor shall have established International Quality systems and certification like ISO 9001/ISO 14001/IRIS. The subcontractor shall submit supporting documents in this regard.
- (vi) The subcontractor shall undertake to provide support during Installation, Testing & Commissioning, service trials, revenue service and DLP period either by themselves or through sister company or a partner in India. The subcontractor shall submit detailed proposal in this regard.
- (vii) The sub-contractor shall provide all the required documents for obtaining the vendor approval for Electrical Panels as per ERTS 5.1.5.
- (viii) The subcontractor shall ensure availability of components used in Electrical Panels for a period of 15 years from the last date of taking over of whole of Works.
- (ix) The subcontractor shall submit Inspection & Test Plan / Quality manual.
- (x) The subcontractor shall extend support of positioning subcontractor's staff in Depots of Bangalore for meeting DLP obligation to carry out technical / wiring modifications in Electrical Panels.

4.3 Vendor approval (ERTS Clause 5.1.5)

Vendor approval from BMRCL is mandatory for all Electrical Panel suppliers. Accordingly, the request for Vendor approval with all relevant references and details as per Vendor approval format (Refer Annexure-1) shall be submitted along with the technical offer, Company profile, Product range and the organization structure. The acceptance of the technical offer is subject to approval of the Vendor by BMRCL based on the vendor approval details submitted by the subcontractor. Refer ERTS 5.1.5 for complete information.


It shall be obligatory for the Contractor to obtain Notice of No Objection from the Project Manager for the selection of the sub-contractor and vendors for all items of work, even if the name of the subcontractor and vendor is named in the Contractor's Proposal and the works to be done including purchase of materials and equipment's is in accordance with the Standards specified in the Contract. List of items for which Project Manager's approval of vendors is obligatory shall be proposed by the Contractor during preliminary design (well before finalising the vendors), which will be reviewed for approval by the Project Manager. On submission of the list by the Contractor, the Project Manager may direct the Contractor to include other items for which vendor approval shall be mandatory.

The request for vendor approval shall be comprehensive with all relevant references and details establishing their compliance to the specified conditions. Along with the vendor approval proposal, a commitment from the proposed vendor shall also be submitted that in case of any future procurement action by Employer, they shall quote directly to Employer.

4.4 Indigenization (ERGS Clause 1.3)

The subcontractor shall make efforts to source maximum number of equipment and materials from India and Electrical Panels to be indigenized to meet the required performance requirements and quality standards and facilitate ease in maintenance and easy availability of spares of Electrical Panels.

To facilitate ease in maintenance and easy availability of Electrical Panels, BEML/ BMRCL is keen in standardization and expects subcontractor to make efforts to manufacture in India and materials from India.

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Employer's Requirements-General Specifications shall be indigenized and sourced from India to meet the required performance requirements and quality standards.

Subcontractor shall choose their partner in India or open a wholly owned subsidiary in India for manufacturing of indigenized items. Subcontractor shall arrange granting of unqualified licenses to their chosen Indian partners to manufacture and sell such indigenized items for other than BMRCL 5RS-DM contract requirements also.

During vendor approval stage, the subcontractor shall also submit a commitment that in case of any future procurement action by BMRCL, they shall quote directly to BMRCL.

Subcontractor shall submit comprehensive proposal indicating details of the Indian Partner(s), the place of manufacture in India, work schedule etc. within six months of the Commencement date for approval by the BEML/BMRCL. Maintaining quality standards, ensuring performance requirements and timely delivery shall be the sole responsibility of the subcontractor.


5 Scope of Supply and Work (Hardware)

5.1 General

Subcontractor shall design and select the components of each panel in accordance with the drawings provided by BEML. Subcontractor shall provide all components of Electrical Panels (**EDB Panel for DMC Car, MCB Panel for DMC Car, EDB Panel for TC Car, BCB Panel for TC Car, EDB Panel for MC car**) to BEML in pre-wired condition. The Subcontractor shall provide all the Electric Boards/Panels but not limited to as per the scope of supply given in the Cl. No.5.2 & 5.3 of this PTS.

If the components are used incorrectly, the subcontractor shall, at his own expense, take whatever action is deemed necessary, such as, rectification, readjustment or design changes to the satisfaction of the BEML and BMRCL. The subcontractor shall consider TS 18, for design of each board and purchase of Electrical / Electronic components.

The specification, quantity and location etc., of components such as Relays, Contactors, MCB, TB's etc., provided in the BOM of the drawings will undergo change during review of Proto train & design document by BMRCL. The subcontractor shall absorb those design changes without any additional cost to BEML.

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Subcontractor shall consider ERGS & ERTS of BMRCL 5RS-DM project during design of the Electrical Panels. The Subcontractor shall provide, as a minimum, the following:

5.2 Scope of Supply for Electrical Panels

The list of Electrical Boards/Panels to be supplied by sub-contractor for BMRCL 5RS-DM is as per **Table-I** below:

Sl. No.	DRAWING NUMBER	ITEM DESCRIPTION	QTY/CAR		
			DMC	TC	MC
1	507-21773	EDB PANEL (DMC CAR)	1 No.	-	-
2	507-21777	MCB PANEL (DMC CAR)	1 No.	-	-
3	507-21774	EDB PANEL (TC CAR)	-	1 No.	-
4	507-21775	EDB PANEL (MC CAR)	-	-	1 No.
5	507-21776	BATTERY CONTROL BOX (TC CAR)	-	1 No.	-

Table -1 List of Electrical Panels

S/ N	DRAWING NUMBER	DESCRIPTION	Total quantity required
a. All Electrical monitoring, control and protection panels.			
1	507-21773	EDB PANEL (DMC CAR)	4 nos
2	507-21777	MCB PANEL (DMC CAR)	4 nos
3	507-21774	EDB PANEL (TC CAR)	4 nos
4	507-21775	EDB PANEL (MC CAR)	4 nos
5	507-21776	BATTERY CONTROL BOX (TC CAR)	4 nos

Table -2 List of Unit Exchange Spares (As per ERGS 14.5.7 Attachment-4)

S/ N	DRAWING NUMBER	DESCRIPTION	Total quantity required
1	507-21773	EDB PANEL (DMC CAR)	1 No.
2	507-21777	MCB PANEL (DMC CAR)	1 No.

Table -3 List of items required for Simulator

* *Set* - means '6-Car Train Set'


5.3 Guideline Components of Electrical Panels

The components used for similar type car are described below. After detailed circuit diagram, Electrical Panels and the components may require to be changed accordingly. But the components, described below, can be guideline components to design Electrical Panel for BMRCL 5RS-DM contract.

1) Common components

Following components were used in common.

- Name Plate
- Cable Bar
- Cables
- Handle
- Mounting Support
- Painting

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- Earth Pad
- Fixing Hole Pad
- Accessories


2) Electrical Boards

Sl. No.	COMPONENTS
1	MCBs
2	AUXILIARY SWITCH
3	RELAYS
4	CONTACTORS
5	TIMER RELAY & SOCKETS
6	INDICATORS
7	CONNECTORS
8	ELECTRICAL OUTLET
9	TERMINAL BLOCKS
10	FUSE
11	RESISTOR
12	ANY OTHER COMPONENTS REQUIRED


The components described above are just guideline components to select the components for BMRCL 5RS-DM contract.

The subcontractor shall provide all components related to the Electrical Panels, but not limited to, the following.

1. All components to meet the performance requirements of the Electrical Panels
2. Complete tools, Hardware, Facilities, Jigs, Fixture diagnostic etc. for whole Electrical Panels shall be in line with contractual & Engineers Requirement.
3. Enclosures & Mounting arrangements has to be provided by the subcontractor for all equipments supplied by subcontractor.
4. Cables between equipments:
 - i. Subcontractor shall supply the cable harness with the heat shrink tube, protective jacket, numbering tube, bundle name-tag, strain relief bushings, ferrules for terminal block and in case of lead cable, the brackets for fixing cable and fasteners must be supplied by the subcontractor.
 - ii. Cable Number/Tagging must be under transparent heat shrinkable tube and should have a life of 35 years. Same is also applicable for Name Plate or Name labels.
5. All connectors & its mating connectors, Pins, Hood, Gland etc., for car body side wiring shall be supplied by the subcontractor.
6. The connector, terminal blocks, relays, indicators, contactors, MCB's and other items shall be from OEM as per BEML drawings.

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7. Mating connectors for vehicle side with all pins even if pin is not used, back shells and accessories shall be supplied by the subcontractor.
8. Non-screwed and self-locking type connectors for complete system shall be ensured.
9. Earth pad / stud and fasteners for fastening (preferably which suits to M6 and 6 sq. mm. cable)
10. Name plates or Name Labels
11. Rubber (packing or gasket) for the water-tightness when the subsystem or components are installed shall be supplied by the subcontractor.
12. The subcontractor shall provide one full set of connectors and its contacts as mounted on the equipments for each car-type (DM, T & M cars) to carry out vehicle level voltage withstand test at BEML factory.
13. The Cable markers provided shall be fire retardant heat shrinkable type. The cable markers shall be protected against fading by providing Fire retardant heat shrinkable clear sleeve.
14. The subcontractor shall position the DLP & commissioning spares at BMRCL depot. The sub-contractor shall submit along with the tender, the list of DLP & commissioning spares for approval of BMRCL.
15. The ratings and make of MCBs, Relays and Contactors to be submitted for approval of BEML / BMRCL for operation with dust proof box based on the de-rating factors of temperature and proximity.
16. The cables required for manufacture of the above Electrical boards will be supplied by BEML to the subcontractor.
17. All cable accessories shall conform to EN45545, HL3 standard.
18. Painting specification & process wherever applicable shall be as per the approved Painting Specification provided by BEML.
19. The Gold pin contacts to be provided for all shield cables (core + shield).
20. All size of cables should be properly crimped with suitable crimp pins at MCB's, Relays, Contactors, Connectors Diode Terminal Block, Resistor Terminal Block & Terminal Blocks.
21. Based on the cable sizes (for cable entering to the EDB panel from Train side), suitable Glands to be provided at bottom of the Panel.
22. To accommodate more cables & to avoid cable insulation damage, the connector Glands (plastic with EN45545, HL3 complied) to be provided with suitable max inner diameter size.
23. Cable bunches shall be segregated into small bunches to avoid cable bunches touching the door edge while closing the door and ensure that EDB panel door to be closed smoothly without any extra effort.

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24. Subcontractor to ensure that Cable bunch do not touch the Relays/Components/Panel Edge after doors are closed.
25. Cable routing / installation shall be followed as per EN 50343 standard.
26. Material & Workmanship shall be followed as per ERTS chapter-18.
27. Sub-contractor shall be responsible to carry out EDB Wiring modification at BEML factory/Depot at any stage and necessary cable accessories, Pins etc., required for modification to be provided by sub-contractor.
28. Sub-contractor shall provide Torque list details for the items used inside the Electrical Panels.

Those components, systems and assemblies which require routine maintenance, frequent attention or unit replacement, shall be easily accessible for in situ maintenance as per ERTS clause 19.4.3. Hence, it's the responsibility of supplier to maintain sufficient quantity of DLP spares at all depot until the end of DLP period.

All information and contact details of the sub-suppliers shall be provided to contact the sub-suppliers after expiry of warranty.

5.4 Warranty

The subcontractor shall be responsible for any defect or failure of equipment's provided in the cars, due to defective design, material or workmanship during warranty period.


The warranty period of special tools, test and diagnostic equipment, maintenance and unit exchange spares shall be as per GS of BMRCL 5RS-DM from the date of acceptance by BMRCL.

The repair and/or replacement of failed components and equipment and installation of repaired/replaced components/equipment shall be taken by the subcontractor on his own charge at the Site (BEML' works/ BMRCL depots).

The subcontractor shall bear GST, custom duty, freight charges and all other expenses involved in collection of defective components and equipment from the Site and transportation to the manufacturer's works in India or abroad and its return to Site after repairs.

Further, should any design modification be required to any components or equipment as a consequence of failure analysis, the period of 18 months shall recommence from the date when the modified part is commissioned into service and modification shall be carried out free of charge.

The subcontractor shall carry out all replacement and repairs under the warranty promptly and satisfactorily on notification of the defect by BEML so that no car is out of revenue service for more than 48 hours. Also Refer General Terms and Conditions (GTC) of the tender.

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6 Standards and Codes

All equipment supplied shall be in accordance with the requirements of the standards and codes specified in the ERTS/ERGS. The subcontractor may propose an alternative equivalent international standard during the design stage. The acceptance of alternative standard will however be subject to review by BEML/BMRCL. When a Standard or Code is referred to, it shall be assumed that the revision that is current during the design finalization shall be applicable, unless otherwise stated.

Where no standard is identifiable, the subcontractor shall make a proposal, based on the best international practice, which shall be subject to review by BEML/ BMRCL.

During the preliminary design phase, the subcontractor shall submit a consolidated list of all the standards that he intends to use for the design, manufacturing and testing and other phases of the contract, for review of BEML/ BMRCL.

During the pre-final design phase, the subcontractor shall supply one original copy each of the standards and codes in form of searchable pdf format to BEML and BMRCL representatives.

7 Requirements of Documentation

All drawings, documents and information by Subcontractor shall be prepared in English and submitted to BEML for approval as per Appendix 4 and 3.3 of ERGS.

Except for drawings, all documents and information to be submitted shall be of Microsoft Office format on CD-ROM or e-mail.

The Subcontractor shall provide BEML with the drawings of component of Electrical Panels in a format readable with AutoCAD 2013 (latest), CATIA V5 on CD-ROM via e-mail as requested by the BEML or BMRCL Representative.

The drawings shall contain minimum three (3) viewpoints (for example, front view, top view and left view) for three (3) dimensional modeling. The Subcontractor shall provide STEP file or CATIA file to BEML/ BMRCL.


8 Equipment side connectors for Di-electric test

Subcontractor shall supply one full set of connectors and its contacts as mounted on the equipment's for each car-type (DM, T & M cars) to carry out vehicle level voltage withstand test at BEML factory. Detailed list shall be decided and finalised before first supplies.

9 Interface

9.1 Mechanical Interface

BEML shall be responsible for defining the technical and the design constraints and the technical requirements. The Subcontractor shall be responsible for the optimum design of the Electrical Panels, the submission of design information (drawings, technical documents and 3-dimensional modeling data) and the execution of test & inspection in a timely manner without any delay. Any changes of Electrical Panels design shall be submitted in a timely manner for approval. The Subcontractor shall have full responsibility to declare and clarify if there is any required information

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or data from vehicle side and/or running/operating conditions to prevent any design defect under revenue service in the main line.

The Subcontractor shall be responsible for all costs of labor and material, for defect identification and location and for removal, repair or replacement of defective parts and for alteration, repairs, tests and adjustments in connection therewith made to fully comply with the requirement in PTS, TS, GS and Contract Specification, all such replaced or repaired shall be guaranteed for the reminder of the warranty period.

The following is a brief of requirements for Mechanical Interface

- Outline dimension.
- Electrical connection position.
- Fastening, point & torque.
- Demands, free space for installation and maintenance of cover.
- Weight and center of gravity.
- Earth position, size and type
- Thickness of flitting frame & Size and distance dimension of fitting hole.
- Cooling & clearance for ventilation
- Interface with interior facilities & train body
- Anti-vibration material such as rubber

9.2 Electrical Interface


Time to time BEML will facilitate direct face to face meeting between other sub-supplier either at sub-contractors works, BEML works, and another sub-supplier works or at Employer place. Subcontractor is responsible to resolve the issues to achieve the ERGS and ERTS requirement.

The following is a brief of requirements for Electrical Interface

- Power requirements.
- Technical specification.
- Rated current, voltage characteristic and consumption.
- Connector (male and female) with pin and socket part no.
- Connector/terminal arrangement
- Cable inlet/outlet diagram (Size for cable gland)

10 Design Information

The Subcontractor shall provide all necessary documents, drawings and software for BEML according to the time schedule defined by BEML. The Subcontractor shall provide the technical requirements and design information as a minimum as per below mentioned Table,

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S. No.	Description		
1.	List of control equipment and manufacturers		
2.	List of indicators including function, control & display		

The above list is not exhaustive. Detailed design submission list will be finalized during design stage. Further, if any additional documents demanded by end Employer /statutory authority same shall be submitted by the subcontractor.


- The drawings and documents shall be submitted to BEML including preliminary, pre-final, and final design submissions, the final contract document, and all other submission both in the paper copies and electronic format.
- The Subcontractor shall require the interface information, which possibly affects performance, fitting and form, from BEML.

10.1 General


The Subcontractor shall provide, but not be limited to, the following general information in accordance with the schedule approved by BEML before contract award.

To satisfy BEML that the Subcontractor have the ability to supply the Electrical Panels in accordance with the requirement of PTS, before contract award the Subcontractor shall provide BEML for review and approval the following information.

- (a) Vendor approval documents
- (b) Project Management Plan
 - 1) Data Submission Plan
 - 2) Design Submission Plan
 - 3) 1st Production Plan
 - 4) Type Test & FAI Plan
 - 5) Mass Production after Testing and Delivery Plan
 - 6) Training Plan
 - 7) O&M Manual Plan
 - 8) As Built-In Drawing Plan
- (c) Preliminary Inspection and Test Plan (hereinafter, ITP)
- (d) Preliminary Quality Assurance Plan (hereinafter, QAP)
- (e) Preliminary Technical system/product/function description (including Lay-Out drawing)
- (f) Subcontractor's Option Suggestion about PTS requirements
- (g) Clause by Clause commentary for PTS

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- The sub-contractor shall be fully responsible for integrated testing and commissioning including Commissioning Type tests and Commissioning Routine tests of the Electrical Panels at BEML works (Factory test) and at BMRCL site (Depot & Main line tests) for 6-car train formation.
- The sub-contractor shall be responsible to maintain the DLP and commissioning spares at BMRCL site. The list of DLP and commissioning spares shall be furnished by the sub-contractor for review and approval by BEML/ BMRCL.
- The sub-contractor shall provide all the documents for BMRCL 5RS-DM project and shall also provide any other documents required by BMRCL as per ERGS 2, ERGS 3, ERGS 4, Appendix- 5, 7, 8 & 9 of ERGS and ERTS 15 & 20.
 - a) *Design documents – Preliminary, Pre-final & Final.*
 - b) *Description of Electrical Panels with drawings.*
 - c) *Quality assurance plan (QAP)*
 - d) *Type test procedure for Electrical Panels*
 - e) *Routine test procedure for Electrical Panels*
 - f) *Inspection and test plan (ITP)*
 - g) *Factory tests, Depot tests and main line test procedures*
 - h) *Testing and commissioning plan*
 - i) *Interface plan*
 - j) *Type test and Routine test reports*
 - k) *Operation and maintenance manual*
 - l) *Spare parts catalogue*
 - m) *Special tools & Testing equipment*
 - n) *Any other documents requested by BEML/DMRC.*
- The sub-contractor shall provide valid type test certificates/documents and routine test certificates/documents for the Electrical Panels.
- The supplier shall maintain the Electrical Panels and supply of spares for at least 15 years from the date of completion of the contract.
- The supplier shall provide the list of spares of Electrical Panels during DLP period
- The sub-contractor shall provide training in operation and maintenance to BEML and BMRCL staff.

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- Only 110V D.C. (ranges from 77VDC – 138VDC) would be made available on train for control power supply of Electrical Panels system. The Electrical Panels shall continue to operate correctly with the 110 V DC car battery voltage supply.

10.2 Design Submission

The objective of the design submission process is to ensure that the proposed resulting works comply with the specifications are capable of being produced consistently to exacting quality standards, achieve low life cycle costs and can be operated safely to the satisfaction of the Engineer.

The design submissions include Design Calculations, Design Reports and Design Drawings. All design submissions shall include a 'clause by clause' compliance status to all applicable contract clauses of ERTS.

In the event that a statutory body (e.g. Government of India Ministry of Railways, RDSO, Commissioner of Metro Railway Safety, etc.) requires design information in a particular format, it shall be incumbent upon the subcontractor to provide the same, as directed by BEML/ BMRCL.

The subcontractor shall submit all necessary documents viz., documents and drawings describing function description, product description, design calculations, interface requirement description, RAM requirement description, Life cycle calculations, Fire safety, Type & routine test specifications, list and details of spares, related calculations etc.


The Design Phase will be undertaken in three stages:


- Preliminary Design
- Pre-final Design and
- Final Design.

Sl. No	Description of Stage	Submission from subcontractor to BEML (from LOI / contract award)
1	Preliminary design completion including BMRCL approval	2 weeks
2	Pre final design completion including BMRCL approval	2 months
3	Final design completion including BMRCL approval	4 months


The design details for the above 3 stages shall comply with the requirements of clause 5.7 of ERGS.

Design calculation, Design reports, Design drawings and deliverables, as per the requirements specified in Chapter-3 of ERGS, but not limit to, the following design deliverables to BEML according to the time schedule defined by BEML.

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Design Stage	Document/Deliverables	Submission date required (from LOI / contract award)	
Evaluation Stage	Refer to Submittals Checklist as per Annexure-3	Within 2 weeks after receiving PTS.	
PDR	Project Management Plan (PMP): The Subcontractor shall resubmit, if there is any amendment of PMP, in time for acceptance of BEML. - Illustrated project schedules, Chart, tables - List of Submission Data, - Configuration Management Plan	Within 2 weeks Shall update / submit whenever any change happens.	
	Schedule Plan for - Design Deliverables/Drawing submission - Design, Validation, Test & Inspection and Manufacturing	Within 2 weeks. Shall update/ submit whenever any change happens.	
	Compliance certification to all required Standards of Electrical Panels	Within 2 weeks	
	General description		
	Concept design Drawings (Dimensional Installation Drawings: CATIA V5 file)	Within 2 weeks	
PFDR	Technical Description (incl. at least following information) - The detailed submission schedule of each item shall be submitted for approval according to required design stage.	Required to keep updating to the latest design.	
	- Compliance certificate to Standard applied for design, test & manufacturing	Within 3 weeks	
	- Detailed Tech. Spec. & data of Electrical Panels	Within 3 weeks	
	- Estimated/Measured weight of all Electrical Panels	Within 3 weeks	
	- Material List/Spec. & Certification for Fire safety	Within 3 weeks	

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Design Stage	Document/Deliverables	Submission date required (from LOI / contract award)
	- Surface Finish & Painting Specification (Painting to ERTS 14.19.)	Within 3 weeks
PFDR	Preliminary Design Drawings (Dimensional Assembly Drawing: CATIA V5 file)	Within 1 month
	Water-Tightness Method	Within 2 months
	Caution Instruction for Electrical Panels Installation	Within 2 months
	Replacement Instruction & Demonstration of Electrical Panels	Within 2 months
	Life expectancy of major parts and LRUs	Within 2 months
	Consumables List for Electrical Panels	Within 2 months
	Preliminary Plan/schedule for Testing & Inspection	Within 2 months
	O&M Manual, IPC submission List	Within 2 months
	Preliminary list of spares, special tools and test equipment	Within 2 months
	List of equipment identification labels	Within 2 months
	Type Test Procedure (incl. record sheet) & Report	Within 2 months
	Routine Test Procedure (incl. record sheet) & Report	Within 2 months
	FAI Procedure & Report	Within 2 months
	Combined Test procedure (incl. record sheet) & Report	Within 2 months
	Type/Routine Test Procedure (incl. record sheet) & Report in Completed car	Within 2 months
	Commissioning Type Test Procedure & Report	Within 2 months
FDR	Final Design Drawings (Dimensional Sub-assembly drawings: CATIA V5 file)	Within 2 months
	The manufacturing details of all Electrical Panels	Within 2 months
	Installation Instruction of all Electrical Panels	Within 3 months
	Cleaning, storage and handling instruction of Electrical Panels	Within 4 months

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Design Stage	Document/Deliverables	Submission date required (from LOI / contract award)	
	Maintenance & Inspection Instructions (Video Manual)	Within 4 months	
	Detailed Test & Inspection Plan/Schedule	Within 4 months	
	Updated list of LRUs	Within 4 months	
	Final List of Special Tools, Spare Parts, Test Equipment	Within 4 months	
	Draft & Final O/M manuals	Within 4 months	
	Draft & Final IPC (Illustrated Parts Catalogue)	Within 6 months	
	Training Manuals & Materials	Within 6 months	
	Details of equipment identification labels		
	All relevant Operation & Maintenance Information and Training Manual for Special Tools and Test Equipment	Within 6 months	
	As-built drawings & List	Within 6 months	

11 Testing

The Subcontractor shall carry out, as a minimum, the followings for Electrical Panels.
The Subcontractor shall perform, as a minimum, the following tests for Electrical Board (EDB-DMC, EDB-TC, EDB-MC, MCB panel & BCB).

- (1) Routine and type tests of equipment and sub-systems.
- (2) Complete vehicle Type tests for Electrical Board of the BMRCL 5RS-DM project.
- (3) Commissioning Type test for Electrical Board of the BMRCL 5RS-DM project.

The vendor shall furnish the type test & routine test procedure and valid type test certificates for Electrical Board/Panels.


The detailed requirements are specified in the ERGS 4.5 & ERTS 20.

11.1 Operation and Maintenance Manuals and Spare Parts Catalogues

The Subcontractor shall provide the Operation/Maintenance Manuals and Spare Parts Catalogues of the Electrical Panels both in the copies and electronic format. The requirement for Operation/Maintenance Manuals and Spare Parts Catalogues shall be provided for Approval of BEML according to the time schedule defined by BEML.

The subcontractor shall provide the following O & M manual:

- i. Volume 1 – Technical Manual.

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- ii. Volume 2 – Operation Manual.
- iii. Volume 3 – Maintenance Manual.
- iv. Volume 4 – Fault Diagnostics Manual.
- v. Volume 5 – Spare Parts Manual.
- vi. Volume 6 – Software Manual.
- vii. Volume 7 – Special Tools & Test Equipment Manual.

The subcontractor shall provide the operation/maintenance manuals and spare parts catalogues to BEML for approval of BMRCL.

11.2 Investigation & Design Document

11.2.1 Technical Investigation Document


Subcontractor who wants to be involved in making Electrical Boards for BMRCL project shall submit the Technical Investigation Document and estimated costs for each component. At the Technical Investigation Document, all components shall be compared with another company's goods, component by component.

11.2.2 Investigation Point

- 1) Control Relay, Safety Relay, Contactor & Time Relay
 - Make: Schneider / Morssmitt,
 - Investigation Point:
 - Is it suitable for DMRC project (think about IEC standard)?
 - Coil Rating, Contact Rating, Power consumption.
 - How many contacts can we use?
 - Lifetime
 - Does it comply with International Standard (IEC, etc.)?
 - Does it have reliability (have ISO certification or not)?
 - Is it useful under Noise and Vibration?
 - On/Off time.
 - Size, Fixing method, working condition.
 - Can we buy it from India.
 - Etc.

- 2) Indicator
Make: EAO

- Investigation Point:
- Is it suitable for DMRC project (think about IEC standard)?
 - Rating, Power consumption.
 - Shape & Color
 - Lifetime
 - Does it comply with International Standard (IEC, etc.)?
 - Does it have reliability (have ISO certification or not)?
 - Is it useful under Noise and Vibration?
 - On/Off time.
 - Size, Fixing method, Working condition.
 - Can we buy it from India.
 - Etc.

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3) Connector

Make: Harting, Weidmuller, FCI, etc.

Investigation Point:

- Is it suitable for DMRC project (think about IEC standard)?
- Pin & Socket Rating.
- Insulator rating.
- How many Pins & Sockets can we use (30-60P)?
- Lifetime
- Distance between Pins/Sockets
- Pin/Socket type (Gold plating or Silver plating)
- Usable cable size for Pin/Socket.
- Does it comply with International Standard (IEC, etc.)?
- Does it have reliability (have ISO certification or not)?
- Is it useful under Noise and Vibration?
- Size, Fixing method, Working condition.
- Can we buy it from India.
- Etc.

4) MCB

Maker: Schneider / Siemens

Investigation Point:


- Is it suitable for DMRC project (think about IEC standard)?
- Rating and Trip time.
- Can we use auxiliary contact?
- Lifetime
- Does it comply with International Standard (IEC, etc.)?
- Does it have reliability (have ISO certification or not)?
- Is it useful under Noise and Vibration?
- On/Off time.
- Size, Fixing method, Working condition.
- Can we buy it from India.
- Etc.

5) Terminal Block

Make: WAGO, Weidmuller, etc.

Investigation Point:

- Is it suitable for DMRC project (think about IEC standard)?
- Rating.
- Lifetime
- Is it ease to add Terminal blocks
- Does it comply with International Standard (IEC, etc.)?
- Does it have reliability (have ISO certification or not)?
- Is it useful under Noise and Vibration?
- Size, Fixing method, Working condition.
- Can we buy it from India.
- Etc.

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6) Panel

- Investigation Point: Material, Size, Painting

7) The REST (Resistor, Hinge, Fuse, Outlet, Weight)

- The Subcontractor shall recommend Maker who has ISO certification and a component complied with IEC.

12 Spares, Special Tools and Testing Equipment

The Subcontractor shall hand over the Spares, Special tools and testing equipment in accordance with the delivery schedule of BEML.

As per ERGS clause 14.5.1 during DLP period, the subcontractor shall as its own cost and expense, maintain sufficient stock of all spares & consumables required to meet the comprehensive maintenance obligations at all times, this shall include but not be limited to the following:

- (i) Unit Exchange Spares (refer to clause 14.5.7)
(Note: UES are to be supplied separately and shall not be considered as part of DLP spares/stock at Depot/BEML to be positioned by supplier)
- (ii) Consumable spares for maintenance of all trains during commissioning, service trials and up to completion of Warranty period
- (iii) Mandatory spares
- (iv) Recommended spares
- (v) Overhauling spares
- (vi) Special tools, Testing and Diagnostic equipment
- (vii) Special Jigs, Fixtures & Gauges required for maintenance, repair and overhaul of various equipment, sub-systems in particular and the complete trains in totality
- (viii) Rotational spares required for each depot to meet the train availability requirements as per ERGS/ERTS shall be ensured for performing overhauling of equipment's and delivery of the equipment after overhaul & testing to BEML depot staff at respective depots.

12.1 Recommended Spares

Subcontractor shall recommend and supply spares which are not covered under above sections but are expected to be required during DLP, as recommended spares. The list shall be submitted along with the technical offer.


12.2 Special Tools, Jigs, Fixtures, Gauges, Testing and Diagnostic equipment

The subcontractor shall provide recommended lists of Special Tools, Jigs, Fixtures, Gauges, testing and diagnostic equipment separately for maintenance, overhaul and diagnostics of Electrical panels. These shall be delivered at three different maintenance depots at Bangalore.

12.3 Commissioning and DLP Spares & Technical support

The subcontractor shall supply commissioning and DLP spares. Subcontractor shall submit to BEML for review, a list of minimum spare parts that he intends to make available during the installation, erection, and commissioning and defect liability periods, along with the technical offer.

The subcontractor shall keep on site, at his own cost, throughout the installation, erection, commissioning and defect liability periods, stocks of spare parts, as per the


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list to enable replacement of any item found to be defective or in any way in nonconformance with the specification.

Employer at his sole discretion may exercise the option to increase/decrease the quantities (to any extent) of spares indicated under milestones. For increased quantities, payment to the contractor shall be on the basis of actual supplies made and quoted unit rates and no escalation or any other additional sums shall be payable. Any decrease in quantities, if considered by the Employer, shall be intimated by Employer within two years of the commencement date. However, increase in quantities may be intimated at any time during the execution of Contract and the delivery period for the enhanced quantities only shall be mutually agreed and the subcontractor shall comply with the same

13 DLP

- a) Defect Liability period shall start from start of revenue service of last trainset + 24 months.
- b) The supplier shall remedy, at no extra cost to BEML, the defect or failure (fair wear and tear excluded) after any part of the work until the end of defect Liability Period.
- c) The supplier shall be responsible for any defect attributable to defective design, material or workmanship during warranty period. The supplier will not be liable for damages caused BEML or any other third parties did not follow the written operation and maintenance instructions or did not use the metro trains in accordance with the technical documents.
- d) The warranty of the sub-system for which outstanding works are to be completed by the supplier shall start only after completion of all outstanding works.
- e) "Defects Liability Period" shall mean the defects liability period stated in the PO calculated from the date of taking over of whole of the scope of supplies and not any sub-section or part thereof. Provided that, if any part of the Scope of supplies or sub-systems or component of that part has been replaced, renewed or repaired, the "Defects Liability Period" in respect of that part or sub-system or components of that part shall start from the date of such replacement, renewal or repair has been completed to the satisfaction of BEML.
- f) The supplier shall ensure implementation of all improvements/corrective actions against all technical issues reported (during Design, Manufacturing, Installation, Commissioning, Interface Testing, Operation & Maintenance etc.) in earlier projects/supplies of their sub-system and submit the compliance documents during design stage. The supplier shall certify the implementation of such engineering change proposals, before despatch of items.
- g) The supplier shall attend & close all snags, defects, deficiencies, punch points w.r.t. suppliers' sub-system reported by BEML/ BMRCL in various stages of the project (at BEML Factory & BMRCL Depot) promptly before ROD (revenue operation date) of Trains. The list of unattended pending issues (which does not affect the operation of train) along with action plan & timeline to attend/close the same shall be submitted by the supplier.
- h) The supplier shall be required to investigate any design issues, interface issues,


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field failures (conveyed through NCRs, BMRCL Inspection Notes, Minutes of meetings etc.) of supplied sub-system in detail & submit investigation report along with corrective action report to BEML in a time bound manner for obtaining BMRCL's approval. Based on BMRCL's approval, the supplier shall be required to implement the corrective action (viz. Hardware modification), without any additional cost, in all Trains during entire DLP.

- i) The supplier shall not convey their recommendations on replacement of items/anything related with DLP process directly to BMRCL without prior information to/consent of BEML. If the supplier recommends any spares/consumables/other items besides the items quoted to BEML during the PO/Design finalization stage, then the supplier should supply these items free of cost for entire DLP of all trains.
- j) The supplier shall provide Training of their sub-system to BEML T&C personnel for familiarization of their sub-system in terms of testing, commissioning & comprehensive maintenance.
- k) Submission of detailed hardware modification fleet replacement proposal based on detailed investigation to address the recurrence of the fault/improving the reliability of sub-system towards closure of BMRCL Inspection Notes/MoM Points/Open Technical Issue/Punch points/Epidemic Failures etc.
- l) Implementation of hardware modification/fleet replacement of component/complete unit/complete sub-system in all Trains as well as in supplied Spares. Monitoring of sub-system/Train's performance after implementation of hardware modification/fleet replacement.
- m) Submission of OEM Maintenance Manuals, Maintenance Work Instructions, Maintenance Schedule [Specifying the frequency of various inspections/service checks synchronized with Master Maintenance Schedule of Train (As Per RAMs documents viz. Daily, 72 Hrs., A, B1, B4, B8, C1, C2, C3, C4 service checks, C5 Mid-life refurbishment etc.), detailed scope of work during such inspections/service checks including facilities & manpower requirement, Down-time of Train etc.] of supplied sub-system. Finally, the frequency of various inspections/service checks shall be followed as per approved Train level "Operation & Maintenance Manual" and "Master Maintenance Schedule".
- n) Handling obsolescence issues of supplied sub-system's component/subassembly assembly /maintenance terminals/tools/special tools/spares/consumables or any item related with supplied sub-system during Life cycle of the supplied sub-system.
- o) Failures of 6-Car Train sets caused by the failures of the individual equipment/ subsystems or any other defects shall only be treated as warranty failures. BEML decisions in this regard shall be final.
- p) The final acceptance will not cancel the particular conditions specified in the contract, such as hidden defects, reliability requirements, life span, etc


After sale services

- During this period, the supplier will undertake the necessary repair works due to

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failure at his own risk and expense including spare parts and labour.

- All the equipment and material necessary for testing, defects and repair in connection with warranty obligations will be provided by the supplier bearing all the connected expenses.
- Spare parts for faulty components replaced shall be provided by the supplier and are not included in the stock of spare parts that will be provided for the regular maintenance purpose. In the other case a specific agreement between the BEML and the supplier shall be set up.
- "After sale" service organisation set up by the supplier during all the warranty period including any extension shall be described in term of permanent resident staff, with requisite qualification and experience. During the warranty period, the supplier shall be responsible free of charge for the detection and repair of defects and components replacements where the metro train does not conform to the Functional specification and performance requirements. Normal wears and tears are excluded from these defects.
- The repair and or replacement of failed components and equipment and installation of repaired/replaced components/equipment shall be undertaken by the supplier free of charge at Site. The supplier shall bear custom duty, freight charges and all other expenses involved in collection of defective components and equipment from the Site, and transportation to the manufacturer's works in India or abroad and its return to Site after repairs. Further, should any design modification be required to any component or equipment as a consequence of failure analysis, the minimum period of warranty i.e 24 months shall recommence from the date when the modified part is commissioned into service and modification shall be carried out free of charge. In all such cases, warranty will be applicable on complete sub-assembly; even when only component has been modified/replaced/repared due to design change
- All replacement and repairs under the warranty shall be carried out by the supplier promptly and to the complete satisfaction of BEML/BMRCL on notification of the defect by the BEML so that no car is unfit for revenue service for more than 48 hours, which shall exclude time taken for withdrawal/ induction of trains from/to revenue services. In case any train remains out of revenue operation beyond specified duration above due to reasons attributable to supplier, BEML may at his sole discretion impose a penalty on the supplier, commensurate with the revenue and opportunity loss to the BEML/BMRCL. Decision of BEML/BMRCL shall be final and binding.
- BEML will notify the supplier in writing of any defect together with a brief description thereof. Upon receipt of such notice, the supplier shall within a reasonable period of time and at his own costs remedy this defect. If within reasonable time, the supplier fails to full fill his obligations after a reasonable number of trials for repair (at least three trials), the BEML may fix by written notice a reasonable final time for completion of the supplier's obligations. In case the supplier fails to fulfil his obligations within such final time, BEML may himself undertake the necessary repairs works employ a third party to do so, always at the risk and expense of the Supplier.

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Specific warranty in case of Serial or Hidden defects

- The aim of this chapter is to define specific warranty requirements for serial and hidden defects including modifications, parts and labour. Serial or Hidden defects will be covered by a specific warranty period over the general warranty period as defined above.
- Serial or Hidden defect is defined as an identical failure on a part or components which occurs on at least 15 % of total identical part and components with the same function of the rolling stock fleet during the General Warranty period. The occurrence of serial defects is calculated with the personal computer-based Failure Reporting and Corrective Action (FRACAS) System in charge to demonstrate compliance with specified train and equipment reliability as required in Chapter 19 clause no 19.2.6 (iv) of the (Employer' s Requirements) - Technical Specification.
- In the case of Serial or Hidden defects, the supplier shall investigate all the concerned parts and present a technical solution or modification including spare parts modification or replacement for all the metro train fleet including the metro trains no more covered by the General Warranty period. The Serial or Hidden defects shall be repaired by the supplier free of charge (modification, material and labour).
- In the case of Serial or Hidden defect, a period of specific warranty of 24 months shall recommence from the date when the modified part is commissioned into service (including spare parts) and modification carried. In all such cases, specific warranty will be applicable on complete sub-assembly, even when only one component has been modified/replaced/repared due to design change.
- "The warranty period of unit exchange, mandatory and overhauling spares, special tools, testing and diagnostic equipment, special jigs, fixtures and gauges, or any other item / equipment delivered shall be Either 24 months from the date of acceptance or up to expiry of the defect liability period of trains, whichever is later. "
- Supplier shall position the DLP spares at BMRCL depots in three months advance of the train receipt at the depots.
- The DLP spares shall be proposed by the supplier based on MDBCf & LCC of each assembly/sub-assembly item (The minimum qty. shall be one number per depot) and upon approval of the same from BEML & BMRCL, the same shall be positioned at Depot at least Three months before delivery of First Train-set. The spares shall be jointly reviewed/audited quarterly and qty/item shall be increased based on the failure pattern of items and recoupment lead time.
- The list of DLP spares will be reviewed on the actual MDBCf/Failure pattern of the it ems and the quantity/items shall be increased on the actual failure of the system.
- The Contractor shall agree that if any identical defect or deficiency occurs on more than 10% (ten per cent) of the equipment or parts of the Train sets in any rolling period of 36 (thirty six) months commencing from the second year of

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Supply, such defect or deficiency shall be deemed to be an epidemic defect (the “Epidemic Defect”) and the Contractor shall promptly take corrective actions for such Epidemic Defect under an epidemic defect warranty to be maintained by the Contractor for the Maintenance Period (the “Epidemic Defect Warranty”).

- The Vendor shall Pick up of the faulty items from BMRCL Depot, sending (if required) to their Factory/OEM for investigation, repair, testing etc. & return to BMRCL Depot along with final testing/quality clearance documents, in a time bound manner.
- During entire DLP, the supplier shall be required to demonstrate the FRACAS, RAMS, LCC of their supplied sub-system. In case, the supplier is not able to achieve the desired targets (as approved during design stage of the subsystem), the supplier shall take all required actions to improve the FRACAS, RAMS, LCC and provide warranty support till the targets are demonstrated by the supplier. Also, all open technical issues shall be attended /closed by the supplier before closure of DLP. Any penalty imposed or payment deductions made by BMRCL will have to be borne by the supplier and deductible from the payments due to the supplier.
- Any penalty imposed or payment deductions made by BMRCL during entire DLP, for the reason attributable to the Supplier, on account of De-boarding, Trip delays, Trip Cancellation, Non-availability of Trains for service due to supplier's sub-system failures, improper workmanship, non-availability of required spares of supplier's sub-system or for any other reason whatsoever, such amount shall have been borne by the supplier and deductible from the payments due to the supplier

14 Storage, Packing Crating and Marking

The Subcontractor shall be fully responsible for the provision and maintenance of acceptable storage facilities for the Plant and any materials or equipment he intends to use for the carrying out of the Works.

The Subcontractor shall prepare, protect and store in a manner to be accepted by the Engineer, all equipment and materials so as to safeguard them against loss or damage from repeated handling, from climatic influences and from all other hazards arising during shipment or storage on or off the Site. Secure and covered storage shall be provided for all equipment and materials other than those accepted by the Engineer as suitable for open storage.


The detailed requirements are specified in ERGS 9.

15 Training

15.1 General:

The subcontractor shall provide the training for Employer's operating staff and maintenance staff according to the requirements specified in ERGS 10.

The detail requirements for training schedule including the number of times will be informed later.

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15.2 Training Requirements:

The sub-contractor shall provide training to BEML/BMRCL staff at Factory and BMRCL site. The subcontractor shall submit a training proposal to BEML.

Training shall be carried out such locations as will provide the maximum benefit to the trainees. Such locations may be at places of manufacture, assembly or testing or other locations shall be furnished by sub-contractor.

The detailed requirements are specified in ERGS 10.1.

15.3 Training Manual

The subcontractor shall provide one original and five colored copies and electronic copies of the training manual for use by the Employer for conducting in-house training. The Manuals shall cover all requirements specified in ERGS 10.

After completion of the training, training aids and materials used shall become the property of BEML to enable and further training to take place.

16 Engineering Support


Subcontractor shall depute the engineer(s) for the following;

- 1) The Subcontractor shall depute the technical experts for design review meetings and for technical discussions to sort out design / technical issues whenever required. Following are tentative meetings duration which might be required during design approval.
 - CDR meeting: 2~3 days
 - PDR meeting: 2~3 days
 - PFDR meeting: 5~6 days, two times
 - FDR meeting: 8~10 days, two times
 - Other interface meeting, if necessary with TCMS, Signaling and Telecom
- 2) Installation guide for first train: Depending on manufacturing schedule
- 3) Testing
 - Equipment Type / Routine test (at subcontractor's place)
 - Factory Acceptance (Complete car) test: Full support depending on the test schedule
 - On-Site (Depot & Mainline) Test: Full support depending on the test schedule
 - Subcontractor shall provide additional days to resolve faults and defects of Electrical Panels.
- 4) The Subcontractor shall depute the design engineer(s) / technical experts for design review meetings and for technical discussions to sort out design / technical issues as per above requirements. All costs related to the meetings shall be borne by the Subcontractor.

17 General Requirements

17.1 Weight

The weight of each component of Electrical Panels shall be verified and controlled by the subcontractor in accordance with the requirements defined by BEML.

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The Subcontractor shall comply with all weight reductions judged as necessary by BEML. Any unit exceeding the permissible weight shall be rejected. Overweight tolerance is not permitted.

The subcontractor shall submit the list which describes the exact weights of all equipment. The subcontractor shall maintain and publish a weight control document. The weight control document shall list the weight and center of gravity of all components with tolerances.

The subcontractor shall furnish the weight of the Electrical boards.

17.2 Fastener Requirements

- Normally screw threads smaller than M5 size shall not be used. Screw and bolt heads shall be of hexagonal form on all M5 and larger screws. Screws smaller than M10 shall be of high tensile material.

17.3 Label Requirements


- All items shall be labeled in English with the maker's name and type and form of the piece or item, discrete serial number and rating data and the date of manufacture of the particular piece of equipment. It is desirable that the labels used for different equipment / subsystems / systems on the train are of standard pattern.
- The labels shall be clearly stamped, cast or engraved and securely attached to the equipment. Where appropriate equipment shall be labeled with warnings of high temperature and electric shock risk. Warning labels shall be written in both (English and Kannada) as per ERTS 18.10.

18 Project Management

Along with the technical offer, the subcontractor shall submit a Project Management Plan which shall provide a clear over-view of the Contractor's organization, the management system and methods to be used for completion of the works. The organization resources for the design, procurement, manufacture, installation, testing & commissioning and setting to work shall be clearly defined.

The Project Management Plan shall provide the following information.

- A diagram showing the organizational structure for the management of the Contract with locations, names and position titles of staff and their line and staff relationship. The diagram shall include associate organization and sub-suppliers and show clearly the individuals and lines of responsibility linking the various groups. It shall also identify the persons designated as contacts with BEML.
- The names, qualifications, positions and current resumes of key executive, supervisory and engineering staff to be employed full-time for the works.
- A narrative describing the sequence, nature and inter-relationship of the main Contract activities including timing for exchange of information.
- Procedure for documentation control.
- To fulfill the subcontractor's obligations during the Testing and Commissioning and the Defect Liability Period, the subcontractor shall nominate experienced maintenance engineers and organise deployment before undertaking testing and commissioning in depots at Bangalore. Separate maintenance engineer shall be positioned in each depot.

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- The subcontractor shall submit relevant CVs of the Design Manager, Production Manager, Quality Manager, Interface Manager and Maintenance Engineer in addition to the Project manager in the technical offer.

19 Fire Safety

The subcontractor shall submit a Fire-safety Plan providing the list of Non-metallic material items, wires & cables that are proposed to be used in the Electrical Panels with details of material, applied mass, fire safety compliance (Flammability, smoke, toxicity) and fire load calculations, during the preliminary design phase.

All materials/items used in Electrical Panels shall conform to Fire Safety requirements of EN 45545 Part 1 to 7(Category 4-A, Hazard level HL3) latest editions as a minimum or better international standards applicable for similar Metro for underground operations with front evacuation, subject to the acceptance of the Engineer as per ERTS 3.14 & 19.8.

- Flammable materials shall be well contained with At least IP 65 protection as per ERTS 2.19.1 (iii)
- ERTS 18.13.2: The insulation of all wires and cables including those used within equipment / subsystem shall be halogen-free flame- retardant and formulated to minimise generation of smoke, noxious emissions and corrosive fumes, in the case of overheating or fire in compliance with EN 45545 (Hazard level HL3) latest edition. All Cables shall comply NF F 63-808 (for low voltages), and NF F 63-826 (for high voltages), EN 50306 (part 1 to 4), EN 50264(Part 1 to 3) and EN 50382 as approved by the Project Manager.

19.1 Fire Load Calculation


The maximum heat release rate per car shall be restricted to low levels.

Fire load calculation for all non-metallic materials have to be calculated with heat release rate data tested in accordance with EN 45545 HL3. The calculations shall be included in the Fire safety plan submitted as the source of heat value.

19.2 Fire Performance Deliverables

The fire performance deliverables shall be provided in accordance with following table.

Sl. No.	Deliverables	Remarks	Submission Schedule
1	Fire safety plan	As per EN45545 HL3	Preliminary Design stage
2	Fire safety Test Reports of the items including heat release rate for standard items common with other projects of the subcontractor	As per EN45545 HL3	Pre-Final Design stage
3	Fire safety Test Reports of the items including heat release rate for all other items	As per EN45545 HL3	Final Design stage

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20 EMC Requirement

NA

21 Quality

21.1 General

All works for product shall be executed and controlled by a quality management system, which can assure the quality of the product. And it is essential that the supplier of electronic components shall be certified as a minimum, ISO 9001/2 according to the TS 18.25.5. The requirement for quality described in this document was issued on the basis of GS & TS and ISO 9000 quality system requirements.

And the subcontractor shall follow and perform both this document and the contractual requirements.

If there are conflicts and/or different level of requirements between this quality requirement and contracts from BMRCL, the contracts from BMRCL shall have the priority over this document.

21.2 Quality System Requirements

Subcontractor shall maintain and perform appropriate quality system for the quality assurance of product in the step of following matters.

- Design
- Development & Testing
- Production
- Installation
- Servicing

The Quality Assurance System shall be applied without prejudice to, or without in any way limiting, any quality assurance system that the subcontractor already maintains.


21.3 Quality Assurance Program

This section describes quality assurance program required to assure the quality of products supplied from the Subcontractor to BEML. The Subcontractor shall assure the quality of product and maintain quality system to achieve high quality of the product.

21.4 Quality Assurance Plan

The Subcontractor shall develop and submit to BEML QC team for review and approval a Quality Assurance Plan (QAP) based on ISO 9001 and GS 9.17.1. The subcontractor shall have the following

- a) Organization chart
- b) Certification of Personnel
- c) Evidence of Compliance
- d) Certificates of compliance
- e) Calibration of measurement equipment and tools

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The subcontractor shall comply with the detailed Quality Assurance Plan provided by BEML.

21.5 Quality Assurance activities

The Subcontractor shall address, as a minimum, the following activities and shall provide a means of self-correcting any shortcomings in his Quality Assurance Plan (QAP) as per GS 9.17.

- a) Procurement
- b) Manufacturing Inspection
- c) Production Conformance Testing
- d) Receiving Inspection
- e) Shipping Inspection
- f) Ensure inspection with latest Revision/Changes.
- g) Identification of items using tags etc.,
- h) Handling (storing, preserving, packaging, marking and shipping).
- i) Non-conformance Control.

21.6 Quality Audit

The Subcontractor shall permit Quality Audit by BEML and/or the Employer of BEML. The scope of the audit will be only the field related with the implementation of this project and the Subcontractor's QAP. If any Nonconformity is detected while the audit, Corrective Action request will be issued to the Subcontractor. For the Corrective Action Request, the Subcontractor shall prepare and submit appropriate action plan within 10 (ten) days, perform the action plan and reply the result to BEML QC team.

21.7 Inspection and Test Plan (ITP)

ITP shall be submitted to BEML QC team for review and approval as following no later than 30 days after purchase order by BEML. Subcontractor shall comply with ERTS 20.

A) The ITP includes all the major inspection and test activities planned prior and during the design, procurement and installation phases.

B) Witness/Hold point of Inspection/Test

After review of the ITP received from the Subcontractor, BEML will designate witness/hold point (if required) of BEML and/or the Employer of BEML and notify them to the Subcontractor.


C) Inspection/Test Notification of Witness/Hold point

After receiving of ITP, BEML will inform Notification schedule and procedure to the Subcontractor according to the Main Contract between BEML and the Employer of BEML.

22 System Assurance (SA)

22.1 Safety Assurance Plan

The subcontractor shall meet the Safety Assurance Programme Plan compliant with the requirements specified in TS 19.9.

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22.2 System Safety Assurance

NA

22.3 Hazard Analysis

The subcontractor shall provide the hazard analysis, Fault tree analysis and Failure Modes Effects and Criticality Analysis (FMECA) of the Electrical board and assist the contractor to perform the interface hazard analysis compliant with the requirements specified in TS 19.7.

22.4 Reliability: General

The subcontractor shall comply with the Reliability and maintainability requirements prepared by BEML in accordance with the requirements specified in TS 19.

22.5 Quantitative Reliability

The subcontractor shall comply with Quantitative reliability levels for the train and equipment specified by BEML in accordance with the requirements specified in TS 19.

22.6 Maintainability

The subcontractor shall comply with the Maintainability requirements specified in TS 19.

22.7 Reliability and Maintainability Demonstrations

The subcontractor shall assist BEML to complete a Final Report to enable the Employer's Representative to assess acceptability of the vehicle and its components for reliability, maintainability and system safety.

The detailed requirements are specified in TS 19.

22.8 Maintenance

The subcontractor shall comply with the Maintenance requirements specified in TS 19.


23 Materials & Workmanship

The Subcontractor shall be responsible for meeting the requirement of Constructional details, material and workmanship. All materials and workmanship shall be in every respect in accordance with the proven up-to date best practice.

The requirements for material and workmanship of Electrical Panels shall meet, but not be limited to, TS 18.

24 Testing


- 1) The Subcontractor shall be responsible for undertaking and passing all necessary testing activities for Electrical Panels.
- 2) The subcontractor has the responsibilities to dispatch their engineers(s) at their own

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cost to perform the tests viz., equipment type test, FAI, vehicle level performance type test and static & dynamic commissioning type test until successful completion.

- 3) The Subcontractor shall develop, organize and implement the test that verify the Electrical Panels to meet all functional, safety, systems reliability and performance requirements.
- 4) The tests and commissioning are conducted according to Guideline for the performance test of railroad/ Standard for the performance test of urban railway, Guideline for the manufacturing inspection of railroad and ERTS.
- 5) BEML and/or End user have the right to witness any of these tests and inspections at any stage of the test & inspection process.
- 6) All test & inspection specifications and reports including all repair activities and check-lists shall be submitted to and approved by BEML and end-user.
- 7) The Subcontractor shall ensure that the equipment is compliant to all requirements prior to inviting for testing and FAI. The pre-test result prior to official testing/FAI shall be submitted with the invitation letter to request Employer's witness.
- 8) If any inspections or tests indicate that specific hardware or documentation does not meet the specified requirements, the appropriate items shall be repaired, replaced, upgraded, or added by the Subcontractor with its own cost, as necessary to correct the noted deficiencies. After correction of a deficiency, all tests necessary to verify the effectiveness of the corrective action shall be repeated.
- 9) Prior to the start of testing, BEML and End user shall have all approved test plans and procedures for the test and all relevant prerequisite testing shall have been completed by subcontractor.
- 10) Type test of sub-supplier equipment and train level will be responsibility of sub-supplier; sub-supplier shall depute their engineers to conduct the vehicle level type test at BEML's Factory and Depot at Bangalore/Mainline for testing as per schedule prepared by BEML's project management team. Sub-supplier shall continuously update themselves about the type test schedule of Factory and Site as it may happen that first schedule could not be followed due to rise of unexpected hindrance.
- 11) Sub-supplier shall arrange all necessary tools & instruments for relevant field test.
- 12) If there is a problem during testing & commissioning and thus BEML request dispatching engineer to solve the problem, the subcontractor should dispatch engineer within 24 hours.
- 13) The test requirements shall meet, but not be limited to, the following sections in the ERTS and ERGS:

ERTS Chapter 15 - Electrical and Control Equipment
ERTS Chapter 20 - Inspection, Tests and Trials
ERTS Appendix A - International Standards
ERGS Chapter 4 - Testing and Commissioning

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25 Inspection, Testing and Commissioning Plan

The subcontractor shall provide BEML with all information for the completion of Inspection, Testing and Commissioning Plan and also comply with the plan defined according to the requirements specified in ERGS 4 and ERTS 20.

The type tests for the Electrical Panels at both the component level and complete train level shall be re-performed by the Subcontractor under BEML and BMRCL participation, if BMRCL wants to witness the tests even though the tests were accepted by BEML.

All such tests shall be carried out at the subcontractor's cost, wherever performed, in the presence of and to the satisfaction of BEML and BMRCL, who reserves the right to witness any or all of the tests.

All defects and shortfalls in the subcontractor's system, discovered during all tests / in service, shall be rectified and re-tested to the satisfaction of BEML and BMRCL. The subcontractor shall provide full instrumentation to conduct all tests and carry out modifications as required.

All test procedures, reports including all maintenance activities and check lists shall be submitted and approved by BEML and BMRCL within the defined period. The results of all tests shall be submitted to BEML and BMRCL, who will record his conclusions as to whether or not the equipment being tested has passed satisfactorily.

The subcontractor shall produce a test report, in three copies, and in an approved format, within a defined period following the test, for acceptance by BEML and BMRCL. The detailed requirements are specified in ERGS 4 & ERTS 20.

Following items shall be complied

1. All test equipment shall carry an appropriate and valid calibration label.
2. The subcontractor shall sign all reports of Tests
3. The subcontractor shall present a comprehensive Testing and Commissioning Program.
4. Test procedures shall be amended, as required by the subcontractor throughout the duration of the Contract, to reflect changes in system design or the identification of additional testing requirements.
5. All costs including labor, supervision of testing, provision of specialized equipment and materials, and the cost of hiring Consultants and the services of other specialized personnel or independent assessors etc shall be borne by the subcontractor. The subcontractor shall also bear any expenses incurred due to re-testing caused by defects or failure of equipment or any other account to meet the requirements of the contract.


The detailed requirements are specified in ERGS 4.

25.1 Inspection Hold Points

The subcontractor shall propose a set of inspection hold points in the Inspection, Testing and Commissioning Plan in accordance with the requirements specified in ERGS 4.

25.2 First Article Inspection

All the materials, fittings, equipment, manufacturing processes, and assembly workmanship shall be subject to inspection by BEML and BMRCL, wherever carried out in accordance with the requirements specified in ERTS 20.2.

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The supplier shall offer the first set of Electrical Panels for First Article Inspection (FAI) by BEML and BMRCL. After clearance from BEML, mass production shall be taken up.

25.3 Test Procedure


Each Test procedure shall include all information necessary to ensure the successful, accurate and safe performance of the described test as stipulated in TS 20.4. At a minimum, each test procedure shall include:

- 1) Relevant specification applicable to each of the tests.
- 2) Type, routine and special tests to be carried out.
- 3) Description of the tests, scheduled dates, and locations of the tests.
- 4) Test parameters to be measured.
- 5) Constraints to be applied during the test.
- 6) Defined pass/fail criteria
- 7) Facilities, equipment and test and measurement tools.
- 8) Test procedures shall be amended, as required by the subcontractor throughout the duration of the Contract, to reflect changes in system design or the identification of additional testing requirements.
- 9) Scope and objectives for each test
- 10) Prerequisites for test to be conducted
- 11) Organization/entity and person(s) conducting the test
- 12) Safety Precautions
- 13) Identification of the specification section(s) that are verified by the test
- 14) Scope of test (what is being tested and how many)
- 15) Test equipment required (by model number, make) and latest calibration information
- 16) Other personnel required
- 17) Any special conditions required, including condition of the equipment under test
- 18) Reference drawings, schematics, or documents
- 19) Clearly understood step-by-step instructions for performing the test, test equipment set-up
- 20) Clear pass/fail criteria, including applicable tolerances, nonconformance correction, retest provisions
- 21) Data sheets to record test results, including confirmation of test equipment certification
- 22) Raw data correlation procedures
- 23) Sample test report format

Test procedure shall be submitted to BEML for review and acceptance during PFDR and FDR and at least ninety (90) days in advance of the notification of the actual testing. All procedures must be approved prior to notifying the test witness request.

25.4 Test Reports

- 1) All test reports of the component, system, factory and field acceptance test for Electrical Panels shall be prepared by the Subcontractor and they shall be submitted to BEML. The Test reports shall include, but not be limited to, the followings:
 - (a) The reference to the corresponding Test Procedure
 - (b) The date of the test was executed
 - (c) Description of any test conditions, input data, or tester actions
 - (d) Details of test instruments used (Make, Model) along with calibration certificate.

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- (e) The test results for each test including a Passed / Failed indication
 - (f) Identification of the Subcontractor's test engineer
 - (g) Action and the result of the action for comments by End user's representative
 - (h) Copies of any deficiency reports generated as a result of the execution of the correction.
 - (i) Configuration data that fully describes the hardware and software that was tested, including software version and identifiers for every software module
- 2) Written reports of all tests performed shall be submitted within Fourteen (14) days of test performance to BEML for acceptance.
 - 3) Records of all inspection and testing shall be kept completely by the Subcontractor and available to End user during the performance of this Subcontract and for a minimum of ten (10) years after expiration of the warranty period.

25.5 Sequence of Tests

1. Routine and type test of equipment and sub-systems in accordance with relevant standard and specifications in Contractor/Sub-contractor's factories.
2. Factory and Site Tests of complete cars in accordance with IEC 61133.
3. Testing and Commissioning of cars/trains in Depot in accordance with IEC 61133.

26 Type and Routine tests of equipment and sub-systems

The Electrical Panels shall comply with the requirements of ERTS 20.

26.1 Type Test, Electrical Panels


This test is required to verify that the Electrical Panels operate in accordance with the Approved Design Data.

Type test of each component shall be performed by the Subcontractor under BEML and BMRCCL participation in accordance with the requirements specified in ERTS 20.

Subcontractor has responsibility for the type test of the component. During test the criteria shall be observed and recorded in a log book and necessary alterations and adjustments carried out.

The subcontractor shall perform, as a minimum, the following test in accordance with the requirements specified in ERTS 18.25, 20.

S.No.	Test Items	Type Test	Routine Test	Requirement
1	Visual & dimensional inspection (incl. weight and power consumption measurement)	<input type="checkbox"/>	<input type="checkbox"/>	Approved, Test standard/specification. Any optical distortion or any visual defect is not allowed.
2	Electrical Test. (Dielectric Test & Insulation Resistance Test).	<input type="checkbox"/>	<input type="checkbox"/>	IEC 60077

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3	Bell Test.	-	<input type="checkbox"/>		
4	Vibration & shock Test.	<input type="checkbox"/>	<input type="checkbox"/>	IEC 61373	
5	Dust Proof Test.	<input type="checkbox"/>	-	IEC 60529	
6	Water Proof Test	<input type="checkbox"/>	-	IEC 60529	
7	Dry Heat Test.	<input type="checkbox"/>	-	IEC 60068	

The subcontractor shall submit the valid type test report of Electrical Panels.

- ✘ Dimensional Inspection: This inspection shall be done with the specimen picked by a lot of product. If the result is not proper, all quantities of the lot product shall be inspected to the approved drawing.
- ✘ Type tests for certain equipment may be waived if these were carried out earlier on equipment of identical design, witnessed by a reputed organization, and the service performance of such equipment was found to be reliable. The sub-contractor shall submit a proposal in this regard to BEML for review. The waiver of Type Test is entirely at the discretion of the BEML's Engineer and BMRCL. Change of manufacturing place may require re-type test. Incase waiver of certain type test is accepted by BEML's Engineer or BMRCL, sub-supplier must carry out type test in accordance with approved test plan.
- ✘ Above lists are indicative and sub-supplier shall be responsible to carry out any additional test required by client within the scope of ERTS, ERGS.

26.2 Routine Test, Electrical Panels

This test is required to verify that the Electrical Panels have been built in such a way that it satisfies the requirements of the Approved Design Data as verified by the Type Test.


During test, the criteria shall be observed and recorded in a logbook and necessary alterations and adjustments carried out.

Records from Routine test shall be held by the Subcontractor and made available timely for BEML and BMRCL inspection. Copies of the approved routine test results shall be submitted together with the associated logbook. Additional copies of records of all tests/inspections result shall also be held at the Subcontractor work to be made available to BEML and BMRCL on demand.

This test basically includes function test, visual inspection and dimensional inspection but not be limited.

The subcontractor shall perform, as a minimum, the following test and submit the routine test report to BEML:

- (1) Operation Tests
- (2) Visual Inspection

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- (3) Dimensional Inspection
- (4) Bell test
- (5) Dielectric and Insulation Resistance test
- (6) Earth continuity test
- (7) Operation test

26.3 Factory tests of complete cars

26.3.1 Type Test, Completed car, unit and Train Tests

The individual cars, complete units and trains (6-car) shall be type tested by Subcontractor for Electrical Panels aggregates in accordance with IEC 61133 and ERTS 20.

The Subcontractor, Design Engineer, shall also participate in this testing to ensure that Electrical Panels aggregates meet the performance requirements specified at the contract and do not introduce any adverse effects into the train.

26.3.2 Routine Test, Completed car, unit and Train Tests

The individual cars, units, complete trains (6-car & 8-car) shall be routine tested by Subcontractor for Electrical Panels aggregates in accordance with IEC 61133 and in accordance with ERTS 20. The Subcontractor shall be responsible for correcting any interfacing defects.

26.4 Testing and Commissioning of cars/trains in Depot

26.4.1 Type Commissioning Tests

The subcontractor shall carry out commissioning **Type Test** on the complete 6-car & 8-car trains in accordance with IEC 61133 & ERTS 20.

26.4.2 Routine Commissioning Tests

The subcontractor shall carry out commissioning **Routine Test** on the complete 6-car & 8-car trains in accordance with IEC 61133 & ERTS 20.


26.5 Fire Performance Test

The sub-contractor shall perform the fire performance tests of Electrical Panels in accordance with the requirements specified in ERTS 3.14 and 20.27

26.6 Shock and vibration test

The sub-contractor shall perform the Withstanding Vibration and Shock test of Electrical Panels aggregates in accordance with the requirements specified in international standard ERTS 3.3.10(iv) and IEC61373.

The test results shall be submitted for approval.

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26.7 Integration Test

BEML will perform the integration test with the assistance of sub-contractor according to ERGS 4 and ERTS 20.

The subcontractor shall submit all information for the integration test to BEML. If needed, the concerned engineer from subcontractor shall participate in the test.

26.8 Service Trials

BEML will perform the service trial for BMRCL 5RS-DM corridor and the sub-contractor shall supply the sufficient information and assistance if necessary according to ERGS 4 and ERTS 20.

The subcontractor shall submit all information for the service trials to BEML. If needed, the concerned engineer from subcontractor shall participate in the service trial.

27 Submittals – Technical offer:

The Subcontractor shall provide as a minimum, the following along with the technical offer. The submittals check-list as per Annexure-2 of this PTS shall also be submitted.

- 1) Complete Technical offer for Electrical Panels indicating the make of the components
- 2) Type Test procedure for carrying out the Type test
- 3) Supply details with references for same / similar design for the last 3 years for metro projects along with performance certificates from Employer's (Metro Corporation) to support the qualification criteria as per section 4 of this document.
- 4) The list of spares as detailed at clause 5.3 & 10.1 of this PTS
- 5) Clause wise compliance against
 - a) PTS - Doc no. GR/TD/6942
 - b) ERTS
 - c) ERGS

In the following format,

- Complied: "Complied" shall be indicated by the supplier where the supplier is able to comply with the clause.
- Noted: will be considered as Complied
- "Complied with comments" will be considered as fully complied for the clause with no additional commercial impact.

Offers with Non-compliance and deviations to any of the ERTS, ERGS & PTS clauses with regard to Electrical Panels, are liable for rejection.

28 Attachment

- i. ERGS
- ii. ERTS
- iii. EDB Panel Drawings
- iv. Annexure-1: Vendor Approval Format
- v. Annexure-2: Submittals check list

Request for Vendor Approval

We hereby request for Notice of No Objection from the Project Manager (GC) for the selection of vendor/sub-contractor as described below:

Date:	DD-MMM-YYYY			
Customer:	Bangalore Metro Rail Corporation Limited (BMRCL)			
Contract:	5RS-DM			
Product/Item name for which approval is required:				
System <input type="checkbox"/>	Subsystem <input type="checkbox"/>	Equipment <input type="checkbox"/>	Service <input type="checkbox"/>	Others <input type="checkbox"/>
Proposed vendor name:				
Vendor's contact data:	Postal address :			
	Contact person name:			
	E-mail address:			
	Telephone:			
	Mobile:			
	Fax:			
	Company website:			
Company Profile (Brief introductory description, business areas)				
Manufacturing Plant for proposed product/item				
Detailed Product Information	Please see Annex 1			
Manufacturing Supply Records	Please see Annex 2			
Commitment Declaration	Please see Annex 3			

Vendor's Production capacities and facilities with their location	
Organisation structure for this product/item	
Certification to international standards ISO, IRIS, OHSA...etc	
Time limit of the project	
Reason that motivates the proposal	
National production or imported	
Is Product/item belongs to table-1C/1D of ERGS ?	<i>(if Yes, provide compliances to ERGS 1.3)</i>
Proposed percentage of local content	
Energy Efficiency	

According to ERGS clause 1.3 and ERTS clause 5.1.2, 5.1.3, 5.1.4 and 5.1.5 BEML hereby submit the information given in the above table for Project Manager's review and Approval.

Yours Sincerely,

Mr. ----

Project Manager

BEML

Annex 1

1. Detailed description of the product.

2. List of detailed product (components) information:

S.N.	Product	Type	Name of OEM	Address of OEM	Additional information
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Annex 2

The product shall be a state of the art and of proven design and meet the following:

- Manufacturing and supply of equipment /sets / components shall have been in use and have established their satisfactory performance and reliability on at least three mass rapid transit systems in commercial / revenue service over a period of three years or more (in each MRTS) either outside the country of origin in three different countries **(FORMAT-A)** or in MRTS in India **(FORMAT-B)**.
- Manufacturing and supply of equipment /sets / components used in existing Rolling Stock in MRTS in India do not get automatically qualified for use unless specifically approved by the Project Manager for this project.
- If required by the Project Manager, certificate of satisfactory performance for a period of three years or more from the Metro operators. Where similar sub-systems of a different rating are already proven in service as per the above criteria then the design shall be based on such sub-systems.
- The number of years in commercial / revenue service and operation for the above requirements shall be calculated as on the contracted Key Date No. 3.1 corresponding to 'Pre-Final Design Completion'.

In case the Contractor proposes to use sub-system(s) that do not fulfil all criteria described in ERTS 5.1.2, then the Contractor shall furnish sufficient information to prove the basic soundness and reliability of the offered sub-system(s) for review of the Project Manager.

FORMAT-A :

[illegible]

FORMAT-B :

[illegible]

[VENDOR'S LETTER HEADER]

Annex 3

Vendor's Declaration

To whomsoever it may concern:

We hereby declare that we, **[Name of the Company]** will supply **[Product Name]** to BEML for Contract No. 5 RS-DM made between Bangalore Metro Rail Corporation Ltd. (BMRCL) and BEML.

We hereby further declare that we shall supply requisite quantity of spares indicated in the Contract, and if additional procurement of spares is required by BMRCL after the expiry of Contract Period, we shall make direct quotation of such spares to the BMRCL. Such quotation shall supersede any contract which we have with M/s BEML Limited, whether express or implied.

Signature: _____


Name:

Designation:

Company:

Stamp/seal

ANNEURE-2 OF PTS

	TECHNICAL OFFER SUBMITTALS CHECK SHEET	Project BMRCL 5RS DM
Aggregate:	Electrical Panels	PTS DOC No.: GR/TD/6942
BEML Enquiry/ RFQ Reference:		

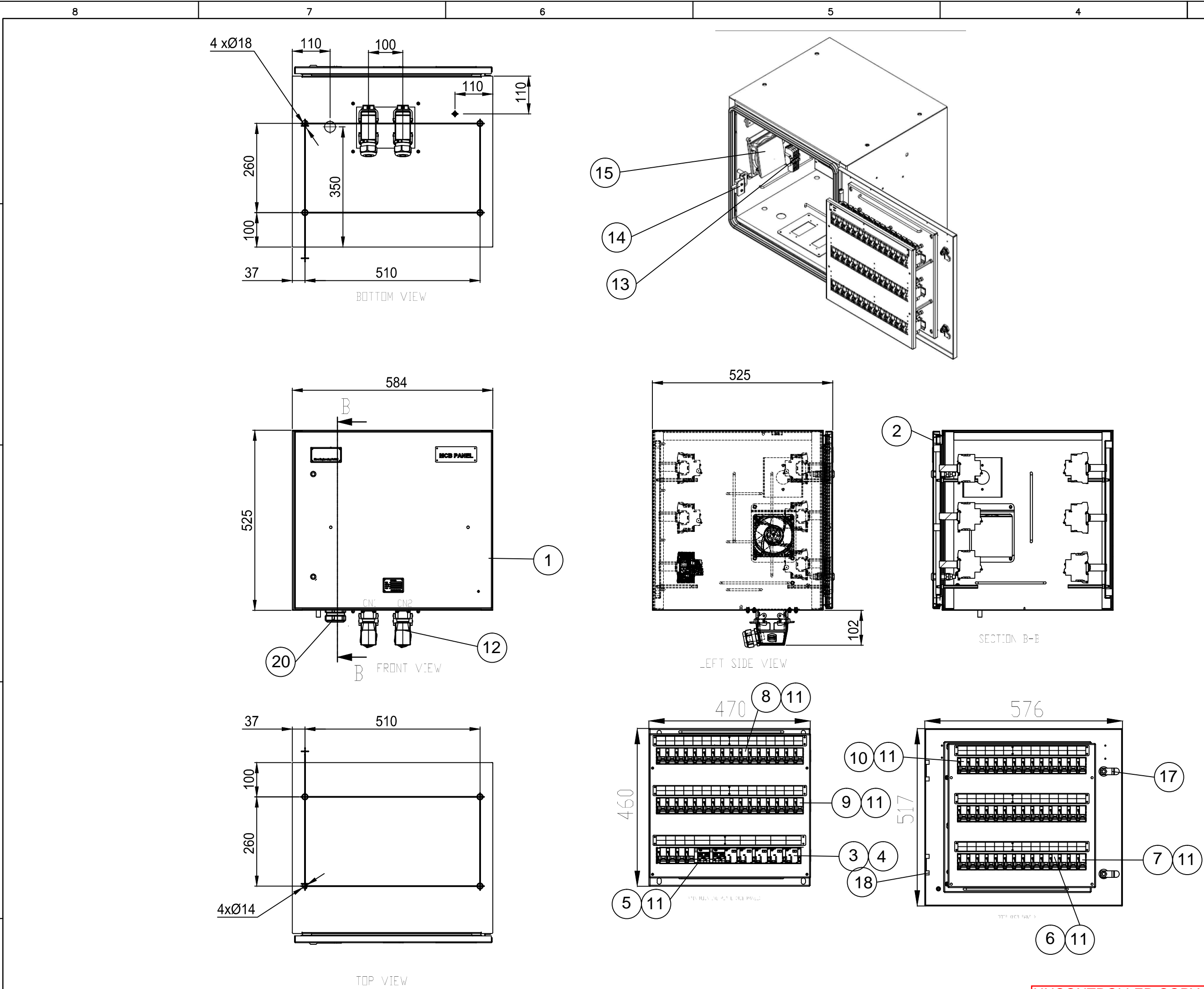
SL.NO.	DETAILS	SUBMITTED	NOT SUBMITTED	DOC. REF
1	Complete Technical Offer for Electrical Panels along with technical description, specification drawings, weight and power consumption details.	<input type="checkbox"/>	<input type="checkbox"/>	
2	Supporting documents for qualification criteria as per Clause 4.2.	<input type="checkbox"/>	<input type="checkbox"/>	
3	Duly filled and signed (along with company seal) Vendor approval Documents including QAP, ITP, company profile with infrastructure facilities, product range etc., as per Clause 4 and Annexure-1 (refer Clause 27)	<input type="checkbox"/>	<input type="checkbox"/>	
4	Duly filled and signed Annexure-2 of PTS. (Refer Clause 27)	<input type="checkbox"/>	<input type="checkbox"/>	
5	Clause-wise compliance against the PTS (refer Clause 27)	<input type="checkbox"/>	<input type="checkbox"/>	
6	Clause-wise compliance to ERTS & ERGS (refer Clause 27)	<input type="checkbox"/>	<input type="checkbox"/>	
7	Spares technical offer along with LCC	<input type="checkbox"/>	<input type="checkbox"/>	
8	Project Management Plan and CV's of personnel of the team	<input type="checkbox"/>	<input type="checkbox"/>	

Note : Incomplete submissions are liable for Rejection.

Signature of the Bidder with Seal

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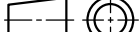


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N3	0.1	▽
N4	0.2	▽
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N6	0.8	▽
N7	1.6	▽
N8	3.2	▽
N9	6.3	▽
N10	12.5	▽
N11	25	▽
N12	50	▽
SURFACE ROUGHNESS		



- NOTE:**
- PAINTING SPECIFICATION & PROCESS SHALL BE AS PER THE APPROVED PAINTING SPECIFICATION PROVIDED BY BEML.
 - ALL SHARP EDGES TO BE SMOOTHENED AND GROMMETS TO BE PROVIDED AT EDGES IN THE PANEL. ALL THE CABLES ARE TO BE PROPERLY SECURED WITH PROTECTIVE SLEEVES.
 - REFER TO DRG No.507-21777 SHEET 2 OF 2 FOR INTERNAL PANEL WIRING.
 - THE CABLE MARKERS PROVIDED SHALL BE FIRE RETARDANT & HEAT SHRINKABLE TYPE.
 - THE CABLE MARKERS SHALL BE PROTECTED AGAINST FADING BY PROVIDING FIRE RETARDANT HEAT SHRINKABLE CLEAR SLEEVES.
 - THE CABLE TIES USED FOR SECURING THIS CABLE SHOULD BE OF FIRE RETARDANT TYPE.
 - ALL CABLES SHOULD BE PROPERLY CRIMPED WITH LUGS & FERRULES
 - GOLD PINS TO BE PROVIDED FOR ALL SHIELDED CABLES.
 - TORQUING MARK TO BE ENSURED FOR TERMINATIONS
 - TORQUE CHECK SHEET TO BE PROVIDED ALONG WITH THE ITEM
 - ALL MATERIALS USED IN MCB PANEL SHALL CONFORM TO FIRE SAFETY REQUIREMENTS OF EN 45545 PART 1 TO 7(CATEGORY 4-A, HAZARD LEVEL HL3)
 - THE SPECIFICATION, QUANTITY AND LOCATION etc., OF COMPONENTS SUCH AS RELAYS, CONTACTORS, MCB, TB's etc., - PART NO & QTY PROVIDED IN THE BOM OF THE DRAWINGS WILL UNDERGO SOME CHANGE DURING FINAL DESIGN FREEZE / PROTO TRAIN & DESIGN DOCUMENT BY BMRC. THE SUBCONTRACTOR SHALL ABSORB THOSE DESIGN CHANGES WITHOUT ANY ADDITIONAL COST TO BEML.
 - MATING PART OF HARTING CONNECTOR, CODE PINS & HOODS TO BE SUPPLIED BY THE VENDOR.
 - LED LIGHTS TO BE PLACED PROPERLY IN SUCH A WAY THAT ALL COMPONENTS ARE ILLUMINATED.
 - BASED ON THE CABLE SIZES (FOR CABLE ENTERING TO THE EDB PANEL FROM TRAIN SIDE) SUITABLE GLANDS TO BE PROVIDED
 - TERMINAL BLOCKS OF GREEN YELLOW COLOR TO BE USED FOR OV/RETURN PATH CONNECTION & QTY WILL BE FINALISED DURING DESIGN STAGE

3		2					1			
MACHINING DEVIATIONS FOR LINEAR DIMENSIONS	RANGE	0 – 6	6 – 30	30 – 120	120 – 315	315-1000	1000-2000	2000-4000	ABOVE 4000	RA
	TOLERANCE	±0.1	±0.2	±0.3	±0.5	±0.8	±1.2	±2	±3	~
FOR DIMENSIONAL TOLERANCES OF SHEET METAL PARTS AND WELDED STRUCTURES, REFER STD. RD-227										
UNSPECIFIED TOLERANCE FOR LINEAR AND ANGULAR DIMENSIONS REF. IS 2102 (PT-1) (MEDIUM)							QUALITY OF WELD JOINTS REF. RD 230 MEDIUM			
VALUES OF SURFACE TEXTURE SHALL BE AS PER COMPANY STD DS. 1012.C.							STATUS:			
WELDING SHALL BE CARRIED OUT AS PER IS: 9595-96										

24	2	1.209.4000.50	PLASTIC GLAND (M32x1.5)		MAKE: HUMMEL
23	1		COMPANY NAME PLATE	AISI 304	0.6T
22	1		PROTECTION COVER	ACRYL	T=3
21	1	PMF 100444	PROTECTIVE VENT	ASSY	
20	1		CABLE GLAND	ASSY	M50
19	1		EARTH PAD	ASSY	M6-20MM
18	2	96-MA-80-24	HINGE	ASSY	
17	2		LOCKING DEVICE	ASSY	AB-2401-2
16	1		LED LIGHT	ASSY	LIGHT SUPPLIER SCOPE SEE NOTE 9
15	1	4656 N	FAN	ASSY	MAKE: EBM PAPST SEE NOTE 8
14	1	KH-9015-PBL	LIMIT SWITCH	ASSY	MAKE: KOINO
13	5	282-681	TERMINAL BLOCK, 3P, 6 SQ.MM	ASSY	MAKE: WAGO
12	2	HAN 72 DD	CONNECTOR (MALE INSERT+FEMALE INSERT+HOUSING+HOOD(1 SIDE HOLE)+PINS)	ASSY	MAKE: HARTING
11	80	S2C-H6R	AUXILIARY SWITCH	ASSY	MAKE: ABB
10	40	S201MT-C10UC	MCB, 1P, 10A C CURVE	ASSY	MAKE: ABB
9	7	S201MT-C6UC	MCB, 1P, 6A C CURVE	ASSY	MAKE: ABB
8	26	S201MT-C3UC	MCB, 1P, 3A C CURVE	ASSY	MAKE: ABB
7	2	S201MT-C2UC	MCB, 1P, 2A C CURVE	ASSY	MAKE: ABB
6	3	S201MT-C1UC	MCB, 1P, 1A C CURVE	ASSY	MAKE: ABB
5	2	DS201T C20 A30	MCB, 20A, 30mA	ASSY	MAKE: ABB
4	5	5ST3 010(5SU1,2P)	MCB AUX FOR 2P	ASSY	MAKE: SIEMENS
3	5	5SU1154-7KK10	MCB 2P, 10A, 10mA	ASSY	MAKE: SIEMENS
2	1		BOX	AISI 304	t=2
1	1		PANEL	AISI 304	t=2

						PRODUCT	BMRCL 5RS-DM METRO CARS				
						REF DRG					
						MATERIAL					
						HEAT TREAT.	APPD	M.SADHASIVAM	07.10.2024		
						SURFACE TREAT.	REVD	M.SADHASIVAM	07.10.2024		
						TITLE	MCB PANEL (DMC CAR)		CHKD	V.SARANYA	07.10.2024
							DRWN	V.SARANYA	07.10.2024		
							SCALE		SHEET	Wt.(Kg)	
							1:10	1 OF 1	-		
ALT.NO.	ECN NO/CHANGES	DATE	BY	CHKD	APPD	DRG No.					ALT
						 BEML LIMITED					507-21777
											

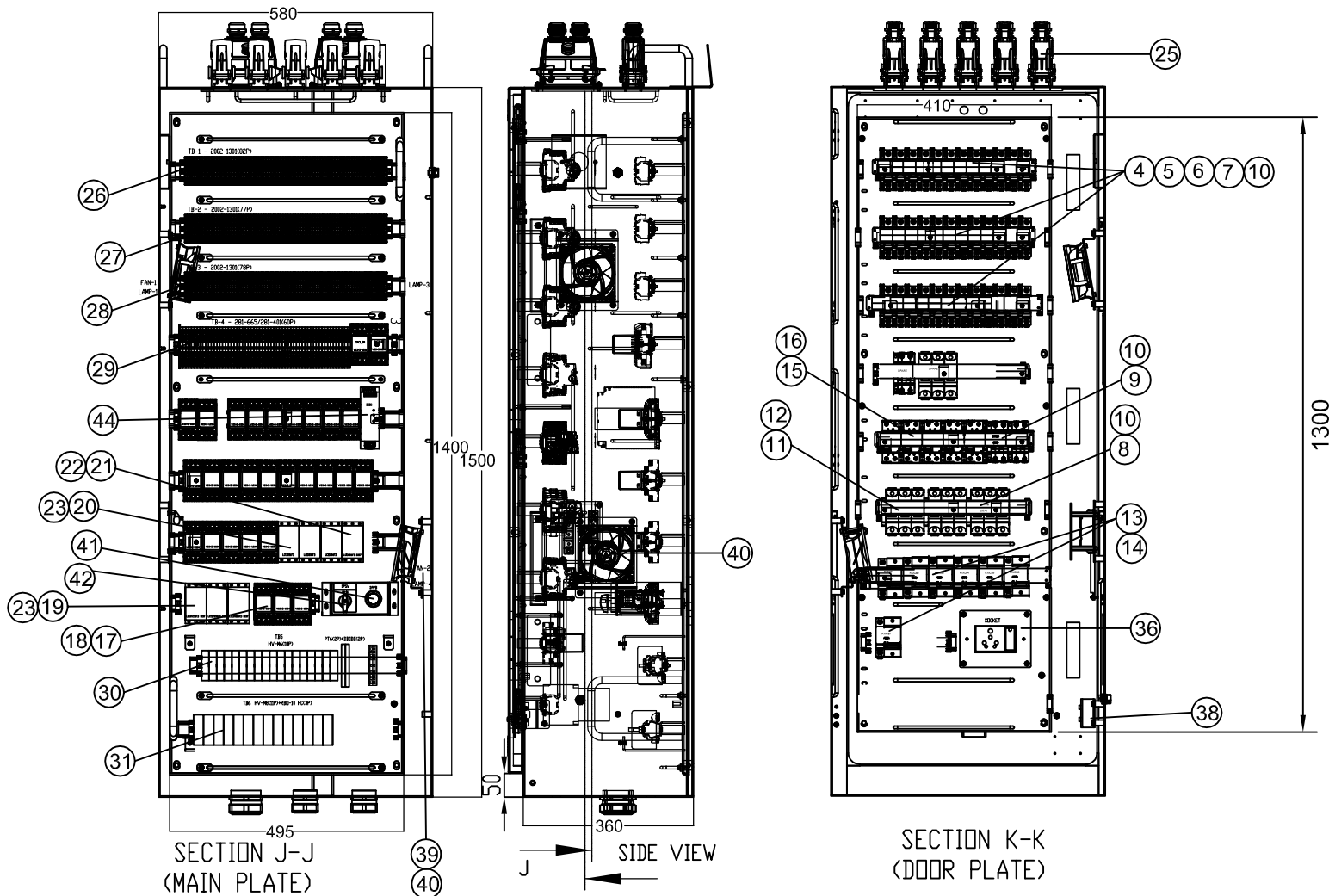
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GRADE No.	SYMBOL	VALUE	ROUGHNESS
N1		0.025	
N2		0.05	
N3		0.1	
N4		0.2	
N5		0.4	
N6		0.8	
N7		1.6	
N8		3.2	
N9		6.3	
N10		12.5	
N11		25	
N12		50	

NOTE:

1. PAINTING SPECIFICATION & PROCESS SHALL BE AS PER THE APPROVED PAINTING SPECIFICATION PROVIDED BY BEML.
2. ALL SHARP EDGES TO BE SMOOTHENED AND GROMMETS TO BE PROVIDED AT EDGES IN THE PANEL.
ALL THE CABLES ARE TO BE PROPERLY SECURED WITH PROTECTIVE SLEEVES.
3. THE SPECIFICATION, QUANTITY AND LOCATION etc., OF COMPONENTS SUCH AS RELAYS, CONTACTORS, MCB, TB's etc., PROVIDED IN THE BOM OF THE DRAWINGS WILL UNDERGO SOME CHANGE DURING FINAL DESIGN FREEZE / PROTO TRAIN & DESIGN DOCUMENT BY DMRC. THE SUBCONTRACTOR SHALL ABSORB THOSE DESIGN CHANGES WITHOUT ANY ADDITIONAL COST TO BEML.
4. MATING PART OF HARTING CONNECTOR, CODE PINS & HOODS TO BE SUPPLIED BY THE VENDOR.
5. THE CABLE MARKERS PROVIDED SHALL BE FIRE RETARDANT & HEAT SHRINKABLE TYPE.
6. THE CABLE MARKERS SHALL BE PROTECTED AGAINST FADING BY PROVIDING FIRE RETARDANT HEAT SHRINKABLE CLEAR SLEEVES.
7. ALL 1.5SQ.MM, 6SQ.MM & 16SQ.MM CABLE SHOULD BE PROPERLY CRIMPED WITH FERRULES TB's.
8. AIR TURBULATOR(AC AXIAL COMPACT FAN) SHALL BE PROVIDED INN EDB PANEL TO ACHIEVE UNIFORM COOLING. LOCATION FOR INSTALLATION SHALL BE DECIDED ACCORDINGLY.
9. LED LIGHTS TO BE PLACED PROPERLY IN SUCH A WAY THAT ALL COMPONENTS ARE ILLUMINATED.
10. ALL ITEMS, CABLE ACCESSORIES USED IN PANELS SHALL CONFORM TO EN45545, HL3.
11. THE GOLD PIN CONTACT TO BE PROVIDED FOR ALL SHIELD CABLES(CORE+SHEILD).
12. PART NO & QUANTITY WILL BE FINALISED DURING DESIGN STAGE WITHOUT ADDITIONAL COST TO BEML
13. LHD/SHD & ITS CONTROL UNIT MOUNTING LOCATION TO BE PROVIDED
14. BASED ON THE CABLE SIZES, SUITABLE GLANDS TO BE PROVIDED
15. TERMINAL BLOCKS OF GREEN YELLOW COLOR TO BE USED FOR OV/RETURN PATH CONNECTION & QTY WILL BE FINALISED DURING DESIGN STAGE




UNCONTROLLED COPY



54	1	S201MT-C6UC	MCB, 1P, 6A C CURVE	ASSY	MAKE: ABB
53	1		BRACKET HANGER	STS	t=2
52	1		COMPANY NAME PLATE	AISI 304	0.6T
51	2	PI 15 200X120	HANDLE	STS	
50	4	96-MA-80-24	HINGE	ASSY	
49	3	AB-2401-2	LOCKING DEVICE	ASSY	
48	1		PROTECTION COVER	ACRYL	t=3
47	2	PMF 200444	PROTECTIVE VENT	ASSY	MAKE: GORE
46	1	110M63 SPECIAL	CABLE GLAND & GLANDNUT METALLIC, M63	ASSY	MAKE: CGS
45	2	110M50 SPECIAL	CABLE GLAND & GLANDNUT METALLIC, M50	ASSY	MAKE: CGS
44	1	QUINT-PS/1AC/24DC/5	DC-DC CONVERTER (FOR REMOTE CIRCUIT BREAKER)	ASSY	MAKE: PHOENIX
43	2	MDD26-16N1B	DIODE	ASSY	MAKE: IXYS
42	1	CH16 IN3059	SWITCH (2NO + 2NC, 2 POSITIONS)	ASSY	MAKE: K&N
41	1	704.032.518(3A1B,green)	PUSH BUTTON+AUX BLOCK	ASSY	MAKE: EAO
40	2	4656 N	FAN	ASSY	MAKE: EPM PAPST SEE NOTE.8
39	4		LED LIGHT	ASSY	LIGHT SUPPLIER SCOPE SEE NOTE.9
38	1	KH-9015-PBL	LIMIT SWITCH	ASSY	MAKE: KOINO
37	1	17-411130DC	INDICATOR RED(1P)	ASSY	MAKE: EAO, DIA:16MM
37	1	17-411135DC	INDICATOR GREEN(1P)	ASSY	MAKE: EAO, DIA:16MM
36	1	673045DM,673008DM 673213DMA	SWITCH & SOCKET OUTLET 5P, 16A, MYRIUS SERIES	ASSY	MAKE: LEGRAND

MACHINING DEVIATIONS FOR LINEAR DIMENSIONS	RANGE	0 - 6	6 - 30	30 - 120	120 - 315	315-1000	1000-2000	2000-4000	ABOVE 4000	RA
	TOLERANCE	±0.1	±0.2	±0.3	±0.5	±0.8	±1.2	±2	±3	~
FOR DIMENSIONAL TOLERANCES OF SHEET METAL PARTS AND WELDED STRUCTURES, REFER STD. RD-227										
UNSPECIFIED TOLERANCE FOR LINEAR AND ANGULAR DIMENSIONS REF. IS 2102 (PT-1) (MEDIUM)										
VALUES OF SURFACE TEXTURE SHALL BE AS PER COMPANY STD DS. 1012C.										
WELDING SHALL BE CARRIED OUT AS PER IS: 9595-96										
STATUS:										

35					
34	2		DIODE 20A	ASSY	
33	2	PT6-QUATTRO (3212934)	TERMINAL BLOCK FOR 20A DIODE	ASSY	MAKE: PHOENIX
32	1	HV-M6(13P)	TERMINAL BLOCK, TB7	ASSY	MAKE: PHOENIX
31	1	HV-M6(11P)+RBO-10HC(3P)	TERMINAL BLOCK, TB6	ASSY	MAKE: PHOENIX
30	1	HV-M6(18P)	TERMINAL BLOCK, TB5	ASSY	MAKE: PHOENIX
29	60	281-665/281-401	DIODE TERMINAL BLOCK, TB4	ASSY	MAKE: WAGO
28	82	2002-1301	TERMINAL BLOCK, TB3	ASSY	MAKE: WAGO
27	77	2002-1301	TERMINAL BLOCK, TB2	ASSY	MAKE: WAGO
26	78	2002-1301	TERMINAL BLOCK, TB1	ASSY	MAKE: WAGO
25	7	HAN 108 DD	CONNECTOR (Male Insert+Female Insert+ Housing+Hood(2 top hole+Pins))	ASSY	MAKE: HARTING
24	1	LRD226	OVERLOAD RELAY	ASSY	MAKE: SCHNEIDER
23	6	LADN226	AUXILIAY CONTACT BLOCK	ASSY	MAKE: SCHNEIDER
22	1	LADN406	AUXILIAY CONTACT BLOCK	ASSY	MAKE: SCHNEIDER
21	1	LC1D656FD S207	MAGNETIC CONTACTOR	ASSY	MAKE: SCHNEIDER
20	3	LC1D256FD S207	MAGNETIC CONTACTOR	ASSY	MAKE: SCHNEIDER
19	3	LC1DT256FD S207	MAGNETIC CONTACTOR	ASSY	MAKE: SCHNEIDER
18	29	V23	RELAY SOCKET	ASSY	MAKE: MORSMITT
17	29	D-U204N-KL	RELAY	ASSY	MAKE: MORSMITT
16	5	5ST3 010	MCB AUX FOR MCB 2P,10A	ASSY	MAKE: SIEMENS
15	5	5SU1154-7KK10	MCB, 2P, 10A, 10mA	ASSY	MAKE: SIEMENS
14	3	S201MT-C20UC + S2C-CM1	MCB + REMOTE MODULE 1P, 20A, C CURVE, 10KA	ASSY	MAKE: ABB
13	4	S201MT-C10UC + S2C-CM1	MCB + REMOTE MODULE 1P, 10A, C CURVE, 10KA	ASSY	MAKE: ABB
12	2	S800- AUX	AUXILIARY CONTACT FOR 3P, 80A MCB	ASSY	MAKE: ABB
11	2	S803S-K80	MCB,80A,3P,K CURVE	ASSY	MAKE: ABB
10	33	S2C-H6R	AUXILIARY SWITCH	ASSY	MAKE: ABB
9	2	DS201T C20 A30	MCB, 2P, 20A, 30mA	ASSY	MAKE: ABB
8	1	S203MT-K32	MCB,32A,3P,K CURVE	ASSY	MAKE: ABB
7	1	S201MT-C16UC	MCB, 1P, 16A C CURVE	ASSY	MAKE: ABB
6	23	S201MT-C10UC	MCB, 1P, 10A C CURVE	ASSY	MAKE: ABB
5	3	S201MT-C3UC	MCB, 1P, 3A C CURVE	ASSY	MAKE: ABB
4	3	S201MT-C2UC	MCB, 1P, 2A C CURVE	ASSY	MAKE: ABB
3	5		EARTH PAD	AISI 304	M6-20mm
2	1		BOX	AISI 304	t=2
1	1		PANEL	AISI 304	t=2
SL NO.	QTY	PART NO.	DESCRIPTION	MATERIAL	REMARKS

SL NO.	QTY	PART NO.				DESCRIPTION	MATERIAL	REMARKS				
						PRODUCT	BMRCL 5RS-DM METRO CARS					
						REF DRG						
						MATERIAL						
						HEAT TREAT.	APPD	M.SADHASIVAM		16.10.2024		
						SURFACE TREAT.	REVD	M.SADHASIVAM		16.10.2024		
						TITLE	CHKD	V.SARANYA		16.10.2024		
						EDB PANEL (TC CAR)	DRWN	V.SARANYA		16.10.2024		
							SCALE		SHEET	Wt.(Kg)		
							NTS		1 OF 1	-		
							DRG No.					
							507-21774					
							<div>ALT</div> <div>0</div>					
ALT.NO.	ECN NO/CHANGES		DATE	BY	CHKD	APPD	<div> BEML LIMITED</div> <div>NEW FORT ROAD, NEW DELHI</div>					

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GRADE No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
VALUE	0.05	0.1	0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	15.0	20.0	25.0	
SYMBOL																														
SURFACE																														
ROUGHNESS																														









NOTE:

1. PAINTING SPECIFICATION & PROCESS SHALL BE AS PER THE APPROVED PAINTING SPECIFICATION PROVIDED BY BEML.
2. ALL SHARP EDGES TO BE SMOOTHENED AND GROMMETS TO BE PROVIDED AT EDGES IN THE PANEL.
ALL THE CABLES ARE TO BE PROPERLY SECURED WITH PROTECTIVE SLEEVES.
3. REFER TO DRG No.507-21776 SHEET 2 OF 2 FOR INTERNAL PANEL WIRING.
4. THE CABLE MARKERS PROVIDED SHALL BE FIRE RETARDANT & HEAT SHRINKABLE TYPE.
5. THE CABLE MARKERS SHALL BE PROTECTED AGAINST FADING BY PROVIDING FIRE RETARDANT HEAT SHRINKABLE CLEAR SLEEVES.
6. THE CABLE TIES USED FOR SECURING THIS CABLE SHOULD BE OF FIRE RETARDANT TYPE.
7. ALL CABLES SHOULD BE PROPERLY CRIMPED WITH LUGS & FERRULES
8. GOLD PINS TO BE PROVIDED FOR ALL SHIELDED CABLES.
9. TORQUING MARK TO BE ENSURED FOR TERMINATIONS
10. TORQUE CHECK SHEET TO BE PROVIDED ALONG WITH THE ITEM
11. ALL MATERIALS USED IN BCB SHALL CONFORM TO FIRE SAFETY REQUIREMENTS OF EN 45545 PART 1 TO 7(CATEGORY 4-A, HAZARD LEVEL HL3)
12. THE SPECIFICATION, QUANTITY AND LOCATION etc., OF COMPONENTS SUCH AS RELAYS, CONTACTORS, MCB, TB's etc.,- PART NO & QTY PROVIDED IN THE BOM OF THE DRAWINGS WILL UNDERGO SOME CHANGE DURING FINAL DESIGN FREEZE / PROTO TRAIN & DESIGN DOCUMENT BY BMRC. THE SUBCONTRACTOR SHALL ABSORB THOSE DESIGN CHANGES WITHOUT ANY ADDITIONAL COST TO BEML.
13. MATING PART OF HARTING CONNECTOR, CODE PINS & HOODS TO BE SUPPLIED BY THE VENDOR.
14. LED LIGHTS TO BE PLACED PROPERLY IN SUCH A WAY THAT ALL COMPONENTS ARE ILLUMINATED.
15. BASED ON THE CABLE SIZES (FOR CABLE ENTERING TO THE EDB PANEL FROM TRAIN SIDE) SUITABLE GLANDS TO BE PROVIDED
16. TERMINAL BLOCKS OF GREEN YELLOW COLOR TO BE USED FOR OV/RETURN PATH CONNECTION & QTY WILL BE FINALISED DURING DESIGN STAGE
17. RESISTOR VALUES MENTIONED HERE MAY SUBJECT TO CHANGE & SUBCONTRACTOR SHALL ABSORB THE SAME

MACHINING DEVIATIONS FOR LINEAR DIMENSIONS	RANGE	0 – 6	6 – 30	30 – 120	120 – 315	315-1000	1000-2000	2000-4000	ABOVE 4000	RA
	TOLERANCE	±0.1	±0.2	±0.3	±0.5	±0.8	±1.2	±2	±3	~
FOR DIMENSIONAL TOLERANCES OF SHEET METAL PARTS AND WELDED STRUCTURES, REFER STD. RD-227										
UNSPECIFIED TOLERANCE FOR LINEAR AND ANGULAR DIMENSIONS REF. IS 2102 (PT-1) (MEDIUM)							QUALITY OF WELD JOINTS REF. RD 230 MEDIUM			
VALUES OF SURFACE TEXTURE SHALL BE AS PER COMPANY STD DS. 1012.C.							STATUS:			
WELDING SHALL BE CARRIED OUT AS PER IS: 9595-96										

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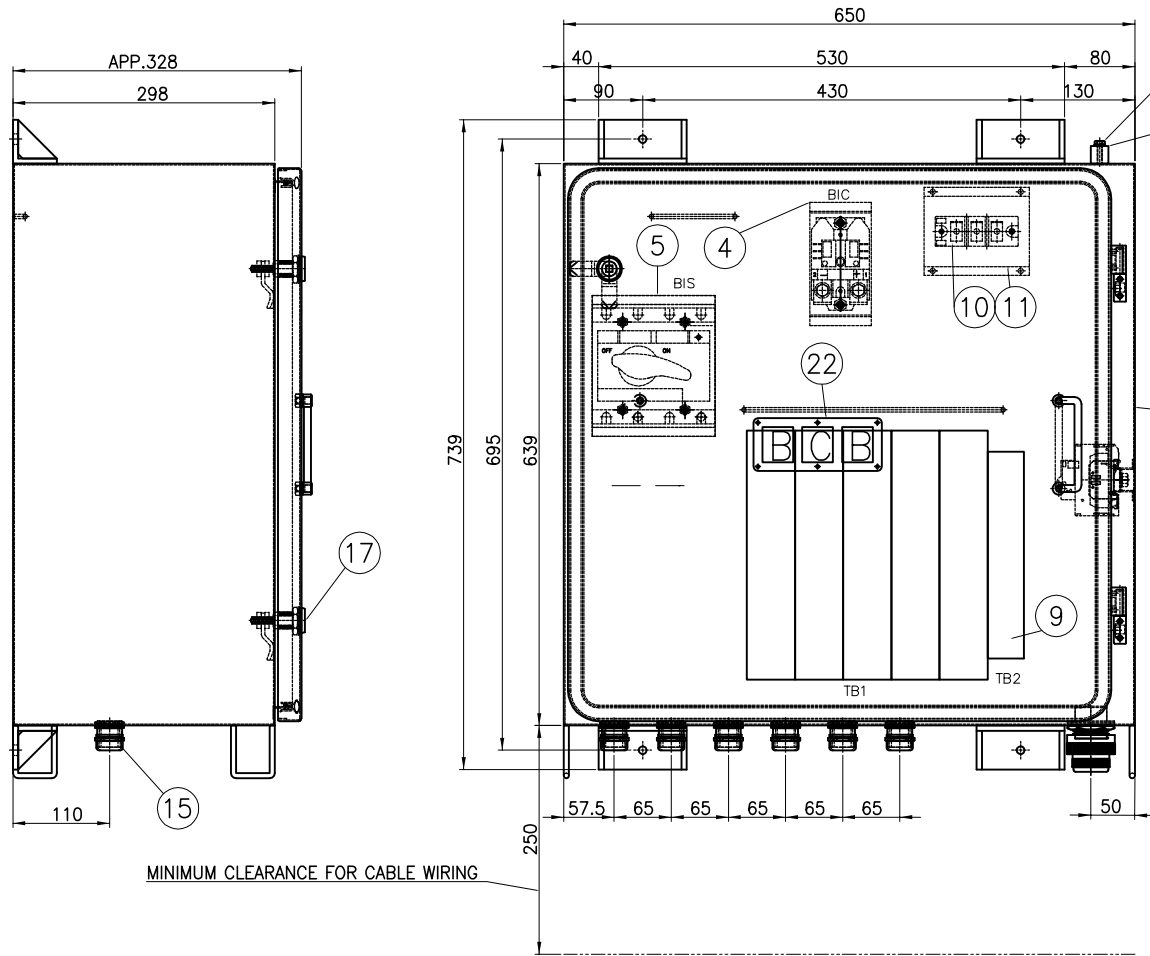
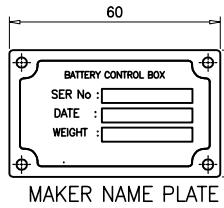
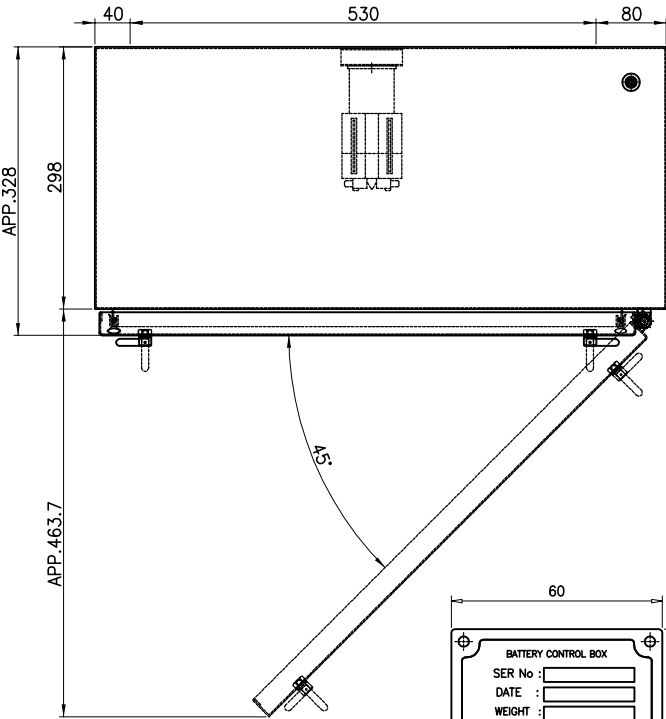
30	1	20KΩ±1%,2W(2P)+281-652(2P)	RESISTORS + TERMINAL BLOCK	ASS'Y	MAKE: WAGO
29	2	MS7V1-9 BS	BATTERY FUSE (MICRO S/W)	TO BE SUPPLIED AS LOOSE ITEM	
28	2	CC 6 GRB 71EF250 & 110MM	BATTERY FUSE & HOLDER	TO BE SUPPLIED AS LOOSE ITEM	
27	1	SHL-W255	DC LIMIT SWITCH		MAKE: OMRON
26	2		BUSBAR	t=6.0	Cu
25	4		SUPPORT	Ø6.0	MS
24	1		NAME PLATE(TITLE)	ASS'Y	t=0.5
23	10		RIVET	AL	Ø3.2
22	1		NAME PLATE(TITLE)	ASS'Y	t=0.5
21	1	M8	PLAIN WASHER		AISI 304
20	1	M8	SPRING WASHER		AISI 304
19	1	M8x16	HEX.BOLT	ASS'Y	AISI 304
18	1	Ø20xL20xM8	EARTH PAD	ASS'Y	MS
17	2		LOCKING DEVICE	ASS'Y	
16	1	MS3474W22-21S MS3475W22-21P	CONNECTOR+PINS	ASS'Y	MAKE: SOURIAU/ AMPHENOL
15	5	PG36	CABLE GLAND	ASS'Y	
	1	PG29			
14	As reqd	PMF100444	METAL VENT	ASS'Y	
13		MOUNTING PROVISION TO BE PROVIDED	LED LAMP		BEML SCOPE (LIGHT SUPPLIER MAKE)
12		MOUNTING PROVISION TO BE PROVIDED	HEAT DETECTOR(LHD)		BEML SCOPE (FOGTEC MAKE)
11	1	SUB37	HEATSINK	ASS'Y	
10	1	DD350N	DIODE	ASS'Y	MAKE: INFENION
9	5	RBO 16-HC (3247989)	TERMINAL BLOCK	ASS'Y	MAKE: PHOENIX
	1	RBO 10-HC (3247976)			
8	1	2002-1301(20P)	TERMINAL BLOCK	ASS'Y	MAKE: WAGO
7	1	S2C-H6R	AUXILIARY CONTACT	ASS'Y	MAKE: ABB
6	1	S201MT-C10UC	MCB, 1P, 10A	ASS'Y	MAKE: ABB
5	1	INS250	ISOLATION SWITCH	ASS'Y	MAKE: SCHNEIDER
4	1	C195S/110ET-U2 004 or C195S/110EV-U2	CONTACTOR	ASS'Y	MAKE: SCHALTBAU
3	1	MTDV4-U204+V23	MONITORING RELAY+SOCKET	ASS'Y	MAKE: MORSSMITT
2	1		COVER	t=2.0	AISI 304

1		BOX (740X650X330)		t=2.0		AISI 304										
SL.No.	QTY	PART / STOCK No.		DESCRIPTION		SIZE		COMPANY STD./IS	Wt. (Kg)							
								MATERIAL								
					PRODUCT	BMRCL 5RS-DM METRO CARS										
					REF DRG											
					MATERIAL											
					HEAT TREAT.		APPD	M.SADHASIVAM	07.10.2024							
					SURFACE TREAT.		REVD	M.SADHASIVAM	07.10.2024							
					TITLE	BATTERY CONTROL BOX, TC CAR		CHKD	V.SARANYA	07.10.2024						
							DRWN	V.SARANYA	07.10.2024							
							SCALE		SHEET	Wt.(Kg)						
							NTS		1 OF 1	-						
ALT.No.						ECN NO/CHANGES		DATE	BY	CHKD	APPD	DRG No.		507-21776		ALT
BEML LIMITED												NEW HYDRAULIC, NEW DRAGS				



BEML LIMITED

507-21776

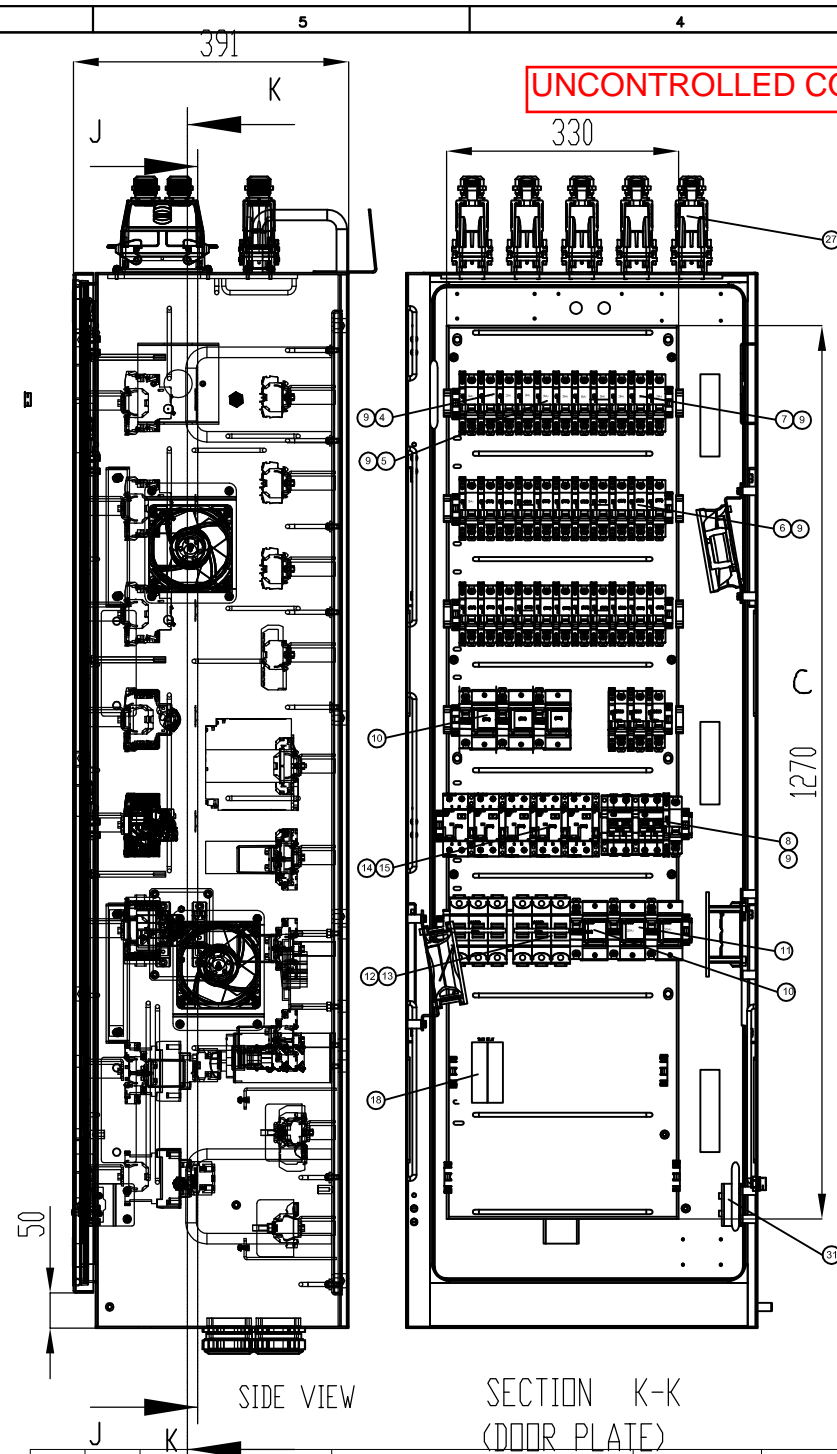
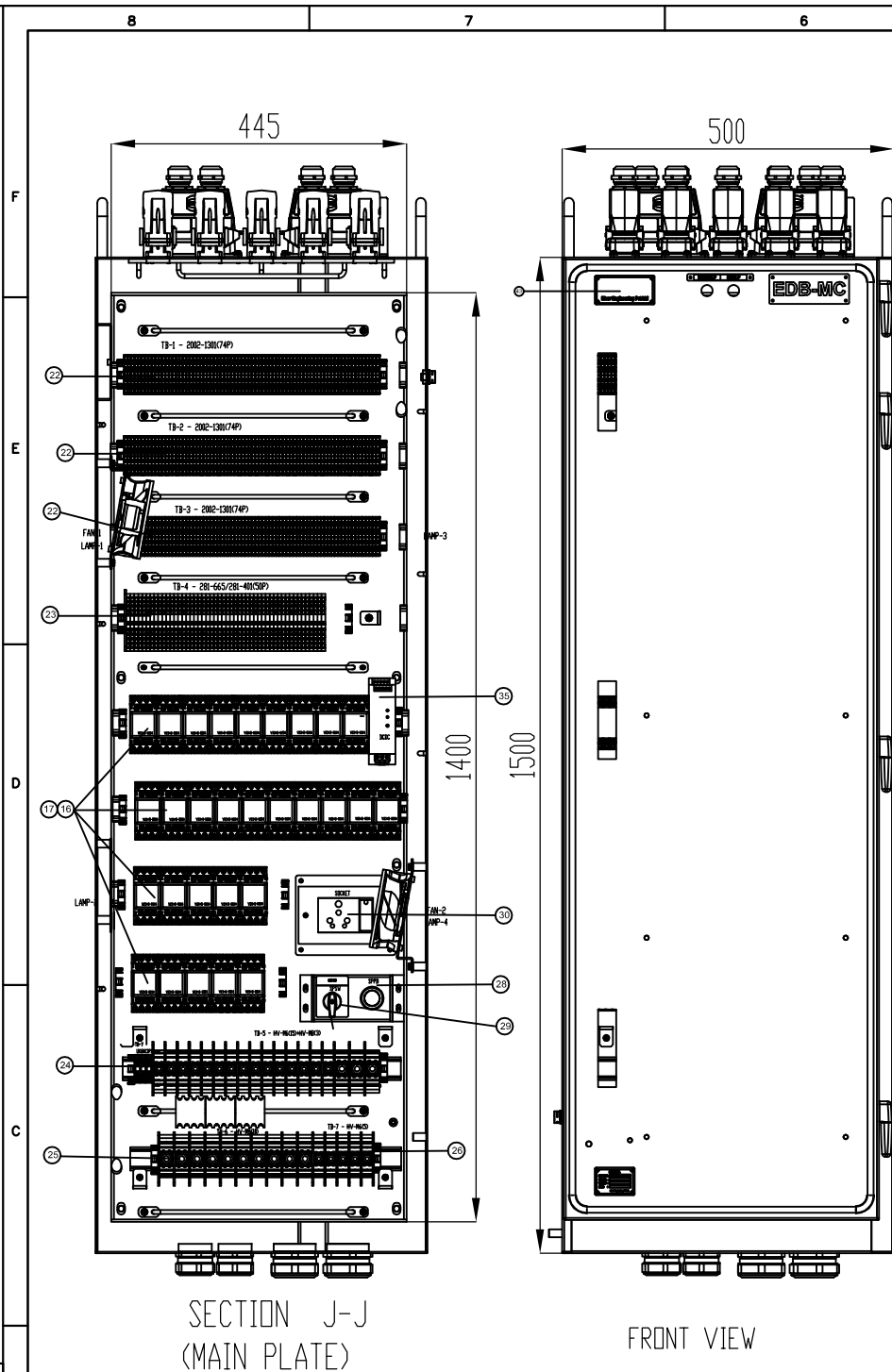


EARTH TERMINAL(M8)

4-Ø12 HOLES FOR MOUNTING (FOR M8 BOLT)

MINIMUM CLEARANCE FOR CABLE WIRING




	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	GRADE No.	VALUE	SYMBOL
SURFACE ROUGHNESS	0.075	0.15	0.3	0.6	1.2	2.5	5	10	20	40	80	160	Rz	0.1	(Symbol)



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3			2						1			
MACHINING DEVIATIONS FOR LINEAR DIMENSIONS			RANGE	0 - 6	6 - 30	30 - 120	120 - 315	315-1000	1000-2000	2000-4000	ABOVE 4000	RA
			TOLERANCE	±0.1	±0.2	±0.3	±0.5	±0.8	±1.2	±2	±3	~
FOR DIMENSIONAL TOLERANCES OF SHEET METAL PARTS AND WELDED STRUCTURES, REFER STD. RD-227												
UNSPECIFIED TOLERANCE FOR LINEAR AND ANGULAR DIMENSIONS REF. IS 2102 (PT-1) (MEDIUM)									QUALITY OF WELD JOINTS REF. RD 230 MEDIUM			
VALUES OF SURFACE TEXTURE SHALL BE AS PER COMPANY STD DS. 1012.C.									STATUS:			
WELDING SHALL BE CARRIED OUT AS PER IS: 9595-96												
34	1	17-411130DC	INDICATOR RED(1P)						ASSY	MAKE: EAO, DIA:16MM		
	1	17-411135DC	INDICATOR GREEN(1P)									
33	2	4656 N	FAN						ASSY	MAKE: EBM PAPST SEE NOTE 8		
32	4		LED LIGHT						ASSY	LIGHT SUPPLIER SCOPE SEE NOTE 9		
31	1	KH-9015-PBL	LIMIT SWITCH						ASSY	MAKE: KOINO		
30	1	673045DM,673008DM 673213DMA	SWITCH & SOCKET OUTLET 5P, 16A, MYRIUS SERIES						ASSY	MAKE: LEGRAND		
29	1	CH16 IN3059	SWITCH (2 NO + 2 NC 2 POSITIONS)						ASSY	MAKE: K&N		
28	1	704.032.518(3A1B green)	PUSH BUTTON+AUX BLOCK						ASSY	MAKE: EAO		
27	7	HAN 108 DD	CONNECTOR (MALE INSERT+FEMALE INSERT+ HOUSING+HOOD(2 TOP HOLE+PINS))						ASSY	MAKE: HARTING		
26	1	HV-M6(5P)+UK6N(3P)	TERMINAL BLOCK, TB7						ASSY	MAKE: PHOENIX		
25	1	HV-M8(10P)	TERMINAL BLOCK, TB6						ASSY	MAKE: PHOENIX		
24	1	HV-M6(15P)+HV-M8(3P)	TERMINAL BLOCK, TB5						ASSY	MAKE: PHOENIX		
23	50	281-665/281-401	DIODE TERMINAL BLOCK, TB4						ASSY	MAKE: WAGO		
22	3	2002-1301(74P)	TERMINAL BLOCK(TB1-TB3)						ASSY	MAKE: WAGO		
21	2	LADN226	AUXILIARY CONTACT BLOCK						ASSY	MAKE: SCHNEIDER		
20	1	LADN406	AUXILIARY CONTACT BLOCK						ASSY	MAKE: SCHNEIDER		
19	3	LC1DT256FD S207	MAGNETIC CONTACTOR						ASSY	MAKE: SCHNEIDER		
18	2	CT-MVS.21	TIMER RELAY						ASSY	MAKE: ABB		
17	29	V23	RELAY SOCKET						ASSY	MAKE: MORSSMITT		
16	29	D-U204N-KL	RELAY						ASSY	MAKE: MORSSMITT		
15	5	5ST3 010	MCB AUX FOR MCB 2P,10A						ASSY	MAKE: SIEMENS		
14	5	5SU1154-7KK10	MCB, 2P, 10A, 10mA						ASSY	MAKE: SIEMENS		
13	2	S800- AUX	AUXILIARY CONTACT FOR 3P, 80A MCB						ASSY	MAKE: ABB		
12	2	S803S-K80	MCB , 80A, 3P K CURVE WITH AUXILIARY CONTACT						ASSY	MAKE: ABB		
11	2	S201MT-C20UC + S2C-CM1	MCB 1P, 20A, C CURVE, 10KA (REMOTE CIRCUIT BREAKER, REMOTE MODULE)						ASSY	MAKE: ABB		
10	4	S201MT-C10UC + S2C-CM1	MCB 1P, 10A, C CURVE, 10KA (REMOTE CIRCUIT BREAKER, REMOTE MODULE)						ASSY	MAKE: ABB		
9	38	S2C-H6R	AUXILIARY SWITCH						ASSY	MAKE: ABB		
8	2	DS201T C20 A30	MCB, 2P, 20A, 30mA						ASSY	MAKE: ABB		
7	4	S201MT-C3UC	MCB 1P, 3A, C CURVE						ASSY	MAKE: ABB		
6	23	S201MT-C10UC	MCB, 1P, 10A						ASSY	MAKE: ABB		
5	5	S201MT-C6UC	MCB, 1P, 6A						ASSY	MAKE: ABB		
4	4	S201MT-C2UC	MCB, 1P, 2A						ASSY	MAKE: ABB		
3	5		EARTH PAD						AISI 304	M6-20MM		
2	1		BOX						AISI 304	t=2.3		
1	1		PANEL						AISI 304	t=2.3		
SL NO.	QTY	PART NO.	DESCRIPTION						MATERIAL	REMARKS		
BMRCL 5RS-DM METRO CARS												
REF DRG												
MATERIAL												
HEAT TREAT.												
SURFACE TREAT.												
TITLE												
EDB PANEL (MC CAR)												
SCALE												
NTS												
DRG No.												
ALT												
0												
507-21775												
BEML LIMITED												
3												
2												
1												
A2												

GRADE No.	N12	N11	N10	N9	N8	N7	N6	N5	N4	N3	N2	N1
VALUE	50	25	12.5	6.3	3.2	1.6	0.8	0.4	0.2	0.1	0.05	0.025
SYMBOL												
SURFACE												
ROUGHNESS												

										BMRCL 5RS-DM METRO CARS						
										REF DRG						
										MATERIAL						
										HEAT TREAT.		APPD	M.SADHASIVAM	16.10.2024		
										SURFACE TREAT.		REVD	M.SADHASIVAM	16.10.2024		
										TITLE	EDB PANEL (MC CAR)	CHKD	V.SARANYA	16.10.2024		
										DRWN		V.SARANYA	16.10.2024			
										SCALE			SHEET	Wt.(Kg)		
										NTS			2 OF 2	-		
											DRG No.	507-21775			ALT	
											BEML LIMITED					
ALT.NO.	ECN NO/CHANGES	DATE	BY	CHKD	APPD										A2	
3						2						1				