

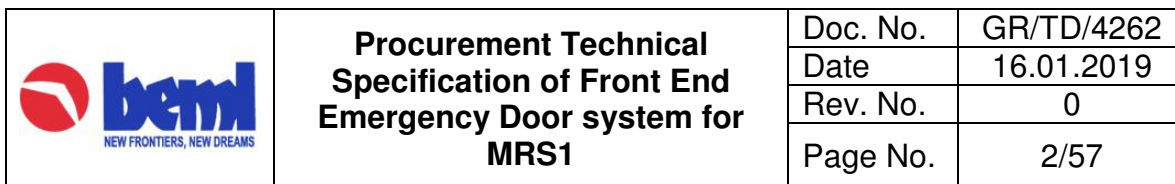


BEML LIMITED
BENGALURU
R & D CENTER

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MRS1 Project
Procurement Technical Specification
of Front End Emergency Door system

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1. Introduction

1.1. General

This Procurement Technical specification (PTS) specifies the technical requirements of Front End Emergency Door/Detrainment Door(hereafter FEED) to be supplied for cars under the 'MRS1' contract (hereafter MRS1). The FEED shall comply in all respects with MRS1 Employer's Requirements General Specification (ERGS) and Employer's Requirements Technical Specification (ERTS).

BEML will carry out all required works and activities as Contractor to the Employer for MRS1 project, while the subcontractor shall be responsible for all works required in this PTS with regard to FEED and shall be responsible for supporting the BEML activities as contractor for MRS1 project.


The scope of work covers design, development, testing, manufacture, supply, testing, commissioning and integrated testing of the FEED and the training of Operation and Maintenance personnel of the owner on the FEED. The scope also covers supply of spares, special tools, testing and diagnostic equipment, jigs and fixtures for maintenance, repair and overhaul of FEED.

The scope of work includes all items of work which may be required to meet the performance requirements, reliable and efficient operation of trains and meeting the best international practices even if not specifically mentioned in this PTS.

The trains shall be operated in GoA2/GoA3 modes with driver/ attendant during initial phase of the project and shall finally be upgraded to GoA4 (UTO). The subcontractor shall ensure that the supplied FEED incorporates and provides all necessary equipment, systems & sub-systems and interfaces compliant for UTO/GoA4.

As per ERTS 1.1.8 & ERTS 1.4, during initial phase of the project, all trains (including prototype train) shall be tested and commissioned for GoA2 modes of automation. Upgradation of all trains to GoA3/GoA4 modes shall be done subsequently. The interface testing may have to be done separately for line 2 & 7 of Mumbai Metro.

The FEED system shall be suitable for Unattended train operation conforming to Grade of Automation-GOA4 as specified in IEC62290-1:2006 or latest, including the training of operating and maintenance staff of the BEML/DMRC, for line 2 and 7 of the Mumbai Mass Rapid Transit System.

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1.2. Train Composition

The rake formation shall generally be as follows:

3 Car unit formation : * DM – T – M –

6 Car Train formation: * DM –T–M – M – T – DM*

In case of 8-car formation (if required):

2 Car unit formation : – T – M –

8 Car Train formation: * DM – T – M – T – M – M – T – DM*

In case of 8 car formation (if required), the performance features of extra 2 Car unit (T-M) shall be suitably designed in line with ERTS sub-clause 3.22.10.

where,

DM : Driving Motor Car

T : Trailer Car with pantograph

M : Non -Driving Motor Car


Accordingly, the subcontractor shall ensure that the design of the FEED system complies to the emergency evacuation requirements of both 6 car and 8 car train.

1.3. Car Weights

	DM-Car	T-Car	M-Car
Tare weight (AW0)	Less than 42,000 kg	Less than 42,000 kg	Less than 42,000 kg
Fully loaded(AW3)	Less than 68,000 kg	Less than 68,000 kg	Less than 68,000 kg
Axle load	17,000 kg	17,000 kg	17,000 kg

1.4. Climatic & Environmental Conditions


The car shall operate reliably and safely under the climatic and environmental conditions specified at ERTS clause 3.10. Accordingly, the FEED shall be designed to operate with satisfactory performance under the following conditions as per ERTS clause 3.10.

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Description	Limiting Values
Maximum ambient temperature (See note below)	36 °C
Minimum temperature	14.3 °C
Humidity	≥ 95% RH
Rainfall	The annual precipitation is 2,078 mm with 34%(709mm) falling in the month of July.
Atmosphere during hot season	Extremely dusty including bird feathers
Maximum wind speed	150 km/h
Vibration and Shocks	The sub-systems & their mounting arrangements shall be designed to withstand satisfactorily the vibration and shocks encountered in service as specified in IEC 61373 and IEC 60571.
SO ₂ level in atmosphere	80 – 120 micro gram/m ³
Suspended particulate matter in atmosphere (TSPM)	360 – 540 micro gram/m ³
Flood Proofing	The traction sub-systems mounted on the under-frame will be designed to permit propulsion of the train at 10 kmph through water up to a depth of 50 mm above rail level. Traction sub-systems shall be made splash proof in accordance with International Standards.
Life	The Metro car is designed for min.35 year of life. Accordingly, the subject items & accessories shall also not deteriorate in their performance for 35 years

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 70 °C.
- 2) Any moisture condensation shall not lead to any malfunction or failure.
- 3) Adequate margin shall specially be built into the design particularly to take care of the higher ambient temperatures, high humidity, dusty and corrosive conditions, etc. prevailing in Mumbai area.

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1.5. Vehicle Performance Requirements (ERTS clause: 3.22)

The vehicle performance requirements with fully loaded train and tangent track are as per the following table


Item		All Corridors
Safe speed	With inflated secondary suspension	90 kmph
	With deflated secondary suspension	80 kmph
Maximum operational speed	With inflated secondary suspension	80 kmph
	With deflated secondary suspension	70 kmph
Minimum Design Average Acceleration rate for fully loaded (AW3) train on level tangent track shall be as under: 0 kmph to 40 kmph 0 kmph to 60 kmph 0 kmph to 80 kmph		1.0 m/s ² 0.75 m/s ² 0.40 m/s ²
Minimum Operational Average Acceleration rate for AW2 loaded train on level tangent track shall be as under: 0 kmph to 35 kmph 0 kmph to 60 kmph 0 kmph to 80 kmph		1.20 m/s ² 0.80 m/s ² 0.45 m/s ²
Average Service braking rate from 80 kmph to standstill for fully loaded(AW3) train on level tangent track.		1.0 m/s ²
Average Service braking rate from 80 kmph to standstill for AW2 train on level tangent track.		1.1 m/s ²
Average Emergency braking rate from 80 kmph to 0 kmph for fully loaded trains on level tangent track		1.3 m/s ²
Jerk rate (Maximum)		0.75 m/s ³
Annual running distance of one train (for design purpose)		150,000 km
Note: The specified average minimum acceleration shall be the finally achieved values inclusive of the specified jerk rate. Test procedure has been specified in Chapter 15 of ERTS		

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1.6. Track structure Parameters (ERTS clause: 3.14)

The MRS1 cars will operate with the track parameters as specified in the following table:


Description	Elevated and At-grade Corridor		Underground Corridor
	Ballasted	Ballast less (DFF)	Ballast less (DFF)
Track Laying Gauge	1435 mm		
Rail Type (Main Line & Depot)	60 E1 (UIC 60) 880/HH	60 E1 (UIC 60) 1080/HH	60 E1(UIC 60) 1080/HH
Rail Profile	UIC 861-3		
Inclination Of Rail	1 in 20		
Sleeper Spacing (Main line)	600 mm ± 10mm	600 mm ± 10mm	700 mm ± 10mm
Sleeper Spacing (Depot)	650 mm ± 10mm	Not applicable	
Ballast Cushion Depth(Main line)	300mm	Not applicable	
Ballast Cushion Depth (Depot)	250mm	Not applicable	
Standard Rail Length	13m and 18m	18m	
Rail Panel Lengths	Longer than 200m		
Minimum Radius of Curvature	200m-Underground 110m-Elevated 100m-Depot		
Minimum Turn out Radius (Main line)	1 in 9 - 300m radius 1 in 7- 190m radius		
Minimum Turn Out Radius Depot	1 in 7 - 190m radius		
Maximum Cant Permissible	110 mm		
Maximum Cant Desirable	110 mm		
Maximum Cant Deficiency Permissible	85 mm		
Maximum Cant Deficiency Desirable	85 mm		
Maximum Permissible Cant Gradient	1 in 440		
Maximum Desirable Cant Gradient	1 in 720		
Turn-out Speed : Turnout (1 in 9) R-300	45 km/h	45 km/h	40 km/h
Turn-out Speed : Scissors (1 in 9) R-300	45 km/h	45 km/h	40 km/h

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Turn-out Speed : In Depots (1 in 7) R-190	35 km/h	35 km/h	25 km/h
Turn-out Speed : Turnout (1 in 7) R-190	35 km/h	35 km/h	25 km/h
Turn-out Speed : Turnout(1 in 12) R-410	50 km/h	50 km/h	50 km/h
Turn-out Speed : Turnout(1 in 12) R-410	50 km/h	50 km/h	50 km/h
Turn-out Speed : Turnout (1 in 8.5) R-218	30 km/h	30 km/h	30 km/h
Turn-out Speed : Turnout(1 in 8.5) R-218	30 km/h	30 km/h	30 km/h
Maximum Gradient Main Line	4%		
Maximum Gradient Depot Connection	4%		
Minimum vertical curve radius of curvature	1500m		

1.7. Current Collection System (ERTS clause 3.17)

System Particulars	For all sections and depot
Supply Voltage System	25kV AC single phase 50Hz
Type of OHE	a. Auto tensioned flexible catenary for elevated and at-grade sections. b. Rigid catenary for underground sections. c. Flexible catenary for depot.
Current Collection	Through Pantograph
Height of Contact wire from rail level	a. 4800mm min. and 5500mm max. for elevated, at-grade and depot sections. b. 4318mm min. for underground sections.
Stagger	±200mm for Rigid Catenary; ±300mm for Flexible Catenary
Nominal Voltage	25.0 kV AC
Minimum Voltage	19.0 kV AC
Maximum Voltage	27.5 kV AC
Instantaneous min Voltage	17.5 kV AC

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Occasional max Voltage	31.0 kV AC
Voltage for guaranteed performance	22.5 kV AC
Variation in frequency	48 to 52 Hertz

1.8. Signalling System (ERTS clause 3.18)

Item	Description
Train Control System	CBTC based On board Continuous Automatic Train Control system (CATC) consisting of i) Automatic Train Protection ii) Automatic Train Operation (ATO) iii) Automatic Train Super-vision (ATS) iv) Attended/Unattended train operation (GoA2/GoA3/GoA4)
Train Control mode	i) Automatic mode ii) Coded Manual modes iii) Restricted Manual mode iv) Run on Sight mode v) Cut-out mode vi) UTO vii) Standby

1.9. Principal Notional Vehicle Dimensions/ Leading Particulars (ERTS Clause 4.3.2)

Description		Dimension
Gauge		1,435 mm
Maximum Length over body(including end-fairings)	DM car	22,010 mm
	T and M cars	22,010 mm
Maximum Length over couplers for all cars		23,000 mm
Maximum Width over Body		3,200 mm
Minimum Passenger Saloon Headroom		2,050 mm
Locked down pantograph height for 25kV AC cars from rail level at Car Centre Line		4,048 mm
Maximum Floor height above rail level of any unloaded vehicle		1,130 mm
Minimum Floor height above rail level of fully loaded vehicle		1,100 mm
Maximum height of coupler above rail level for unloaded vehicle		815 mm


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Minimum height of coupler above rail level for fully loaded vehicle		740 mm
Bogie Wheel Base	Maximum	2400 mm
	Minimum	2200 mm
Distance between bogie centres	Maximum	15,100 mm
	Minimum	14,400 mm
Wheel diameters	New	860 mm
	Fully worn	780 mm
Maximum axle load		17 Tonne (including all tolerances as per IEC 1133-1992)

1.10. Platform Interface (ERTS Clause 3.16)

The principal details of the Platform Interfaces are as per the following table.

Particulars		Measurements
Length of Platform (8 cars)		185 m
Width of Platform: Island type		8.0 to 12.0m
Side type		3.0 to 6.0m
Height above rail level	Ballasted Track	1080mm±5mm
	Ballastless Track (DFF)	1090mm±5mm
Floor height of the rolling stock		1130mm (max)
		1100mm (min)
Distance between track centre and platform edge	At-Grade Corridor	1680 mm(max.) and 1670 mm (min.)
	Elevated Corridor	1680 mm(max.) and 1670 mm (min.)
	Underground Corridor	1670 mm (max.) and 1660 mm (min.)
Minimum horizontal curvature at platform		1000 m
Distance between track centre and platform edge on platforms at curve of 1000m	At-Grade Corridor	1700 mm(max.) and 1690 mm (min.)
	Elevated Corridor	1700 mm(max.) and 1690 mm (min.)
	Underground Corridor	1700 (max.) and 1690 (min.)

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2. Definitions and Abbreviations

The following definitions and abbreviations are applicable to the PTS.

2.1. Definitions

- **“Employer”** means Delhi Metro Rail Corporation Limited (DMRC), its legal successors and assignees..
- **“Subcontractor”** means the Supplier who supplies the required FEED to BEML for MRS1 project. Subcontractor shall carry out the works in accordance with ERTS and ERGS with regard to FEED.
- **“Contractor”** means the persons or person appointed by the Employer to undertake the execution of the works for MRS1 project. In order to avoid misunderstanding of the roles of the Contractor in ERTS and ERGS, the term “Contractor” shall be read as “Subcontractor” in ERTS/ERGS for those ERTS/ERGS clauses referred to in this PTS.
- **“Contract”** means the contract between Subcontractor and BEML in relation to the supply of FEED for MRS1 project.
- **“Engineer”** means any person nominated or appointed from time to time by the Employer to act as the Engineer for the purposes of the Contract and notified as such in writing to the Contractor.
- **“Engineer’s Representative”** means any Assistant of the Engineer appointed from time to time by the Engineer.
- **“GTC”** means “General Terms and Conditions for Supply of FEED for MRS1 Project” issued by BEML.
- **“BEML”** means the Contractor to procure the FEED for MRS1 project cars.

2.2. Abbreviations

GOA	:	Grade of Automation
UTO	:	Unattended Train Operation
ERGS	:	Employer’s Requirements General Specifications
ERTS	:	Employer’s Requirements Technical Specifications
FEED	:	Front End Emergency Door


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FMEA	:	Failure Mode Effects Analysis
FMECA	:	Failure Mode Effects and Criticality Analysis
FRACAS	:	Failure Reporting and Corrective Action system
FAI	:	First Article Inspection
ISO	:	International Standards Organization
ITP	:	Inspection and Test Plan
LRU	:	Line Replaceable Unit
MRTS	:	Mass Rapid Transit system
MDBF	:	Mean Distance Between Failures
MDBCF	:	Mean Distance Between Component Failures
MDBSF	:	Mean Distance Between Service Failures
MTTR	:	Mean Time To Repair
NCR	:	Non Conformance Report
PHA	:	Preliminary Hazard Analysis
RDSO	:	Research Design and Standards Organisation (Ministry of Railways)
SOD	:	Schedule of Dimension
TCMS	:	Train Control Management System

For further abbreviations, please refer to APPENDIX-8 of ERGS and APPENDIX-TC of ERTS

3. Precedence of Documents

This PTS shall be read in conjunction with ERGS, ERTS and GTC. It is the intent that all subcontractors providing equipment or services to BEML shall comply with the Employer's requirements. When the Customer does not have any specific requirements, the subcontractor shall comply with the requirements of this PTS as appropriate. Subcontractors must comply with the requirements stated herein unless otherwise agreed to in writing by BEML. Any conflict between the Employer's

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requirements and this specification shall be brought to BEML's immediate notice for resolution. Notwithstanding conflict resolution, the most restrictive requirement shall apply.

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

In case of conflict among contract documents, the following order of priority shall govern:

Order of Precedence	Document title
1	DMRC ERTS
2	DMRC ERGS
3	GTC
4	PTS


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.

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. Qualification Criteria

Subcontractor shall be an Original Equipment Manufacturer (OEM) of FEED for Railway Metro Rolling stock having experience in design, manufacturing, testing, commissioning and Integrated testing.

The subcontractor shall meet the qualification criteria mentioned in ERTS 3.2.2 for FEED. The Proposed type of FEED Manufactured and Supplied by the subcontractor should 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. Satisfactory Revenue service performance certificates for a period of 3 years or more from end users/ Metro Operators for the above shall be submitted along with the technical offer.

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Along with the technical offer, the subcontractor shall submit all the required documents for obtaining the vendor approval from DMRC, for FEED as per ERTS 3.2.5 and Appendix-3 of PTS. Selection of Vendor is subject to DMRC approval.

The proposed type of FEED shall be SIL2 compliant. Accordingly, the subcontractor must have manufactured and supplied FEED systems with SIL2 compliance. The subcontractor shall submit a copy of the SIL2 certificate of similar FEED projects executed by them, along with the technical offer.

The firm should undertake to provide the support during Testing & Commissioning, service trials, revenue service and DLP period either by themselves or through sister company or a partner in India. The firm shall submit detailed proposal in this regard. Local support through any sister company or partner, will be considered only if the same is approved by DMRC.

The technical support of subcontractor shall be made available through permanent positioning of subcontractor's staff at Depots for meeting DLP obligation as per ERTS 3.2.5.

The firm should give an undertaking to supply spares for a minimum period of 10 years from the date of last car supplied by BEML.

5. Interface Responsibilities

5.1. Design Interface

At design stage, BEML shall be responsible for defining the technical requirements and the design constraints. The location of mounting points and the design of equipment installation comprising of FEED shall be defined by the subcontractor and approved by BEML in order to avoid any mechanical interference with other equipment for the vehicle. The subcontractor shall be responsible for mounting methods and providing all requisite materials for mounting of the FEED on the carbody.

Any changes of the components comprising of FEED shall be defined by the subcontractor and approved by BEML in order to avoid the mechanical interference with other equipment for the vehicle.

In order to implement interface requirements, the subcontractor shall provide the information required by BEML or DMRC and shall provide the interface data voluntarily for ensuring the performance of the FEED which need to be used for the mechanical and functional interface. The subcontractor shall have whole responsibility for problems which will happen without any information and notification used for engineering interface with other equipments or car body structure.

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Even if technical information or drawings are approved by BEML or DMRC, the subcontractor shall have responsibility to change/ solve/ modify design failure of production, quality problems and safety issues on its own cost.

The subcontractor shall keep in mind that any FEED initially proposed by him should be customized to meet a situation of this project or the need of DMRC. So, the subcontractor shall implement it to FEED without additional cost. Subcontractor shall solve all issues for proper operation of FEED, at subcontractor's own cost.

5.2. Space Envelope

The FEED assembly shall be designed for mounting within the car body space envelope without any interference.

In order to avoid the mechanical interference with other equipments of the vehicle following sub-assembly mountings shall be taken care during preliminary and pre-final design stage.

- Interface between FEED system and carbody frame
- Interface between FEED system and cab mask
- Interface between FEED system and cab interior
- Interface between Ramp of FEED system and cab mask , carbody and track
- Interface between FEED system and wiper system mounting and related electrical and water connections.
- Interface between FEED system and Front Destination Indicator mounting and related electrical connections.

The design of the FEED system components shall consider the tentative carbody details provided in the enclosed sketch GR-4155 (Refer Appendix-5 of PTS) for the door leaf profile and the available space envelope. The specific details will be finalised during the preliminary design stage.


The Subcontractor shall provide the detailed longitudinal section drawing and the detailed drawing related to FEED during preliminary design stage.

5.3. Interfaces with other systems

5.3.1. Electrical/Communication Interface

The subcontractor shall provide the interface specification between TCMS, Propulsion system, Track work, depot maintenance equipment and vehicle equipment including signaling, such as ATC, ATO, UTO control and any other equipment.

Time to time BEML will facilitate direct face to face meeting between other subcontractors either at subcontractors works, BEML works, other subcontractor works

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or at Employer place. Subcontractor is responsible to resolve the interface issues to achieve the ERGS and ERTS requirements.

The following is a brief of requirements for Electrical Interface

- Power requirements.
- Technical specification.
- Rated current, voltage characteristic and consumption.
- Cable specification (Power, control and grounding).
- Connector (male and female) with pin and socket part no.
- Signal input/output list and interface specification.
- Connector/terminal arrangement

BEML and the subcontractor will comply with and be responsible for the interface requirement and develop the interface specification on his scope of supply.

Necessary Electrical interface shall be supported and implemented by subcontractor during execution phase for successful completion of project even if it is explicitly not mentioned in ERTS, ERGS, PTS.

5.3.2. TCMS Interface

Subcontractor shall provide the necessary interface and participate in finalising the TCMS Interface and carry out necessary testing on-site for successful integration and completion of the project.

The subcontractor shall meet the communication protocol requirements of the lead subcontractor (TCMS) in accordance with the interface document requirements for FEED.

Before the Type Test, commissioning of complete car at the vehicle level, the subcontractor shall meet the TCMS combination test between TCMS and their equipment as per chapter-10 of ERTS. One or several equipments including connector, power, cables etc should be delivered to TCMS supplier's test placement before the testing period by subcontractor. Subcontractor's engineer should attend the combination test for technical support.

5.3.3. Interface with On-board CCTV System

The subcontractor shall provide the required interface for the CCTV system whose camera has to focus and alert the train operator/OCC by automatically flashing the image suitably, when Emergency door is opened.

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5.3.4. Signalling Interface


Refer Appendix 'TD' of ERTS for full details of the division of responsibility between the subcontractor and Signalling. The subcontractor shall comply with the requirements.

Subcontractor shall support and implement necessary interface for GoA2/GoA3/GoA4 during execution phase and carryout necessary fine tuning of his equipment during testing & commissioning and test trials on-site for successful completion and handing over of the trainsets for Statutory approvals and Revenue Service operations for both Line-2 and Line-7.

6. Technical Requirements

6.1. General

- I. The subcontractor shall meet the FEED system requirements of ERTS for the design, development, manufacture, supply, testing, delivery, commissioning and integrated testing and suitable for UTO operation, including the training of operating and maintenance staff of the Project Owner, for line 2 and 7 of the Mumbai Mass Rapid Transit System.
- II. FEED shall fully meet the requirement of ERTS & ERGS of MRS1 and shall be compatible for operating 6 car train (DM - T - M - M -T - DM) and 8 car (DM - T - M - T - M - M -T - DM)(if required) train formation. All FEED system hardware compatibility for operation of 6 car and 8 car formation shall be ensured and executed by the subcontractor for the complete corridor.
- III. The subcontractor shall support in all aspects in obtaining clearance for dispatch of the prototype trains to Mumbai Depot as per the delivery schedule as specified in the ERTS 1.2 & ERGS, after successful completion of tests. The subcontractor shall carryout any modification/ alteration based on results of the tests on the prototype, if required. The subcontractor shall carry out necessary modifications at no additional charge on all trains and shall support in delivering the prototype train.
- IV. The sub contractor shall ensure that the train design incorporates and provides all necessary equipment, systems or sub-systems, facilities, interface etc., generally used/provided in recent operational UTO/GoA4 trains within quoted price, notwithstanding whether these have been specifically mentioned in the ERGS/ERTS or otherwise. In case of any necessary provision required to be incorporated in conformance to this clause the subcontractor shall commit to incorporate the same into design at any stage for ensuring full compliance to this ERTS clause.
- V. The subcontractor shall meet the system requirements of FEED system mainly in accordance with ERTS clause 7.3.
- VI. Subcontractor shall consider all energy saving methodology and submit the

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measures taken for energy saving as part of tender bid submission. This is required since Specific Energy Consumption at Train level has been specified in the contract and the same needs to be achieved to avoid imposition of penalty by employer. In this regard, subcontractor shall submit the details of energy consumption of FEED.

- VII. Subcontractor shall provide the detail of projects interfaced with TCMS along with grade of automation GoA2/GoA3/GoA4.
- VIII. The subcontractor shall comply with the Train withdrawal scenarios for 6-car train specified at Appendix- TG of ERTS.
- IX. The subcontractor shall meet fully the system requirements for FEED System in accordance with the following chapters of ERTS.

Chapter 1 : Introduction

Chapter 2: General Requirement

Chapter 3 : Design and Performance Requirements

Chapter 4 : Vehicle Body

Chapter 5 : Bogies

Chapter 6 : Pneumatics, Air Supply and Brake System

Chapter 7 : Door And Door Control System

Chapter 8: HV and Propulsion Equipment

Chapter 9 : Auxiliary Supply Equipment

Chapter 10 : Train Control Management System

Chapter 11 : Heating, Ventilation And Air-Conditioning (HVAC)

Chapter 12: Electrical and Control Equipment

Chapter 13: Communication System

Chapter 14 : Material and Workmanship

Chapter 15 : Inspection, Tests and Trials

Appendix TA : International standards

Appendix TB : Carbody Mock-ups


Appendix TC : Abbreviations

Appendix TD : Interfaces between Rolling Stock, Signaling & Telecommunication
Contractors

Appendix TE : Drawings and Documents

Appendix TF : Submittals

Appendix-TG: Train Withdrawal Scenarios for 6-car Trains

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6.2. Standards and Codes (ERGS clause 1.6)

All equipment supplied shall be in accordance with the requirements of the standards and codes specified in the ERTS. 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/DMRC. When a Standard or Code is referred to, it shall be assumed that the revision that is current during the design finalisation 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/DMRC.

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/DMRC.

During the pre-final design phase, the subcontractor shall supply one copy each of the standards and codes to BEML.


6.3. Proven Design (ERTS Clause 3.2)

The proposed FEED by the subcontractor against this PTS shall satisfy the “Proven Design” clause 3.2.2 of ERTS. The proposed system shall have been in use and have established its 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.

The subcontractor shall manufacture and supply the FEED only from such manufacturing units that have supplied the FEED that fulfill the proven design requirements as above.(Refer ERTS clause 3.2.2). The credentials of the manufacturing plant shall be submitted along with the technical offer.

Other Design and performance requirements of Chapter-3 of ERTS, relevant to FEED shall be complied with.

The subcontractor shall be fully responsible, for the suitability, adequacy, integrity, durability and practicality of the proposed FEED. The subcontractor shall warrant that the subcontractor's Proposals meets the Employer's Requirements and is fit for the purpose thereof. Where there is any inadequacy, insufficiency, impracticality or unsuitability in or of the Employer's Requirements or any part thereof, the subcontractor's Proposal shall take into account, address or rectify such inadequacy, insufficiency, impracticality or unsuitability at subcontractor's own cost.

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The subcontractor shall warrant that the Works have been or will be designed, manufactured, installed and otherwise constructed and to the highest standards available using proven up-to-date good practice.

6.4. Technical Information of FEED (ERTS Clause 7.3)

- 6.4.1.** Arrangement for emergency egress of passengers from the front shall be provided on the cab front. The door arrangement shall be aesthetically designed ensuring seamless clear view of the track from driving car. The door shall aesthetically harmonize with the lookout glass and driving car front and shall not block the front view giving a look of single front glass. The glass of Front End Emergency Door shall meet the specifications of the windscreen Glass (ERTS 4.13.2). The visibility of the joint between the front door and look out glass shall be bare minimum. The detrainment door system shall be SIL2 compliant and shall be provided with a sealed cover door actuating mechanism. The clear width of the door way and ramp when operated shall not be less than 1100mm with a headroom not less than 1900mm so that two files of passengers can be simultaneously detrained without supervision.
- 6.4.2.** During design stage, subcontractor shall provide all details to the Engineer of the metros where such options can be seen and overall design is decided. If required, the subcontractor shall facilitate visit of Employers representatives to such metros. Suitable arrangement for ensuring safe detrainment of passengers from saloon to the track plinth (both elevated and underground sections) shall be provided. The folding ramp shall be simple in operation and should be operable by passengers without assistance during emergency. The ramp shall have full length longitudinal handrail and fluorescent material marking on both sides. The detrainment door ramp shall be designed for load of 500 kg/m² or more and it shall not sag during evacuation process. The ramp angle shall not be more than 16.5 degree. The ramp shall also be suitably supported on the track to ensure no tilting of the ramp on straight as well as on curved sections. Retrieval of the ramp shall be easy. subcontractor shall demonstrate safe use of the emergency door and ramp in the elevated and tunnel section on different radius curves specified in the specifications. The door design shall be consistent with the latest applicable fire safety standards. Further details shall be decided during design.
- 6.4.3.** The door shall be vibration free and sealed against water ingress and sound transmission. It shall be provided with a safe, simple and secure locking mechanism which shall throughout be unaffected by single point failure.
- 6.4.4.** The opening of the detrainment door & ramp shall be possible by one person. The retrieval and stowage of ramp should be easily accomplished by a single trained staff without dismantling any equipment. Any tool, if required, for manual operation by single person shall be provided in the driving console area. In addition to manual arrangement operable by one person, suitable portable power operated devices for stowage of door and ramp shall also be provided in each train at suitable location. If battery of Portable power is weak, stowage of door shall be operated manually. All necessary ancillary equipment to enable the train to be moved after emergency detrainment shall be provided as parts of the scope

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of equipment under this clause.

- 6.4.5.** For operation of the door, simplicity of operation is imperative. Multilingual (regional language(s) and English and/or Hindi) Instructions shall be displayed to enable passengers, unfamiliar with the equipment to operate the emergency door, in either mode, when the train operator is incapacitated.
- 6.4.6.** There shall be two operation modes, emergency operation mode and depot/maintenance mode. While in emergency operation mode complete deployment shall not take more than 1 minute. Deployment and stowage timings shall be reviewed by the Engineer. The door status shall be interlocked with the train control circuit so that once the door is found unlocked and open:
- (i) Driving console light, Head lights and Flasher lights are automatically lit and CCTV camera automatically operated.
 - (ii) Emergency brakes are applied on the train.
 - (iii) Such event is logged in TCMS.
 - (iv) The detrainment process shall be monitored with CCTV camera. One camera dedicated for detrainment process shall be provided. Flasher light shall automatically turn ON when detrainment door is open. Actuation of door actuating mechanism shall be suitably interlocked and immediately relayed to OCC to take further actions like PA broadcast, switching on onboard CCTV to high speed, floodlit the detrainment area (flood light to be provided separately) and beyond to allow OCC to review the detrainment from the train. The subcontractor shall submit detailed Proposals of the operation of the detrainment doors for review and acceptance by the Engineer.
- 6.4.7.** The door shall be suitable for multiple operations. There shall be no sagging / out of shape of the door at the end of such test.
- 6.4.8.** Subcontractor shall furnish detail evacuation plan. The Evacuation Scenario will also cover the following conditions:
- Evacuation in Emergency, e.g. Fire, collision. The proposed car arrangements shall be compliant with the evacuation requirements specified in Railway Group Standard GM/RT2130 'Vehicle Fire, Safety and Evacuation' or better.
 - Controlled evacuation e.g. failed train or failed power supply. It will include study of evacuation time, the battery capacity calculation and other relevant documentation duly considering the infrastructure as available.

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6.4.9. Emergency detrainment door ramp (in folded condition) shall be suitably covered from inside of driving console. The cover shall have sufficient structural strength, vandalism proof, compatible with fire performance and suitably locked and secured.

6.4.10. Windscreen (ERTS clause 4.13.2)

The Windscreen including glass of the detrainment door shall be constructed of toughened, laminated safety glass, and shall comply with the requirements of UIC 651, IS 2553 (Part-1 and 2), ECE Regulation-43, EN 15152, and UIC 566. The inner and outer surfaces of the windscreens shall be scratch resistant.

6.4.11. Electrically operated Windscreen and Detrainment Door Wiper.(ERTS clause 12.10.5)

Wipers for windscreen and detrainment door shall be provided at appropriate location for operable from the train operator's control panel. Supply of wiper is BEML scope. Interfacing is subcontractor scope.

6.4.12. Bill of Material (BOM)

All components and sub-components used in FEED shall be highly reliable and should have been used and 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).

The subcontractor shall submit the complete Bill of Material (BOM) for FEED including door panels, door electronics & controls, switches, relays, mechanical drives, windscreen glass, etc., along with the list of Models /make and list of projects in which these items are used, along with the technical offer.


6.5. Weight

To minimise energy costs, great importance shall be placed on achieving practical designs of minimum car weight whilst meeting specified structural and performance requirements. Accordingly, the weight of the Complete FEED system shall be kept to a minimum and shall not exceed 350 kg including all accessories.

The subcontractor shall submit details of estimated weights and center of gravity for FEED along with the technical offer.

6.6. Noise & Vibration

Subcontractor should devote particular attention to the design of FEED to get quiet operation condition and should ensure that the transmission loss is above the specified levels. All equipment should be designed to eliminate the rattling and resonance at all

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speeds up to maximum running speed and aerodynamic forces caused by ambient wind, train motion, or the passage of other trains.

The equipment, sub-assemblies and components shall also comply with the requirements laid down in 'Guidelines for Noise and Vibrations for Metro Rail Transit Systems' issued by the Ministry of Railways, Govt. of India (refer pg.000659 of ERGS/ERTS)

Sound reduction index R_w of the door panel assembly measured as per ISO 10140-2 should be equal to or larger than 32 dBA. The estimated R_w value shall be indicated in the technical offer.


The complete FEED shall be capable of withstanding shock and vibrations of the Rolling Stock satisfactorily such that they do not fail prematurely on this account earlier to the designed life. To establish this requirement, all of equipments, sub-assemblies and components shall be subjected to shock and vibration test as per IEC61373.

6.7. 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 organisation, the management system and methods to be used for completion of the works. The organisation resources for the design, procurement, manufacture, installation, testing and commissioning, and setting to work, shall be clearly defined.

The Project Management Plan shall provide the following information.

- A diagram showing the organisational 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 organisations 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.
- The subcontractor shall nominate a suitably qualified and experienced English speaking engineer from his staff to be Project Manager. The proposed Project Manager shall have total experience of minimum 15 years and shall have been the Project Head in at least one Rolling Stock Project in last 10 years. The proposed project Manager shall be the employee of the subcontractor. The CV of the Project manager shall be submitted along with the technical offer.
- 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

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- commissioning in depots. Separate maintenance engineer shall be positioned in each depot.
- The subcontractor shall submit relevant CVs of the Design Manager, Production Manager, Quality Manager, Software Engineer, Interface Manager and Maintenance Engineer in addition to the Project manager in the technical offer.

6.8. RAMS requirements

The subcontractor shall meet RAMS (Reliability, Availability, Maintainability and Safety) requirements as per clause 2.4 to 2.14 of Chapter-2 of ERTS. Also, the subcontractor shall provide all information related to the RAMS requirements. The subcontractor shall comply with, but not limited to, the following ERTS requirements:

6.8.1. Reliability Analysis

The reliability data shall be based on actual operating information for the equipment.

In addition, the subcontractor shall submit a list of typical train withdrawal scenarios for review and acceptance by the BEML. The list shall include all anticipated failure scenarios, which can affect safety, punctuality and passenger comfort. Also, a list of typical train withdrawal scenarios should be based on the reliability analysis.


The reliability block diagrams and prediction of reliability performance shall be submitted to BEML for acceptance.

The reliability block diagrams shall include all elements essential to the successful performance of the system and the interrelationships and interface of these elements.

The subcontractor shall submit reliability prediction to demonstrate by quantitative methods above the achievement of the specified levels of reliability for the scope of supply.

6.8.2. Reliability Target

The fleet average levels of MDBF, during Defect Liability Periods is as specified in Clause-2.8.2 of ERTS.

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Duration	Minimum fleet average MDBF
	6 -car fleet
After 6 months of start of revenue service plus stabilization period of 6 months	100,000
After 12 months of start of revenue service plus stabilization period of 6 months	125,000

$$\text{MDBF} = \frac{\sum \text{Traveled kilometer per train-set}}{\sum \text{Number of Service Failures}}$$

Mean Distance Between Failure (MDBF): The MDBF is the ratio of the total operating distance accumulated by the total available fleet of the trains to the total number of Service Failures.

Reliability Target for FEED

The MDBCF and MDBSF per 6 car train-set of the FEED shall meet the following table, considering 150,000 train-km of annual running mileage.


Equipment	Reliability Demonstration Period			
	After 6months to 12months from start of revenue Service		After 12months to the end of DLP from start of revenue Service	
	MDBCF (train-km)	MDBSF (train-km)	MDBCF (train-km)	MDBSF (train-km)
Front End Emergency Door System	12,500,000	15,000,000	15,625,000	18,750,000

The Reliability performance shall be assessed by the following measure:

$$\text{MDBCF of Emergency Door system} = \frac{\sum \text{Traveled kilometer per train-set}}{\sum \text{Number of relevant Failures}}$$

Where,

Mean Distance Between Component Failure (MDBCF): The MDBCF of a system is the ratio of the total operating distance accumulated by the total population of identical items

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in the available fleet of the system to the total number of relevant failures occurring within the population identical items.

$$\text{MDBSF of Emergency Door system} = \frac{\sum \text{Traveled kilometer per train-set}}{\sum \text{Number of Service Failures}}$$

Where,

Mean Distance Between Service Failure (MDBSF): The MDBSF of a system is the ratio of the total operating distance accumulated by the total population of identical items in the available fleet of the system to the total number of service failures occurring within the population identical items


Relevant Failure: A relevant failure of an item is an independent failure which results in a loss of function of that item caused by any of the following:

- A fault in an equipment or sub-system while operating within its design and environmental specification limits;
- Improper operation, maintenance, or testing of the item as a result of the subcontractor supplied documentation.
- Failures of transient nature including those with post investigation status as 'No fault found', shall be considered as relevant failure if in the opinion of the Engineer these are attributable to rolling stock. The decision of the Engineer shall be final.

Service Failure: Any relevant failure or combination of relevant failures during revenue service operations, simulated revenue operations, or during pre-departure equipment status checkouts to determine availability for revenue service, which results in one of the following:

- Non-availability of the train to start revenue service after successful completion of pre-departure checkout.
- Withdrawal of the train from revenue services.
- A delay equivalent to or exceeding 3 minutes from the Schedule / Time table as noted at the destination station for the one way trip.

The discretion of declaring a train as Not-available to start revenue service after successful completion of pre-departure checkout or withdrawing a train from revenue service on account of any relevant failure rests solely with the Engineer and shall be final. The train withdrawal scenario is placed at Appendix TG of ERTS and includes possible anticipated failure scenarios which can affect safety, punctuality and passenger comfort. The train withdrawal scenario defined in Appendix TG shall be considered as a

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service failure irrespective of whether the DMRC is able to withdraw the train or not due to its operational constraints. This list shall be further developed during DLP.

Pattern Failure: Repeated occurrence of three or more relevant failures of the same replaceable part, item or equipment in same manner in identical or equivalent applications when they occur at a rate which is inconsistent with the predicated failure rate of the part, item or equipment.

The detailed methodology for identification of pattern failures shall be finalized during the design stage. The decision of the Engineer shall be final.

6.8.3. Maintainability Requirements

Design requirements

The design of all components will be such that maintenance is reduced to a minimum, substantially improving service intervals and components will be so arranged that those requiring attention are easily accessible, and readily removable. All equipment should be designed using the Least Replacement Unit (LRU) principle whereby the repair of a fault merely involves the replacement of a faulty module.


The design shall also minimize mean time to repair (MTTR) and costs throughout design life. MTTR is the ratio of cumulative time, including the access time expended during a time interval to the total number of relevant failures.

The subcontractor shall also comply with the maintenance requirement of Clause - 2.12 of ERTS.

6.8.4. Maintenance Interval

Maintenance Type	Interval (Service time or Running Distance)
A Service Check	Every 15 days or 6,000km
B1 Service Check	Every 45 days or 18,000km
B4 Service Check	Every 180 days or 72,000km
B8 Service Check	Every 360 days or 150,000 km
Intermediate Overhaul	Every 4 years or 600,000km
Periodic Overhaul	Every 8 years or 1,200,000 km

Preventive Maintenance Interval of FEED should be in compliance with the interval specified in the above table.

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6.8.5. Maintainability Target

1. The LRU replacement should be less than 30 minutes.
2. The mean time to repair (MTTR) of equipment should be less than specified values as follows

Equipment	MTTR (hour)
Front End Emergency Door System	1.5

3. Corrective Maintenance Operation that does not require a car lifting shall be less than 4 hours.
4. Corrective Maintenance Operation that does require a car lifting shall be less than 6 hours.

6.8.6. Master Maintenance schedule

The maintenance schedules shall be provided stating the parts needing attention at the basic service period and for major overhauls.

The subcontractor shall submit work instructions/manuals for all scheduled maintenance activities, fault finding, and corrective maintenance of all faults likely to be found during maintenance and servicing.


The master maintenance schedule should be incorporated in maintenance manual and subcontractor shall provide the relevant chapter reference no in maintenance manual against the each maintenance task in master maintenance schedule.

6.8.7. Life Cycle Costs

The subcontractor shall provide equipment that has minimum total Life Cycle Cost. The subcontractor shall submit Life Cycle Cost calculation in accordance to Clause - 2.21 of ERTS. The Life Cycle Cost which contains preventive and corrective maintenance activities shall be in compliance with the Maintenance Manuals prepared by the subcontractor.

6.8.8. Reliability and Maintainability (R&M) Demonstrations

The reliability demonstration of each train will start after six months of that train in revenue service and will continue till the end of the defects liability period. Reliability of the trains and of the identified major systems will be demonstrated on fleet basis. Accordingly, the subcontractor shall be required to demonstrate compliance with

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specified equipment reliability. During Defects Liability Period, the values of the R&M target shall be calculated from the records of all faults and service failures. In the event that the R&M target is not achieved, the subcontractor shall, at his own expense, take whatever corrective action to meet the R&M target specified, either by way of change of design of the relevant equipment/ component or software modification.

The subcontractor shall analyze and submit detail report to BEML/Engineer for each and every failure/defect of whether of component, sub-system or system to determine the cause of failure and to propose corrective measures, which would be reviewed by BEML/ Engineer.

Root cause analysis of any failure related to FEED system or incidents due to FEED system shall be done by the subcontractor and report shall be submitted to BEML/ DMRC. Subcontractor must submit such analysis report within the time frame defined by the Engineer, for quick resolution of the failure.

Correction shall be made to components or subsystems that either fail to attain predicted reliability levels or show Pattern Failure, at subcontractor's own cost.

At the subcontractor cost, in Depot at Mumbai, in coordination with BEML, the subcontractors shall demonstrate the maintainability for Periodic Overhaul, Intermediate Overhaul, LRU Replacement and Corrective Maintenance with car lifting and without car lifting. The procedures used in the demonstration shall be the same as those included in the manuals delivered. And the subcontractor is required to submit the list of required spares, consumable spares and tools for the Maintainability Demonstration.

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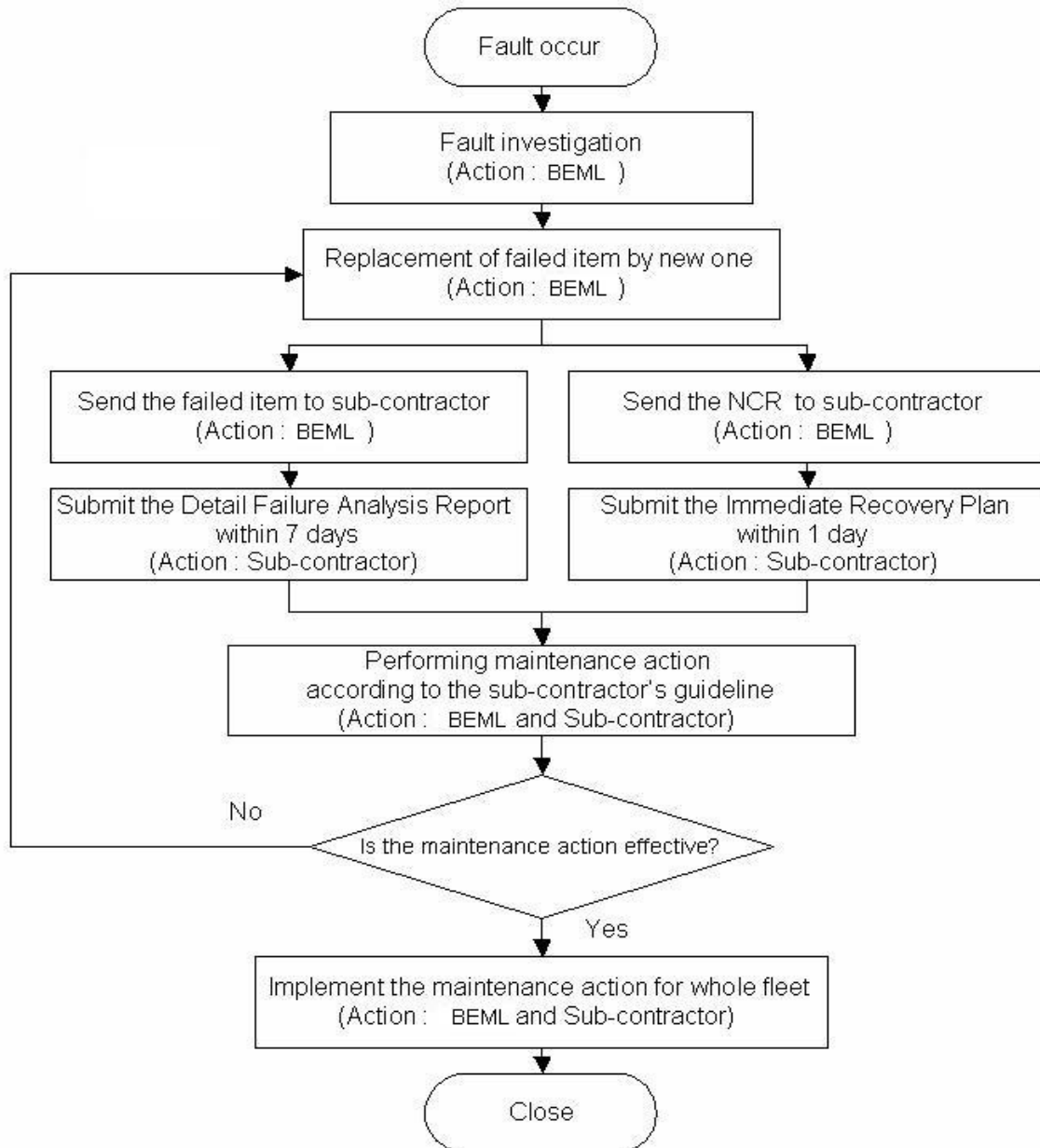



Figure1. Maintenance Procedure of BEML

The subcontractor shall support an active supply for high availability. The Active supply procedure of BEML is same as figure1. Therefore, the subcontractor should comply with BEML's procedure. If some failure needs the subcontractor's support, the subcontractor should depute engineer as soon as possible. Also, if the subcontractor needs some training for BEML's maintenance Engineer, the

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subcontractor shall perform it.

6.8.9. Safety Requirements

The subcontractor shall submit safety assurance plan for FEED. This shall cover design, manufacture, testing, commissioning of the system. This shall also indicate features minimizing the magnitude and seriousness of events or malfunctions, which could result in injury to passengers and damage to the equipment but cannot be completely eliminated.

To meet the safety requirement, the Subcontractor shall submit the following documentations as a minimum.


- 1) System Safety assurance plan as per Clause-2.4 of ERTS.
- 2) Hazard Analysis including preliminary hazard analysis, sub-system Hazard Analysis, operating and support hazard Analysis and interface hazard analysis as per clause 2.5 of ERTS.
- 3) FMECA (Failure Mode, Effects and Criticality Analysis)
- 4) Fault Tree Analysis (FTA) for Safety Critical Events

The subcontractor shall fully compliance with the RAMS (Reliability, Availability, Maintainability and Safety) requirements given in the Clause -2.4 to 2.14 of ERTS.

6.8.10. RAMS Deliverables

The subcontractor shall submit the following RAMS Deliverables.

- 1) System Safety Assurance plan & RAMS during preliminary design stage.
- 2) Product Breakdown Structure during Preliminary Design Stage
- 3) Reliability Analysis with train withdrawal scenarios as per Appendix-TG of ERTS
- 4) Reliability Block Diagram and Reliability Prediction during Pre-final Design Stage
- 5) Hazard Analysis including PHA, Subsystem Hazard Analysis, Operating and Support Hazard Analysis and Interface Hazard Analysis during Pre-final Design Stage
- 6) Preventive and Corrective Maintenance Analysis during Pre-final Design Stage.
- 7) Master Maintenance Schedule during Pre-final Design Stage
- 8) FMECA (Failure Mode, Effects and Criticality Analysis) during Pre-final Design Stage
- 9) LRUs list during pre-final design stage
- 10) Safety FTA during pre-Final design Stage
- 11) RAMS demonstration plan during final design stage.
- 12) Life Cycle Cost Analysis during Final design Stage

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6.9. Fire Safety

6.9.1. General

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 FEED with details of material, applied mass, fire safety compliance (Flammability, smoke, toxicity) and fire load calculations, during the preliminary design phase.

6.9.2. Material Properties

All non-metallic Materials used in the construction of FEED shall be selected to reduce to the maximum extent practical the heat load, rate of heat release, propensity to ignite, rate of flame spread, smoke, emission and toxicity of combustion gases

All non-metallic materials used in the FEED shall confirm to fire safety requirements of EN45545 Part 1 to 7 (Category 4-A, Hazard level HL3) latest editions.

6.9.3. Wiring and Cables(ERTS Clause 12.5)

All wires & cables shall comply to ERTS Clause -12.5.


All wires and cables shall be adequately protected for the maximum design and fault currents and designed for minimum voltage drop.

The insulation of all wires and cables including those used within equipment / subsystem shall be halogen-free flame- retardant and formulated to minimize generation of smoke, noxious emissions and corrosive fumes, in the case of overheating or fire in compliance with EN 45545 Cat-4A& HL3.

Cables shall all comply NF F 63-808 (for low voltages, and NF F 63-826 (for high voltages) or other international standards like EN 50264 and EN 50306 (Part 1 to 4), as approved by the Engineer.

Fire resistant cables shall be proposed for circuits, which should survive for long periods during fire, as per applicable international standards. The cables and wires for door / DCU shall be fire resistant in compliant to EN 50200.

The system adapted to rate cable shall be fully specified for review. All de-rating factors shall be applied, together with the maximum permissible conductor temperature for the particular insulation type. In no case shall the conductor continuous temperature exceed 90°C. The maximum short circuit temperature shall not exceed 250°C. The cable insulation shall be capable of withstanding these

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temperatures.

The minimum cross sectional area of control cables for connections between equipment shall preferably be 1.5 mm². Any deviation from this requirement, in exceptional cases, will be subject to review by Engineer in design stage.

The proposed cables shall be proven on metro Rolling Stock. The subcontractor shall submit the voltage grade, size and type of cable for different applications along with the proposed specification for the cables for review by the Engineer.

6.9.4. 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.

6.9.5. 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

6.10. Quality Assurance Program

6.10.1. General

The subcontractor shall hold ISO 9001/ IRIS certification and shall manufacture the product accordingly. The subcontractor shall submit a copy of ISO 9001 / IRIS

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certification along with the offer. The subcontractor shall monitor and control the Quality systems as per ISO 9001/IRIS guidelines. BEML and/or DMRC's representative may periodically conduct compliance audits of the Subcontractor's Quality management system.

6.10.2. Quality assurance plan

The subcontractor shall submit Quality Assurance Plan (QAP) based on ISO 9001 / IRIS guidelines during the preliminary design phase.

7. Scope of Supply

7.1. General

The subcontractor shall be responsible for the scope of supply of the FEED, which shall comprise, unless specifically excluded, the design, manufacture, testing, delivery, commissioning, integrated testing and rectification of defects during the Defects Liability Period & associated equipment necessary to facilitate operation and maintenance of FEED which includes special tools and testing equipment, spare parts, operation and maintenance manual and training.


Note : If any special tools/equipments are required for installation of FEED onto carbody, the subcontractor shall supply 3 sets of such equipment at his own cost.

The Subcontractor shall meet the system technical requirements for FEED in accordance with ERTS and ERGS, as a minimum.


7.2. Hardware

Subcontractor shall provide all components related to FEED, but not limited to, the following.

- 1) Door operating mechanism
- 2) Door leaf Assembly complete including windscreen glass
- 3) All round boundary of door panel shall be sealed by the rubber profile for water and air tightness.
- 4) Door leaf exterior cover material & colour shall be same as cab mask. Door leaf interior finish shall match to cab interior colour. Details of cab mask material will be furnished to the subcontractor during detail design stage.
- 5) Emergency Door Windscreen glass: Emergency Door Windscreen glass shall be identical as that of the carbody Windscreen glass. Design Details will be finalised during design stage.

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- 6) Pivoting plate, if required, to cover any small gap, if exists, between the support structure and ramp.
- 7) Service proven opening/ closing mechanism to control the opening/ closing of the ramp.
- 8) Ramp with anti-slip material and with full length longitudinal handrails and fluorescent material marking on both sides.
- 9) Suitable supports to support the Ramp on the track and to ensure no tilting of the ramp on straight and on curved sections.
- 10) Service proven locking system.
- 11) Service proven Door/Ramp locked/closed switches.
- 12) Manual stowage handle -1 no. for each FEED
- 13) One no. Portable battery power operated device for stowage for each trainset.
- 14) Support step/Foot step/Flap shall be provided at the end of ramp to guide the passengers to the ground level during emergency evacuation by considering interface with the curved rail.
- 15) Emergency door opening handle with breakable cover
- 16) Detrainment light
- 17) Alarm device
- 18) Emergency manual override device.
- 19) Dummy covers : During UTO mode, Emergency detrainment door ramp (in folded condition) shall be suitably covered from inside of driving console by dummy covers
- 20) Electrical relays/ sensors
- 21) Grease for FEED Lubrication
- 22) Tools and Jigs required for door setting.
- 23) Installation jig for FEED on to the carbody
- 24) Relevant quality stainless steel hardware such as bolts, nuts, spring washers, plain washers and other items required for installation of FEED.
- 25) All types of shims both metallic and non-metallic required for installation of FEED. Subcontractor to note that use of shims during installation or commissioning or adjustments shall not be acceptable, however if unavoidable use of shims shall be restricted to minimum which shall be discussed during design stage and is subject to the approval of DMRC
- 26) All mating connectors between Emergency door system and car body.
- 27) Cable insulation sleeve – Wires/cables routed shall be protected with Fire safe insulation sleeves to protect the cables from direct metal contact .
- 28) All required contacts/pins, lugs, Tools for carbody side wiring.

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- 29) Dust protective caps for unused slots / connector .
- 30) The transient current source (coil, magnet valve, contactor, relay and etc), the suppressor shall be included.
- 31) All cable terminations shall be of the crimped type and soldered connections shall not be used.
- 32) Fire retardant heat shrinkable Cable markers shall be provided for the Emergency door internal wiring. Also fire retardant heat shrinkable Clear Sleeves shall be provided over the Cable marker for avoiding fading of the cable marking.
- 33) Minimum cable size is 1.5mm. If the used cable size is less than 0.5mm, the Subcontractor shall supply the ferrule and/or sleeve.
- 34) A minimum of 10 percent spare terminals shall be provided on each connector or terminal assembly.
- 35) Equipment side connectors for Di-electric test - Subcontractor shall supply one full set of Terminal blocks/connectors and its contacts as mounted on the equipment to carry out vehicle level voltage withstand test at BEML factory. Detailed list shall be decided and finalised before first supplies.”
- 36) Necessary special tools if proposed during design stage by DMRC shall be designed and submitted by subcontractor
- 37) Any other item deemed essential by the subcontractor, for installation & proper functioning, testing, commissioning and integrated testing of the FEED.
- 38) Complete FEED system shall be in ready to fit condition.


7.3. Supply for Simulator (ERGS Clause 8.13)

The subcontractor shall supply all necessary hardware and software along with suitable jig for mounting FEED system for the Driving Simulator and Maintenance Simulator Modules as per Clause 8.13 and Appendix 9 of ERGS.

The subcontractor shall assist / provide all the necessary details required for making maintenance simulator and CBT. Subcontractor shall provide the required documents and drawings of Driving Simulator and Maintenance Simulator Modules, as per the time schedule defined by BEML. The drawings and documentation shall be reviewed and approved by BEML/DMRC.

7.4. Supply for Mock-up

BEML has to supply to DMRC, one no. of Carbody mock-up as per the requirements of clause 6.4 and Appendix-TB of ERTS. Accordingly, the subcontractor shall supply one no. of fully functional Front End Emergency Door System for Carbody Mock-up activity of BEML. The mock-ups shall clearly demonstrate the proposed design and following

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details, as a minimum:

- (i) Front visibility and aesthetics
- (ii) Security when stowed.
- (iii) Method and force required for deployment of folding ramp and handrails to track level and use for evacuation of passengers to track level
- (iv) Method of returning to the stowed position.
- (v) Flood lighting & CCTV coverage of infrastructure including track, OHE & detrainment process.

The Subcontractor shall provide the 3D model of Front End Emergency Door System components in STEP file format for 3D engineering carbody mockup activity of BEML.

The Subcontractor shall carry out any minor modification as suggested by DMRC, during mockup activity.

7.5. Supply of Spares

The Subcontractor shall supply the following items of spares, complying with Chapter-8 of ERGS (i) Unit Exchange Spares (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 FEED.

Subcontractor shall provide the list of equivalent indigenous consumables and spares with all relevant technical specifications and any other details as required.

The subcontractor shall supply the following, as a minimum.

7.5.1. Mandatory Spares

The subcontractor shall supply Mandatory spares as per Clause-8.4 of ERGS, as a minimum, the following items:

Sl. No.	Description	Unit	Qty in units
1	Emergency door	No.	5
2	Emergency door operating mechanism	No.	5
3	Set of sensors/switches of emergency doors	Set	5
Miscellaneous items			
4	Set of all Hardwares -	Set	10

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	mounting bolts, washers etc. for door		
5	Windshield glass	Trainset	14

Please note 'Train set' above means items and quantity required for ' 6-car unit' and 'set' means as used in '3-car unit'.

Apart from the above, the subcontractor shall recommend and supply other spares, deemed essential by them, for the proper functioning, operation and maintenance of the FEED. The list shall be submitted along with the technical offer

7.5.2. Intermediate Overhauling Spares for 5 trainsets of 6 car

During the Contract period Intermediate Overhauling (IOH) of certain number of trains shall also become due. Subcontractor shall supply the overhauling kits for these train sets. Overhauling kits for all those equipment, systems, sub-systems of FEED that will need overhauling during intermediate overhaul of the train shall be included in these kits. The subcontractor shall submit the list of items in such kits and the details alongwith the technical offer.

Sl. No.	Description	Unit	Qty in units
1	Kit for overhauling of door operating mechanism	train set	5

Please note 'Train set' above means items and quantity required for ' 6-car unit'


7.5.3. Recommended Spares

Subcontractor shall recommend and supply spares which are not covered under consumables and mandatory spares but are expected to be required during two years after expiry of defect liability period, as recommended spares, as per ERGS 8.5. The list shall be submitted along with the technical offer.

7.5.4. Warranty

The major spare parts ordered under the Contract shall be manufactured, works tested and inspected in accordance with the relevant quality system, suitable packed and labeled in accordance with the Chapter-13 of ERGS and delivered. All spares shall be subject to inspection by BEML. In the event that any item is known to be going out of production, then the subcontractor shall give advance notice to BEML.

The warranty period of unit exchange, mandatory and overhauling spares, special

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tools, testing and diagnostic equipment, special jigs, fixtures and gauges, or any other item/equipment delivered shall be

- a) either 24 months from the date of acceptance, or
- b) up to expiry of the defect liability period of trains whichever is later

7.5.5. Commissioning and DLP Spares & Technical support

The subcontractor shall supply commissioning and DLP spares as per Clause-8.11 of ERGS.

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 this own cost, throughout the installation, erection, commissioning and defect liability periods, stocks of spare parts, as per the list to enable rapid replacement of any item found to be defective or in any way in non-conformance with the specification.

Spares as per the agreed list shall be supplied at least three months before receipt of first FEED.

Subcontractor shall also provide technical support through permanent positioning of his staff at Depots for meeting DLP obligations as per ERTS 3.2.5. During DLP period, if door setting adjustments are required to be done, it shall be done by subcontractor's experienced staffs. All such settings shall be recommended by subcontractor.


7.6. Design Submission and Deliverables (ERGS Clause 5.1 and 5.5.3)

7.6.1. General

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.

These drawings and documents shall be delivered in English with the data format of, respectively, latest AutoCAD(2015) release. (Document - MS Word, spread sheet - MS excel, data base files - MS Access, Presentation file - MS Power Point).

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The drawings shall contain minimum of three (3) views (for example, front view, top view and left side view). The subcontractor shall provide STEP/IGES (Neutral format) file or CATIA file of 3D model of all FEED components & 2D drawings to BEML for preparing engineering mockup.

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/ DMRC.

The subcontractor shall submit all necessary documents viz., documents and drawings describing function description, product description, data sheets, simulations, 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.

It is subcontractor's responsibility to provide sufficient support and information for obtaining "No Objection Advice" for design document pertaining to subcontractor in accordance with ERTS and ERGS. Failure to submit such deliverables in time by subcontractor may attract Liquidated Damage as defined in GTC.


The Design Phase will be undertaken in three stages:

- a) Preliminary Design
- b) Pre-final Design and
- c) Final Design.

Sl. No	Description of Stage	Submission from subcontractor to BEML (from LOI / contract award)
1	Preliminary design completion including DMRC approval	1 month
2	Pre final design completion including DMRC approval	3 months
3	Final design completion including DMRC approval.	6 months

The design details for the above 3 stages shall comply with the requirements of clause 5.7, 5.8 & 5.9 of ERGS.

Design calculation, Design reports, Design drawings and deliverables, as per the requirements specified in Chapter-5 of ERGS, but not limit to, the following design

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deliverables to BEML according to the time schedule defined by BEML.

All the design drawings shall be submitted in 3-D format and shall be openable and editable in solid works latest version. The same shall be applicable to As Built Drawings (ABD) while submitting the approved version of drawings.

Details of 3-D files shall be of the following but not limited to,


- 1) Visualization of BOM (Bill of Materials) of equipment up to the level of LRU & SRU
- 2) Views of all Components covering all the Recommended preventive as well as corrective maintenance of the OEMs.

7.6.2. Design Deliverables


The format for drawings and documents shall comply with requirements specified at Clause 5.3. of ERGS.

The following shall be supplied, as a minimum.

Stage	Document/Deliverable	Submission and approval
Tender offer	Supporting documents for vendor Qualification criteria as per Cl. 4.	Along with tender technical offer
	Vendor approval documents including QAP, ITP, company profile with infrastructure facilities, product range, manufacturing facility credentials, etc., as per Cl. 4.	
	General Technical Description of proposed FEED including door operation, sealing arrangements, Deployment / stowage timings and Ramp operation details, Electrical, sound insulation & thermal insulation details and concept drawings.	
	Estimated weight of FEED (refer Cl. 6.5)	
	ERGS, ERTS & PTS clause by Clause compliance	
	Project Management Plan	
	Copy of SIL2 Certificate of similar doors of previous projects	
	Spares technical offer including recommended mandatory spares, recommended consumable spares and recommended special tools, jigs and	

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	fixtures.	
	BOM as per Cl. 6.4.12.	
Preliminary Design Review (PDR)	General System Description of proposed FEED	Within 1 month of LOI/ contract award, submission and further updates including BEML/ DMRC approval
	Preliminary design Drawings (Dimensional Installation Drawings: Autocad or CATIA file)	
	Interfacing with carbody and other systems	
	Interfacing with TCMS & other electrical systems	
	List of standards and codes	
	RAMS documents as per Cl. 6.8	
	Fire safety plan	
	Quality Assurance Plan	
	Noise and Vibration plan	
	Inspection, Testing and commissioning Plan	
Pre-Final Design Review(PFDR)	General Assembly, Installation and detail Component drawings of FEED in Autocad, CATIA & Solid works.	Within 3 months of LOI/ contract award, submission and further updates including BEML/ DMRC approval
	Preliminary/Final 3D model of FEED	
	Technical Description of proposed FEED with functional description, detailed technical data sheets, simulations, calculations, etc., of the system and sub-systems.	
	Supply of one copy each of the standards and codes (refer Cl. 6.2)	
	Fire safety Test Reports of the items including heat release rate for standard items common with other projects of the subcontractor	
	RAMS Deliverables as per Cl. 6.8	
	Preliminary test plan for FEED & sub-systems	
	Preliminary outline of 6 types of manuals & Electronic manual	
	Detailed Training proposal	
Final Design Review(FDR)	Final Design Drawings (Dimensional Sub-assembly drawings: Autocad , CATIA & Solid works)	Within 6 months of LOI/ contract award, submission and further updates including BEML/
	Type Test Procedure (incl. record sheet) & Report	
	Routine Test Procedure (incl. record sheet)	

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	& Report	DMRC approval
	FAI Procedure & Report	
	Fire Safety Test Reports including heat release rates	
	Final List of Spares, Special Tools, Test Equipment	
	Draft and final of 6types of manuals & Electronic manual	
	Final Simulator modules	
	RAMS Deliverables as per Cl. 6.8	
	Training Manuals & Materials	
	Type test reports & FAI reports	
	As-Built Drawings(Final drawings) of each part of door system in Autocad, CATIA & solid works.	
All stages upto DLP	Design progress report	Upto DLP
	All PFDR & FDR design deliverable submission with updation based on type tests at unit level, car level, train level at subcontractor's place, BEML factory, depot and mainline, upto the satisfaction of DMRC.	
	Open items list	
	Waiver request/Spec. Clarification items	
	Any other design data requested	
Note: Over and above mentioned documents, subcontractor shall submit any additional documents required by BEML,DMRC.		

BEML will review the submission of subcontractor's design submissions and will furnish review comments in writing or on marked up drawings and specifications to the subcontractor. Within one week of the receipt of comments, the subcontractor shall submit his proposals for implementation in the next submission. Once the design submission is acceptable to BEML, it will be submitted to DMRC for approval and it will be reviewed by them. Subcontractor shall re-submit the revised document incorporating DMRC comments issued during first review within one week. Subcontractor shall submit requested documents/drawings during approval process within one week from each request.

Subcontractor shall establish the project schedule (including design completion schedule) by considering this review turnaround time.

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In the event that the submission is rejected, the Subcontractor shall improve the design to the acceptable completion level and resubmit it for review within one week. Any adjustments in design activities to recover the lost time due to the re-submission shall be the full responsibility of the Subcontractor and shall submit the catch-up plan for no schedule impact.

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 FEED shall be met, to the requirements of ERTS Chapter-14, as a minimum.

The subcontractor should take whole responsibility for occurring Liquidated Damage due to delays with regard to design data submission, production, supply, design error and so on.

The design, hardware & interfaces proposed/agreed during design will be subjected to review and updating /rectification/modification etc. during DLP based on the operational, maintenance reliability or safety requirements and generally in accordance with the subcontractor's proposals. In specific cases, the Engineer may issue specific instructions in writing for undertaking the modifications to meet the above requirements. In such cases, the Engineer instructions shall be implemented as instructed. The contractor shall abide by the Engineer's instructions without any additional cost.

7.6.3. Engineering Support

Subcontractor shall depute mechanical and electrical engineer(s) for following activities to BEML/ DMRC

The subcontractor shall provide sufficient staffs and equipments to be able to present designs and conduct design review meetings and assist in other technical and administrative matters whenever/ how long required. Following meetings need to be attended during design approval and testing.

- PDR meeting
- PFDR meeting
- FDR meeting
- Testing and commissioning at Factory, Depot & Mainline

7.7. PTS, ERTS & ERGS Compliance

The subcontractor shall offer a valid and fully compliant proposal for the FEED as detailed in ERGS, ERTS and PTS. The subcontractor shall submit compliance report for all the clauses of ERTS, ERGS and PTS with regard to FEED.

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The subcontractor shall submit, along with the technical offer, the Clause by Clause Compliance for the ERTS, ERGS and this PTS as follows:

- Complied: "Complied" shall be indicated by the subcontractor where the subcontractor is able to comply with the clause.
- Noted: Where a clause merely provides information.

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

7.8. Operation and Maintenance Manuals(O&M Manual)

The subcontractor shall provide Operation and Maintenance (O&M) manuals, for use by supervisory, operating and technical staff of the DMRC, in English language conforming to Chapter -12 of ERGS.

The O&M manual must provide the all essential operating and maintenance information to a level of detail that enables DMRC staff to operate, test, maintain, overhaul and repair the equipments to meet the specified performance requirements. The information contained within the manual shall comprise text, tables, technical illustrations and diagrams structured. It is the responsibility of the subcontractor to provide the required level of information for all sub-systems and equipment within its scope of supply. The subcontractor shall supply the following types of manuals.

Volume I : Technical Manual

Volume II : Operation Manual

Volume III : Maintenance Manual

Volume IV : Faults Diagnostics Manual

Volume V : Spare Parts Manual


Volume VI : Special Tools and Test Equipment Manual

All the details specified in chapter-12 of ERGS shall be covered in detail in the above volumes.

7.8.1. Electronic manuals

The Subcontractor shall provide manuals in electronic format. This is in addition to the submission of manuals in hard copies.

The Electronic Manuals supplied shall conform to Clause 12.4 of ERGS

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The format of the electronic copies shall be proven in at least two other applications and shall allow for links between parts catalogue and maintenance instructions.

The Documents Management System (DMS) shall be PC based, menu driven and user friendly with extensive linkages between OEM's documents, spare parts catalogues, test certificates, HECPs (Hardware Engineering Change Proposal)/SECPs(Software Engineering Change Proposal) etc. The DMS to be used shall be demonstrated and approval of the BEML/DMRC shall be obtained. After Taking Over Certificate, one copy of the DMS, fully functional shall be handed over. The subcontractor shall however keep another set updated and handover the second set to the Project Owner/Employer one month before the expiry of DLP.

7.8.2. Manuals Deliverables

During Final design stage, the subcontractor shall provide one(1) electronic copy of each of the seven types of manuals for BEML/DMRC review. After receipt of review comments, the revised manuals shall be submitted within 2 weeks.

The final approved manuals shall be delivered during final design stage.

The Subcontractor shall provide one(1) original and Five(5) colored copies each of the final manuals, as well as in electronic format.

7.9. Training


The Subcontractor shall comply with, but not limited to, the following requirements.

To ensure the successful operation and maintenance of the aggregates, the subcontractor shall provide a complete and comprehensive training program covering operation and maintenance of the delivered equipment, to BEML/ DMRC's operating and maintenance personnel, in accordance with Chapter-9 of ERGS.

The subcontractor shall impart the following training for the Project Owner's/Employer's operating/ maintenance personnel.

1. Training of Project owner's Driving instructors and Drivers at depot by OEM experts: 5 man days.
2. Training of Project Owner's/Employer's maintenance personnel in Subcontractor's works and at BEML/ depot by OEM experts: 10 man days
3. Deputation of OEM's Experts for Training of Project Owner's maintenance personnel in depot: 10 man days.

The subcontractor shall submit a Detailed Training proposal including training requirements, objectives, training methods, training aids and training material for BEML/DMRC approval during pre-final design stage.

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Training imparted shall be effective so as to meet the training objectives at Clause 9.2 and 9.3 of ERGS and the trainees who have completed the course are able to achieve the objectives, i.e. to understand the overall system of equipment and to be familiar with operation and maintenance of the equipment.

The training methods employed shall be on a “two-stage” concept inline with clause 9.4 of ERGS i.e. both Class room (theory) training and hands-on practical training so as to enable the trainees to develop skill and expertise necessary for satisfactory Operation, maintenance, repairs and overhaul of the equipment.

The training schedule, time and location shall be according to the requirement of BEML/DMRC.

During the training period, the subcontractor shall provide to the trainees the required training aids and training material. After completion of the training, training aids and materials used shall become the property of BEML to enable further training to take place.

The subcontractor shall provide training manual in one original, 5 colored copies and 2 Nos. electronic interactive format. All the information shall be in English.

8. Testing and commissioning


8.1. General

- The subcontractor shall submit Inspection, Testing and Commissioning Plan according to the requirements specified in Clause-7 of ERGS and Chapter -15 of ERTS during the preliminary design stage.
- Individual cars and complete trains will be type and routine tested in accordance with IEC 61133.
- The FEED and it's sub-systems shall be type- and routine-tested in accordance with detailed respective test procedures to be drawn up by subcontractor and agreed by BEML/DMRC which shall take into account the requirements of respective IEC standards, other international standards, special tests specified in ERTS Chapter-15 and this PTS and test programme drawn up by the subcontractor to demonstrate that the individual equipment, sub-systems and systems meet the specified technical requirements. The test plan shall be approved by BEML/DMRC.
- All such tests shall be carried out at the subcontractor's cost, wherever performed, in the presence of and to the satisfaction of BEML/DMRC, who reserves the right to witness any or all of the tests.
- Wherever any equipment, system or sub-system is not specifically covered by an internationally recognised specification or test procedure, or where the type and routine tests prescribed by IEC or other international standard do not adequately cover the requirement, tests which are acceptable both to the

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subcontractor and to BEML/DMRC, shall be devised.

- Type tests for certain equipment may be waived if these were carried out earlier on equipment of identical design, witnessed by a reputed organisation, and the service performance of such equipment was found to be reliable. The subcontractor shall submit a proposal in this regard to BEML/DMRC for review. The waiver of Type Test is entirely at the discretion of BEML/DMRC.
- Change of manufacturing place may require re-type test.
- BEML /DMRC reserves the right to witness any or all of the tests, and to require submission of any or all test specifications and reports. BEML/DMRC reserves the right to reasonably call for additional tests as are considered necessary, including the quality of welds particularly in highly stressed areas, by nondestructive testing methods. BEML/DMRC may, if considered necessary, call for conducting optional tests as per relevant standards without any additional cost to BEML/DMRC. In case of repetition of tests, as decided by BEML/DMRC, entire cost including that of BEML/DMRC representative(s) shall be borne by the subcontractor.
- The results of all tests shall be submitted to the BEML/DMRC, who will record his conclusions as to whether or not the equipment being tested has passed satisfactorily.
- The Subcontractor shall be responsible for undertaking and passing all necessary testing activities for FEED.
- **All tests essential for Safety Certification and technical clearance of Metro systems by CMRS shall be carried out for FEED by the subcontractor and test reports as per the format insisted by CMRS shall be submitted. The guidelines specified in “Procedure for Safety Certification and Technical Clearance of Metro systems” (refer pg. 000606 of ERGS/ERTS), shall be complied with.**
- Prior to the start of testing, BEML & DMRC shall have all approved test plans and procedures for the test and all relevant prerequisite testing shall have been completed by subcontractor.
- Type test of FEED at train level will be responsibility of subcontractor. Subcontractor shall depute their engineers to conduct the vehicle level type test at BEML factory and Depot at Mumbai/Mainline for testing as per schedule prepared by BEML’s project management team.
- Subcontractor shall arrange all necessary tools & instruments for relevant Vehicle/ train level type tests.
- If there is a problem during testing & commissioning, the subcontractor should depute his engineer to solve the problem within 24 hours of BEML’s request to do so.
- All test & inspection specifications and reports including all repair activities and check-lists shall be submitted to and approved by BEML/DMRC and end-user.

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8.2. Test Planning & Procedure

The subcontractor shall submit detailed test procedures for each of the equipment/subsystem/system for the review of BEML/DMRC during final design stage. The plan test procedures shall include the following information:

- (i) Relevant specification applicable to each of the tests.
- (ii) Type, routine and special tests to be carried out.
- (iii) Description of the tests, scheduled dates, and locations of the tests.
- (iv) Test parameters to be measured.
- (v) Constraints to be applied during the test.
- (vi) Defined pass/fail criteria
- (vii) Facilities, equipment, and test and measurement tools.


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.

BEML/DMRC shall have the facility to monitor all tests and have access to all test records. Ample time shall be allowed within the testing programme for necessary alterations to equipment, systems and designs to be undertaken, together with re-testing prior to final Commissioning.

For each of the identified tests, the subcontractor shall produce a test report, in three copies, and in an approved format, within an agreed period following the test, for acceptance by the BEML/DMRC. The subcontractor shall sign all reports of Tests. The BEML/DMRC reserves the right to reasonably call for additional tests if considered necessary.

8.3. Test Reports

- 1) All test reports of the component, system, factory and field acceptance test for FEED shall be prepared by the subcontractor and they shall be submitted to BEML/DMRC. 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.
 - (e) The test results for each test including a Passed / Failed indication
 - (f) Identification of the Subcontractor's test engineer

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(g) Action and the result of the action for comments by the Engineer

(h) Copies of any deficiency reports generated as a result of the execution of the correction.

- 2) Written reports of all tests performed shall be submitted within 2 weeks of test performance to BEML/DMRC for acceptance.
- 3) Records of all inspection and testing shall be kept completely by the Subcontractor and available to the Engineer during the performance of this contract and for a minimum of ten (10) years after expiration of the warranty period.

8.4. Submittals


The Subcontractor shall submit test documentation to BEML/DMRC, including but not limited to, the followings:

- 1) Inspection and test plan during the preliminary design stage. This plan/schedule is required to keep updating to the latest one until each test report is approved.
- 2) Preliminary Test plan for System and each sub-system for BEML/DMRC acceptance at the Pre-final Design stage
These plans shall list the tests required to fully verify that the System meets all functional, safety, and performance requirements.
- 3) Detailed type test and Routine Test plan and procedure with report format for System and each sub-system for BEML/DMRC approval at Final Design Stage..
Whenever it is revised, it shall be updated to the latest progress status.
- 4) Test Report : All test reports shall be certified and signed by an approved member of the Subcontractor's staff. The subcontractor shall prepare and submit a separate deficiency report, if there is a problem during tests.

8.5. Equipment Type Tests & Routine Tests

The FEED shall be type and routine tested in accordance with relevant standard and specifications at subcontractor's works.

The subcontractor shall carryout the following type tests and routine tests, as a minimum and shall submit the reports.

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Test	Type Test	Routine Test
1. Load and Evacuation test	O	—
2. Endurance Test	O	—
3. Shock & Vibration Test	O	—
4. Noise Test	O	—
5. Fire Safety Test	O	—
6. Operation(Function) Tests	O	O
7. Weight Checking	O	O
8. Water Tightness Test	O	O
9. Door leaf exterior cover & Windscreen glass	O	—
10. Visual Inspection	O	O
11. Dimensional Inspection	O	O
12.SIL testing	O	—

8.5.1. Load and Evacuation test

The FEED shall withstand load 500kg/m² or more and it shall not sag/out of shape during evacuation process.

8.5.2. Endurance Test


The door/detrainment arrangement shall not deform after loading and unloading cycles with equivalent load of passengers in 6 car train/8 car train, for a minimum of 200 cycles.

8.5.3. Shock & Vibration Tests

Shock & Vibration test shall be carried out as defined in IEC 61373 and shall comply with the requirements for Category 1 class A.

8.5.4. Noise test

Sound reduction index Rw of the door panel assembly measured as per ISO 10140-2 shall be equal to or greater than 32 dBA.

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8.5.5. Fire Safety Test

All non-metallic components in the FEED system shall meet fire safety requirements as per category HL-3 of EN 45545. Fire safety test reports shall be submitted.

8.5.6. Functional Tests

The subcontractor shall carry out the functional tests to demonstrate the proper functioning of the FEED system. Also, emergency operation mode complete deployment shall not take more than 1 minute and also the stowing shall not take more than **3 minute**. However, deployment and stowage timings will be reviewed by the Engineer.

8.5.7. Water Tightness test

The water tightness test shall be carried out as per clause 4.10.2 of EN 14752 with continuous water spraying for a duration of 15 minutes. Acceptance criteria as per EN 14752 shall be complied with.

8.5.8. Door leaf exterior cover & Windscreen glass.

The requirements for these items shall comply with the testing requirements for cab mask and side windscreen glass of carbody.

8.5.9. Visual inspection

Visual inspection shall be done for 100% of the supplies. There shall be no cracks, damages or any other defects.

8.5.10. Dimensional inspection

The dimensional inspection shall be carried out for 100% of the supplies and test reports shall be submitted.

8.6. First Article Inspection (FAI)

The subcontractor shall offer the first set of FEED for First Article Inspection by BEML/DMRC in accordance with the Engineer approved FAI plan prior to serial production in order to confirm that the item produced fully complies with the technical specifications, System design and manufacturing process.

The Subcontractor shall ensure that the produced 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 Engineer's witness.

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At the FAI, the subcontractor shall make available all pertinent design and manufacturing process documentation, test records, material certifications, etc.

During FAI, 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 at their own cost, as necessary to correct the noted deficiencies. After correction of deficiency, all tests necessary to verify the effectiveness of the corrective action shall be repeated.

If FAI has to be repeated due to non-compliances/ deficiencies noticed, the cost towards the same and the cost towards BEML/DMRC visit to subcontractor's place for witness of re-FAI shall be to subcontractor's responsibility.

Upon acceptance of the FAI by End User, the subcontractor is then free to proceed to manufacture all pertinent hardware. The hardware must meet or exceed the quality standards set at the FAI, and must incorporate any comments made by End User at the FAI.

Subcontractor shall note that the Engineer's FAI clearance will not relieve the subcontractor's responsibility towards design, production, quality, reliability, availability, maintainability and safety of the systems and sub-systems during the revenue service.

8.7. Installation and Commissioning


After the FEED are delivered, the subcontractor shall depute his Engineer to BEML/ depot for the installation and commissioning of the FEED on the first two train sets.

Modifications/ corrections, if any, shall be carried out by the subcontractor at his own cost.

8.8. BEML Factory Tests

8.8.1. Type Test, Completed car, unit and train tests

The individual cars and complete trains will be type tested by BEML under subcontractor's responsibility for FEED in accordance with IEC 61133, vehicle to demonstrate that the principal features of the FEED are compliant with the ERGS and ERTS. The subcontractor shall participate in this testing to ensure that the FEED meet the performance requirements specified in the contract and do not introduce any adverse effects into the train. The subcontractor shall be responsible for correcting any interfacing defects. The subcontractor shall carryout hardware/ software modifications, if required, at his own cost.

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8.8.2. Routine Test, Completed Car, unit and train tests

The individual cars and complete trains shall be routine tested by BEML under subcontractor's responsibility for FEED test in accordance with IEC 61133. The subcontractor shall be responsible for correcting any interfacing defects.

These tests will be a subset of those tests performed at Type Test, complete vehicle to demonstrate that the principal features of the FEED are compliant with the ERGS and ERTS. This test shall include but not be limited to a test of all safety system.

8.9. Static and Dynamic Commissioning test

8.9.1. Type Commissioning Test , complete car, Unit and train tests

The Type commissioning Test for the FEED and Folding Ramp at the vehicle level shall be performed, with all necessary test equipment prepared by the subcontractor, at BEML Factory or at Depot/Mainline by the subcontractor. And the test shall be conducted in accordance with a test procedure to be prepared by the subcontractor and approved by BEML under BEML and/or DMRC participation.

The subcontractor shall submit the type commissioning test details for FEED and Folding Ramp of complete vehicle and be responsible for correcting any defects.

The subcontractor shall demonstrate safe use of the FEED and Ramp in the elevated and tunnel section on different radius curves specified in the specifications. Hardware modifications, if required, shall be carried out by the sub-contractor, at his own cost.

8.9.2. Routine commissioning Test, Complete Car, Unit and Train Tests

The Routine Test at the vehicle level shall be performed at BEML Factory/ Depot/Mainline on the basis of information and with the necessary test equipment offered from subcontractor, by BEML under subcontractor's assistance for the FEED and Folding Ramp.

The subcontractor shall be responsible for correcting any defects.

These tests will be a subset of those tests performed at Type Test, complete vehicle to demonstrate that the principal features of the FEED and Folding Ramp are compliant with ERGS and ERTS attached in this PTS.

8.9.3. Vehicle level Noise Test

BEML will undertake Type Tests on the trains to demonstrate that the Noise levels of the car interiors are within the specified limits of the requirements of ERTS and ERGS.

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The trains are being supplied to two lines of Mumbai Metro viz., Line-2 & Line-7. Accordingly, the mainline tests will be carried out in both the lines.

The subcontractor's design engineer shall also participate in this testing to ensure that the FEED meet the performance requirements specified in the contract. Modifications, if any, required to the FEED sealing, to meet the train level contract requirements, shall be carried out by the subcontractor, at his own cost.

9. Warranty (Defect Liability)

As per ERGS Clause 1.8 and GTC (General Terms and Conditions).

10. Appendices

1. Employer's Requirement General Specification (ERGS)
2. Employer's Requirement Technical Specification (ERTS)
3. Vendor Approval form
4. Technical offer Submittals Check List
5. Door interface drawing GR-4155

11. Submittals with Technical Offer

The Subcontractor shall provide as a minimum, the following along with the technical offer. The submittals check-list as per Appendix-4 of this PTS shall also be submitted.

1. General Technical Description of proposed FEED including door operation, sealing arrangements, deployment and stowage timings and ramp operation details, Electrical, sound insulation & thermal insulation details and concept drawings.
2. Supporting documents for Qualification Criteria compliance.(Clause 4)
3. Vendor approval Documents including QAP, ITP, company profile with infrastructure facilities, product range, manufacturing facility credentials etc.,(Clause 4) as per Appendix-3 format
4. Clause-wise comments against the ERTS, ERGS & this PTS Doc (Clause 7.7).
5. Spares technical offer along with list (refer Clause 7.5)
6. Project Management Plan and CV's of the personnel of the team (refer Clause 6.7)
7. BOM (refer Clause .6.4.12)

Date:

Proforma No: MRS1/BEML/V.NNO/CAT- __/____/M/____

CHECKSHEET FOR SUBMISSION OF DOCUMENTS FOR NOTICE OF NO OBJECTION FOR SUB-CONTRACTOR/VENDOR FROM DMRC			
ITEMS:			
Category	A	Items manufactured outside India and proposed to be used in all MRS1 trains.	<input type="checkbox"/>
	B	Items manufactured outside India and proposed to be used in all MRS1 trains but likely to be localised after some part quantity from OEM (shall be declared by BEML).	<input type="checkbox"/> Equivalent Localisation Quantity : __ Trainsets
	C	Locally manufactured items proposed to be used in all MRS1 trains.	<input type="checkbox"/>
1	Proforma for Submission of documents		<input type="checkbox"/> YES <input type="checkbox"/> NO
2	Vendor Details	Annexure-I	<input type="checkbox"/> YES <input type="checkbox"/> NO
3	Sub-Vendor Detail	Annexure-I	<input type="checkbox"/> YES <input type="checkbox"/> NO
4	Certificate from BEML	Annexure-II	<input type="checkbox"/> YES <input type="checkbox"/> NO
5	Copy of technical purchase specification of BEML		<input type="checkbox"/> YES <input type="checkbox"/> NO
6	Inspection and Test Plan		<input type="checkbox"/> YES <input type="checkbox"/> NO
Note:	1	Incomplete documents will not be reviewed by DMRC.	
	2	Items used in DMRC's existing rolling stock do not automatically qualify for use unless specifically approved by DMRC for this project.	
<div style="display: flex; justify-content: space-between;"> (BEML Limited) _____ (Proposed Vendor) </div>			

Date:

Proforma No: MRS1/BEML/V.NNO/CAT- __ / ____ /P1/ ____

**PROFORMA FOR SUBMISSION OF DOCUMENTS FOR NOTICE OF NO OBJECTION FOR SUB-CONTRACTOR/VENDOR
FROM DMRC**

1	Item description				
2	Vendor particulars along with proposed manufacturing unit submitted in Annexure-I	<input type="checkbox"/> YES <input type="checkbox"/> NO			
3	Technical Specification & Inspection Plan	—			
3.1	Enclosed copy of Technical Purchase Specification of BEML	<input type="checkbox"/> YES <input type="checkbox"/> NO			
4	Details of experience/ satisfactory performance to establish compliance with ERTS 3.2.2.				
The Information shall be submitted in following format:					
S.No.	Mass Rapid Transit System where proposed sub-system/equipment/component has been used	Country	Quantity Used	Period in satisfactory Revenue Service [from/to] (Min 3 yrs in each MRTS)	Manufacturing Unit
	1	2	3	4	5
1	1				
	2				
	3				
2	1				
	2				
	3				
3	1				
	2				
	3				
4	1				
	2				
	3				
4.1	Based on above, is the proposed item compliant with ERTS 3.2.2				<input type="checkbox"/> YES <input type="checkbox"/> NO
4.2	Is the proposed manufacturing unit compliant with ERTS 3.2.2				<input type="checkbox"/> YES <input type="checkbox"/> NO
4.3	Confirmation that the subsystems used in MRS1, as proposed herein, shall have NO CHANGE in source, manufacturing unit, components, specification, material etc. from those approved unless got specifically approved from DMRC.				<input type="checkbox"/> CONFIRMED <input type="checkbox"/> NOT CONFIRMED
4.4	Information submitted herein as above is certified as correct, strictly in accordance with the MRS1 contract conditions and has been verified by BEML. In case any information is found to be factually incorrect or at variance with contract conditions at any stage, BEML commits to replace the concerned 'sub-system' in complete fleet as per the instructions of engineer, which shall be final and binding. In such case, BEML shall not be eligible either for seeking any claim whatsoever or for seeking extension of contract delivery period.				<input type="checkbox"/> CONFIRMED <input type="checkbox"/> NOT CONFIRMED
4.5	Confirmation that DMRC may depute a team of Engineers (around six) at Sub-contractor/vendor's office for requisite duration with a view to expedite finalization of designs in accordance with contract 'MRS1' conditions ERGS 5.11.3.				<input type="checkbox"/> CONFIRMED <input type="checkbox"/> NOT CONFIRMED
5	Notwithstanding the vendor approval communicated by DMRC on the proposal of BEML, responsibility for manufacture, testing, supply, commissioning and quality control shall continue to rest solely with BEML and BEML will be solely responsible for meeting all contractual requirements.				<input type="checkbox"/> CONFIRMED <input type="checkbox"/> NOT CONFIRMED
<div style="display: flex; justify-content: space-between;"> (BEML Limited) _____ (Proposed Vendor) </div>					

Date:

Proforma No: MRS1/BEML/V.NNO/CAT-___/_____/P2/_____

6	Category B - Sourcing from facilities in India after supply of agreed quantity from approved manufacturing unit.	
6.1	In case OEM wants to use manufacturing facilities in India (other than his own) for items for which the OEM has been approved, it shall enter into an agreement with such selected Indian equipment manufacturer and obtain prior approval from DMRC. No change in composition, rating, type, model no., manufacturing process, quality standards, design, etc. and make of the components used in assemblies/sub-assemblies of such equipment as manufactured by the approved parent vendor shall be made without specific prior approval of the Engineer.	
6.2	In case the vendor uses his own facilities for indigenization after part supply of equipment from the approved manufacturing unit, no change in design, component type/make, quality standards, manufacture procedure, sourcing of materials etc. shall be made without specific prior approval of the Engineer.	
6.3	In case OEM wishes to change/make/type specifications, etc. of any sub-components for supplies to be sourced from Indian facility, specific prior approval of the Engineer shall be obtained for changes made, model, specification, etc. Responsibility for obtaining such prior approval shall rest solely with the contractor.	
6.4	In case of local manufacturing of carbody or any other item(s) manufactured by BEML/OEM and used in initial trains, BEML shall be exclusively responsible for all quality assurance and inspection and their implementation and also ensure provision of physical partition as per the ERGS 1.1.7	
7	Category C- Locally Manufactured Items	
7.1	Does the manufacturing unit satisfy ERTS 3.2.2	<input type="checkbox"/> YES <input type="checkbox"/> NO
7.2	If not, basis/justification for proposal to be submitted for DMRC review	<input type="checkbox"/> YES <input type="checkbox"/> NO
8	BEML confirms that in terms of ERTS 3.2.2, they would seek Notice of No Objection for Sub-Contractor/Vendor from DMRC notwithstanding the item(s) being used in DMRC's existing rolling stock.	<input type="checkbox"/> YES <input type="checkbox"/> NO
9	BEML shall submit Certificate as per enclosed Annexure-II confirming:	
9.1	Compliance with Clause 6.6 of ERGS and GCC Clause 5.8 regarding supply of software tools/documents/materials etc.	
9.2	Compliance with Clause 8.12 of ERGS regarding supply of all drawings, specifications, patterns etc. in case the manufacture of these items is discontinued by the proposed vendor.	
10	Commitment from the vendor that in case of any future procurement action by DMRC, he shall quote directly to DMRC.	
11	Commitment from the Vendor to provide technical support through permanent positioning of Vendor's staff at depots for meeting DLP obligations as per ERTS clause 3.2.5.	
12	BEML commits that the vendor shall be complying with all relevant contract clauses.	
<div style="display: flex; justify-content: space-between; align-items: flex-end; padding-top: 20px;"> <div>(BEML Limited)</div> <div>_____ (Proposed Vendor)</div> </div>		

Date:

Proforma No: MRS1/BEML/V.NNO/CAT-___/___/A1/___

Annexure-I	
SUB-Contractor/VENDOR/SUB-SUPPLIER DETAILS	
1	Vendor/Sub-supplier OEM Name
2	Details of item proposed to be sourced
3	Sourcing by: <div style="display: flex; justify-content: space-between;"> (a) BEML <input type="checkbox"/> (b) Proposed Main vendor <input type="checkbox"/> </div>
4	Marketing Office/Head Office
4.1	Complete address (including website)
4.2	Contact person details in Head Office
	<ul style="list-style-type: none"> Name Designation Telephone Fax Mobile Email
5	Details of proposed compliant plant/manufacturing unit from where item is proposed to be sourced
5.1	Complete address (including website)
5.2	Contact person details
	<ul style="list-style-type: none"> Name Designation Telephone Fax Mobile Email
5.3	Supply details of the manufacturing unit for the proposed item or item with similar design.
5.4	It is confirmed that the proposed manufacturing unit and the vendor are fully compliant with ERTS 3.2.2
5.5	We commit that in case of any future procurement action by DMRC, the proposed vendor shall quote directly to DMRC without any involvement of BEML.
5.6	We confirm that we will provide technical support through permanent positioning of our staff at depots for meeting DLP obligations as per ERTS clause 3.2.5.
5.7	We have carefully gone through all relevant clauses of the MRS1 Contract and shall fully abide by the contract conditions and decisions communicated by DMRC during contract execution without exception.
<div style="display: flex; justify-content: space-between; margin-top: 20px;"> (BEML Limited) _____ (Proposed Vendor) </div>	

Date:

Proforma No: MRS1/BEML/V.NNO/CAT- ___ / ___ /A2/ ___

Annexure-II

**Certificate for compliance with Contract conditions regarding
Software requirements.**

This is certified that in the contract between BEML and _____ (proposed vendor) for supply of _____, specific conditions for confirming total compliance with the following contract condition/clauses have been included and agreed to between BEML and _____ (proposed vendor):

(a) Clause 6.6 of ERGS and GCC 5.8

It is certified that we shall provide full access of application software(s) and any other software /hardware tools to DMRC which they may specifically require for the intended purpose specified in this specification. For all commercial software BEML shall provide all available documentation for the application and maintenance of that software.

Complete documentation along with the software to be supplied by BEML and its Vendor(s) shall comprise of Signal flow diagram, flow charts, functional blocks, details of signals, interpretations so as to enable engineer to debug and implement vehicle/train level modifications based on DMRC's experience, operational & maintenance requirements. Full access to the application software to DMRC shall be provided for this purpose.

It shall be possible for DMRC to modify/change various parameters/logics used in the software and implement the changes on trains. Full facilities including any software/hardware tools, simulation/test bench which are essential for this purpose shall be supplied.

It is committed to supply the software/hardware etc. within the scope specified in respective clauses of ERTS relevant for the proposed item/vendor and we would be fully complying with GCC 5.8


(b) Clause 8.12 of ERGS:

It is certified that _____ (proposed vendor) will supply all drawings, specifications, patterns and any other information required by DMRC for arranging such items in case the manufacture of these items is discontinued within 10 years by the proposed vender.

(BEML Limited)

_____ (Proposed Vendor)

APPENDIX-4 OF PTS

	TECHNICAL OFFER SUBMITTALS CHECK SHEET	Project MRS1
Aggregate :	Front End Emergency Door System	PTS DOC No.: GR/TD/4262
BEML Enquiry/ RFQ Reference :		

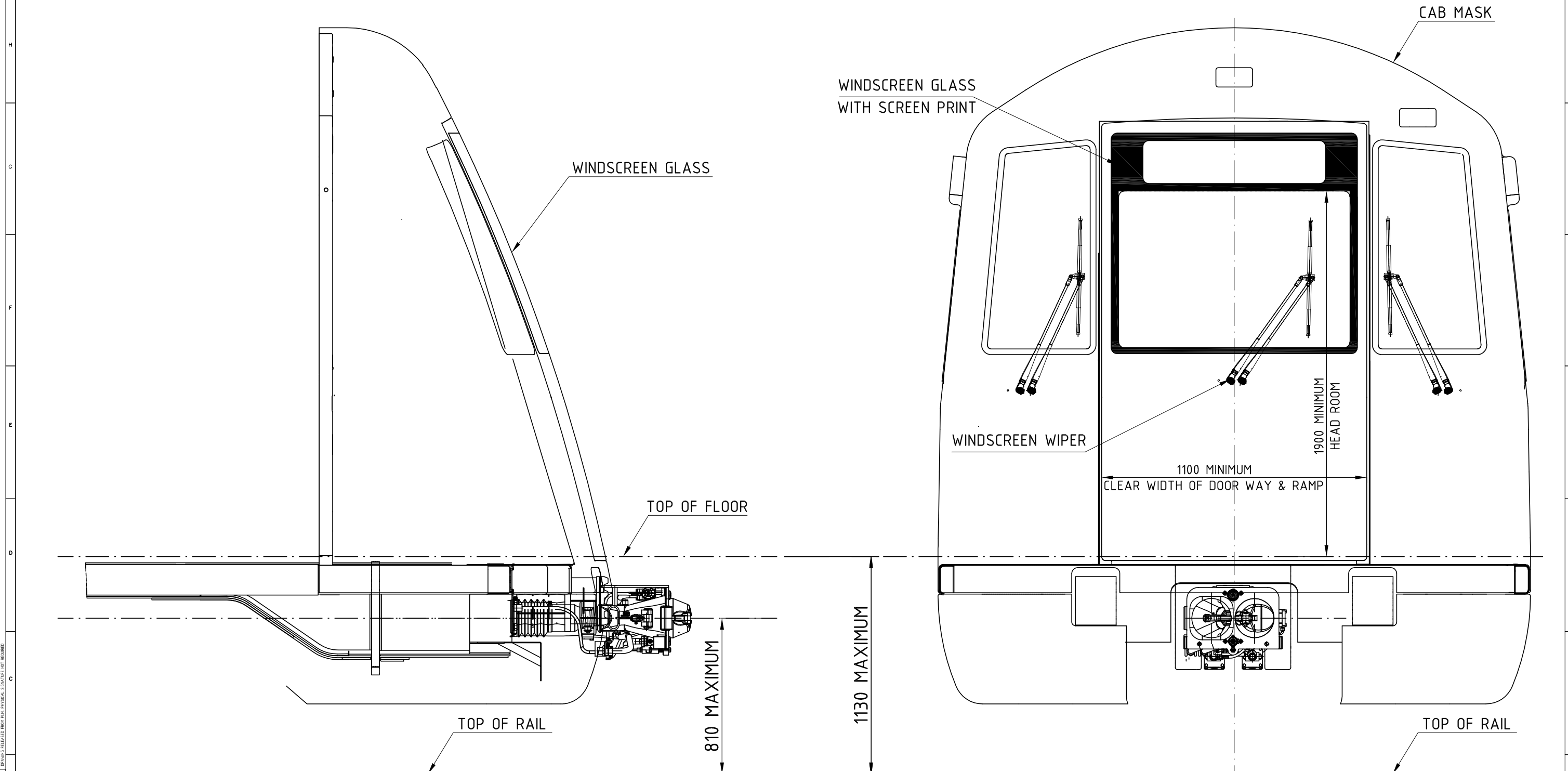
SL.NO.	DETAILS	SUBMITTED	NOT SUBMITTED
1	General Technical Description of proposed FEED including door operation, sealing arrangements, Deployment / stowage timings and Ramp operation details, Electrical, sound insulation & thermal insulation details and concept drawings.	<input type="checkbox"/>	<input type="checkbox"/>
2	Supporting documents for Qualification Criteria compliance.(Clause 4)	<input type="checkbox"/>	<input type="checkbox"/>
3	Vendor approval Documents including QAP, ITP, company profile with infrastructure facilities, product range, manufacturing facility credentials etc.,(Clause 4) as per Appendix-3 format	<input type="checkbox"/>	<input type="checkbox"/>
4	Clause-wise comments against the ERTS, ERGS & this PTS Doc (Clause 7.7).	<input type="checkbox"/>	<input type="checkbox"/>
5	Spares technical offer along with list (refer Clause 7.5)	<input type="checkbox"/>	<input type="checkbox"/>
6	Project Management Plan and CV's of the personnel of the team (refer Clause 6.7)	<input type="checkbox"/>	<input type="checkbox"/>
7	BOM (refer Clause .6.4.12)	<input type="checkbox"/>	<input type="checkbox"/>

Note : Incomplete submissions are liable for Rejection.







Signature of the Bidder with Seal

APPENDIX - 5

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	±12	±2	±3	~
FOR DIMENSIONAL TOLERANCES OF SHEET METAL PARTS AND WELDED TOLERANCES, REFER STD. RD-227											
UNSPECIFIED TOLERANCE FOR LINEAR AND ANGULAR DIMENSIONS REF. IS 2102 (PT-3) (MEDIUM)								QUALITY OF WELD JOINTS REF. RD. 230 MEDIUM			
VALUES OF SURFACE TEXTURE SHALL BE AS PER COMPANY STD. 1012C.								STATUS			
WELDING SHALL BE CARRIED OUT AS PER IS: 9595-96											



GRADE NO.		N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20	N21	N22	N23	N24	N25	N26	N27	N28	N29	N30	N31	N32	N33	N34	N35	N36	N37	N38	N39	N40	N41	N42	N43	N44	N45	N46	N47	N48	N49	N50	N51	N52	N53	N54	N55	N56	N57	N58	N59	N60	N61	N62	N63	N64	N65	N66	N67	N68	N69	N70	N71	N72	N73	N74	N75	N76	N77	N78	N79	N80	N81	N82	N83	N84	N85	N86	N87	N88	N89	N90	N91	N92	N93	N94	N95	N96	N97	N98	N99	N100	N101	N102	N103	N104	N105	N106	N107	N108	N109	N110	N111	N112	N113	N114	N115	N116	N117	N118	N119	N120	N121	N122	N123	N124	N125	N126	N127	N128	N129	N130	N131	N132	N133	N134	N135	N136	N137	N138	N139	N140	N141	N142	N143	N144	N145	N146	N147	N148	N149	N150	N151	N152	N153	N154	N155	N156	N157	N158	N159	N160	N161	N162	N163	N164	N165	N166	N167	N168	N169	N170	N171	N172	N173	N174	N175	N176	N177	N178	N179	N180	N181	N182	N183	N184	N185	N186	N187	N188	N189	N190	N191	N192	N193	N194	N195	N196	N197	N198	N199	N200	N201	N202	N203	N204	N205	N206	N207	N208	N209	N210	N211	N212	N213	N214	N215	N216	N217	N218	N219	N220	N221	N222	N223	N224	N225	N226	N227	N228	N229	N230	N231	N232	N233	N234	N235	N236	N237	N238	N239	N240	N241	N242	N243	N244	N245	N246	N247	N248	N249	N250	N251	N252	N253	N254	N255	N256	N257	N258	N259	N260	N261	N262	N263	N264	N265	N266	N267	N268	N269	N270	N271	N272	N273	N274	N275	N276	N277	N278	N279	N280	N281	N282	N283	N284	N285	N286	N287	N288	N289	N290	N291	N292	N293	N294	N295	N296	N297	N298	N299	N300	N301	N302	N303	N304	N305	N306	N307	N308	N309	N310	N311	N312	N313	N314	N315	N316	N317	N318	N319	N320	N321	N322	N323	N324	N325	N326	N327	N328	N329	N330	N331	N332	N333	N334	N335	N336	N337	N338	N339	N340	N341	N342	N343	N344	N345	N346	N347	N348	N349	N350	N351	N352	N353	N354	N355	N356	N357	N358	N359	N360	N361	N362	N363	N364	N365	N366	N367	N368	N369	N370	N371	N372	N373	N374	N375	N376	N377	N378	N379	N380	N381	N382	N383	N384	N385	N386	N387	N388	N389	N390	N391	N392	N393	N394	N395	N396	N397	N398	N399	N400	N401	N402	N403	N404	N405	N406	N407	N408	N409	N410	N411	N412	N413	N414	N415	N416	N417	N418	N419	N420	N421	N422	N423	N424	N425	N426	N427	N428	N429	N430	N431	N432	N433	N434	N435	N436	N437	N438	N439	N440	N441	N442	N443	N444	N445	N446	N447	N448	N449	N450	N451	N452	N453	N454	N455	N456	N457	N458	N459	N460	N461	N462	N463	N464	N465	N466	N467	N468	N469	N470	N471	N472	N473	N474	N475	N476	N477	N478	N479	N480	N481	N482	N483	N484	N485	N486	N487	N488	N489	N490	N491	N492	N493	N494	N495	N496	N497	N498	N499	N500	N501	N502	N503	N504	N505	N506	N507	N508	N509	N510	N511	N512	N513	N514	N515	N516	N517	N518	N519	N520	N521	N522	N523	N524	N525	N526	N527	N528	N529	N530	N531	N532	N533	N534	N535	N536	N537	N538	N539	N540	N541	N542	N543	N544	N545	N546	N547	N548	N549	N550	N551	N552	N553	N554	N555	N556	N557	N558	N559	N560	N561	N562	N563	N564	N565	N566	N567	N568	N569	N570	N571	N572	N573	N574	N575	N576	N577	N578	N579	N580	N581	N582	N583	N584	N585	N586	N587	N588	N589	N590	N591	N592	N593	N594	N595	N596	N597	N598	N599	N600	N601	N602	N603	N604	N605	N606	N607	N608	N609	N610	N611	N612	N613	N614	N615	N616	N617	N618	N619	N620	N621	N622	N623	N624	N625	N626	N627	N628	N629	N630	N631	N632	N633	N634	N635	N636	N637	N638	N639	N640	N641	N642	N643	N644	N645	N646	N647	N648	N649	N650	N651	N652	N653	N654	N655	N656	N657	N658	N659	N660	N661	N662	N663	N664	N665	N666	N667	N668	N669	N670	N671	N672	N673	N674	N675	N676	N677	N678	N679	N680	N681	N682	N683	N684	N685	N686	N687	N688	N689	N690	N691	N692	N693	N694	N695	N696	N697	N698	N699	N700	N701	N702	N703	N704	N705	N706	N707	N708	N709	N710	N711	N712	N713	N714	N715	N716	N717	N718	N719	N720	N721	N722	N723	N724	N725	N726	N727	N728	N729	N730	N731	N732	N733	N734	N735	N736	N737	N738	N739	N740	N741	N742	N743	N744	N745	N746	N747	N748	N749	N750	N751	N752	N753	N754	N755	N756	N757	N758	N759	N760	N761	N762	N763	N764	N765	N766	N767	N768	N769	N770	N771	N772	N773	N774	N775	N776	N777	N778	N779	N780	N781	N782	N783	N784	N785	N786	N787	N788	N789	N790	N791	N792	N793	N794	N795	N796	N797	N798	N799	N800	N801	N802	N803	N804	N805	N806	N807	N808	N809	N810	N811	N812	N813	N814	N815	N816	N817	N818	N819	N820	N821	N822	N823	N824	N825	N826	N827	N828	N829	N830	N831	N832	N833	N834	N835	N836	N837	N838	N839	N840	N841	N842	N843	N844	N845	N846	N847	N848	N849	N850	N851	N852	N853	N854	N855	N856	N857	N858	N859	N860	N861	N862	N863	N864	N865	N866	N867	N868	N869	N870	N871	N872	N873	N874	N875	N876	N877	N878	N879	N880	N881	N882	N883	N884	N885	N886	N887	N888	N889	N890	N891	N892	N893	N894	N895	N896	N897	N898	N899	N900	N901	N902	N903	N904	N905	N906	N907	N908	N909	N910	N911	N912	N913	N914	N915	N916	N917	N918	N919	N920	N921	N922	N923	N924	N925	N926	N927	N928	N929	N930	N931	N932	N933	N934	N935	N936	N937	N938	N939	N940	N941	N942	N943	N944	N945	N946	N947	N948	N949	N950	N951	N952	N953	N954	N955	N956	N957	N958	N959	N960	N961	N962	N963	N964	N965	N966	N967	N968	N969	N970	N971	N972	N973	N974	N975	N976	N977	N978	N979	N980	N981	N982	N983	N984	N985	N986	N987	N988	N989	N990	N991	N992	N993	N994	N995	N996	N997	N998	N999	N1000
VALUE		50	75	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825	850	875	900	925	950	975	1000	1025	1050	1075	1100	1125	1150	1175	1200	1225	1250	1275	1300	1325	1350	1375	1400	1425	1450	1475	1500	1525	1550	1575	1600	1625	1650	1675	1700	1725	1750	1775	1800	1825	1850	1875	1900	1925	1950	1975	2000	2025	2050	2075	2100	2125	2150	2175	2200	2225	2250	2275	2300	2325	2350	2375	2400	2425	2450	2475	2500	2525	2550	2575	2600	2625	2650	2675	2700	2725	2750	2775	2800	2825	2850	2875	2900	2925	2950	2975	3000	3025	3050	3075	3100	3125	3150	3175	3200	3225	3250	3275	3300	3325	3350	3375	3400	3425	3450	3475	3500	3525	3550	3575	3600	3625	3650	3675	3700	3725	3750	3775	3800	3825	3850	3875	3900	3925	3950	3975	4000	4025	4050	4075	4100	4125	4150	4175	4200	4225	4250	4275	4300	4325	4350	4375	4400	4425	4450	4475	4500	4525	4550	4575	4600	4625	4650	4675	4700	4725	4750	4775	4800	4825	4850	4875	4900	4925	4950	4975	5000	5025	5050	5075	5100	5125	5150	5175	5200	5225	5250	5275	5300	5325	5350	5375	5400	5425	5450	5475	5500	5525	5550	5575	5600	5625	5650	5675	5700	5725	5750	5775	5800	5825	5850	5875	5900	5925	5950	5975	6000	6025	6050	6075	6100	6125	6150	6175	6200	6225	6250	6275	6300	6325	6350	6375	6400	6425	6450	6475	6500	6525	6550	6575	6600	6625	6650	6675	6700	6725	6750	6775	6800	6825	6850	6875	6900	6925	6950	6975	7000	7025	7050	7075	7100	7125	7150	7175	7200	7225	7250	7275	7300	7325	7350	7375	7400	7425	7450	7475	7500	7525	7550	7575	7600	7625	7650	7675	7700	7725	7750	7775	7800	7825	7850	7875	7900	7925	7950	7975	8000	8025	8050	8075	8100	8125	8150	8175	8200	8225	8250	8275	8300	8325	8350	8375	8400	8425	8450	8475	8500	8525	8550	8575	8600	8625	8650	8675	8700	8725	8750	8775	8800	8825	8850	8875	8900	8925	8950	8975	9000	9025	9050	9075	9100	9125	9150	9175	9200	9225	9250	9275	9300	9325	9350	9375	9400	9425	9450	9475	9500	9525	9550	9575	9600	9625	9650	9675	9700	9725	9750	9775	9800	9825	9850	9875	9900	9925	9950	9975	10000																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
SURFACE		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	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127</																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

SL No.	QTY	PART / STOCK No.	DESCRIPTION	SIZE	COMPANY STD./IS		wt. (kg)
					MATERIAL		
			PRODUCT	MUMBAI METRO CARS L2 & L7			
			REF DRG				
			HATERIAL	ASSY			
			REAT		APPD	PVG	10.01.2019
			TREAT		REVD	KP	10.01.2019
			SURFACE		CHKD	GURUPRASAD N.C.	10.01.2019
			TREAT		DRWN	GURUPRASAD N.C.	10.01.2019
			TITLE	DOOR INTERFACE DRAWING			
				SCALE		SHEET	wt1(kg)
				NTS		1 OF 1	0
ALT No.	ECN No/CHANGES	DATE	BY	CHKD	APPD	DRG No.	ALT
						GR-4155	
1			2			1	A1