






**BEML LIMITED**  
**BANGALORE**  
**R & D CENTER**

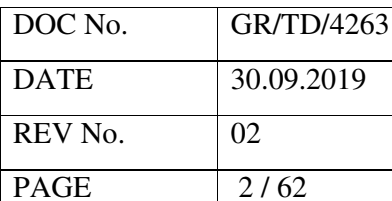
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**Procurement Technical Specification**  
**of Lighting System for**  
**MRS1 Contract**

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## 1. Introduction

### 1.1. General

This document, Procurement Technical Specification (PTS) describes the complete technical requirement of Lighting system to be supplied for cars under the 'MRS1' contract (hereafter MRS1). The Lighting System 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 for MRS1 projects while the subcontractor shall be responsible for all works required in this PTS with regard to Design, supply, testing and commissioning of Lighting system and shall be responsible for supporting BEML activities as Contractor for MRS1 Project.

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

The scope of work shall include all items of work which may be required to meet the performance requirements, trouble free and efficient operation of trains and meeting the best international practices even if not specifically mentioned in the tender specifications as specified in ERTS 1.1.3 (i) to (ix) and ERTS 1.1.7.

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 (UTO) modes shall be done subsequently (refer Note No. 6. of 'Attachment to Appendix FB-1' to 'Form of Bid'). The interface testing may have to be done separately for line 2 & 7 of Mumbai Metro.

The Lighting 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.

The configuration of train formation is as follows.

*DMC – TC – MC –	- 3 car unit formation
*DMC – TC – MC – MC – TC – DMC*	- 6 car train formation


For increase in quantity (if required)

– TC – MC –	- 2 car unit formation
*DMC – TC – MC – TC – MC – MC – TC – DMC*	- 8 car train formation

Where:

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

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

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

### 1.2. Climatic and Environmental Condition (ERTS clause 3.10)


The MRS1 Car shall operate reliably and safely under Mumbai climatic and Environmental conditions as per as per ERTS 3.10 shown in following Table. Accordingly the Lighting system shall be designed to operate with satisfactory performance under the following climatic and environmental conditions

Description	Limiting Values
Maximum ambient temperature (refer note1 below)	36 °C
Minimum temperature	14.3 °C
Humidity (Refer note2 below)	≥95% RH
Rainfall	The annual precipitation is 2,078 mm with 34 % (709 mm) falling in the month of July.
Atmosphere during hot season	Extremely dusty including bird feathers
Maximum wind speed	150 km/hr
Vibration & 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 <sub>2</sub> level in atmosphere	80— 120 mg/ m <sup>3</sup>
Total Suspended particles matter in atmosphere (TSPM)	360 — 540 mg/m <sup>3</sup>
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 50mm 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.



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- 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.


### 1.3. 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 <sup>2</sup> 0.75 m/s <sup>2</sup> 0.40 m/s <sup>2</sup>
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 <sup>2</sup> 0.80 m/s <sup>2</sup> 0.45 m/s <sup>2</sup>
Average Service braking rate from 80 kmph to standstill for fully loaded(AW3) train on level tangent track.		1.0 m/s <sup>2</sup>
Average Service braking rate from 80 kmph to standstill for AW2 train on level tangent track.		1.1 m/s <sup>2</sup>
Average Emergency braking rate from 80 kmph to 0 kmph for fully loaded trains on level tangent track		1.3 m/s <sup>2</sup>
Jerk rate (Maximum)		0.75 m/s <sup>3</sup>
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.		

### 1.4. Track structure Parameters (ERTS clause: 3.14)

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

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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 EI (UIC 60) 880/HH	60 EI (UIC 60) 1080/HH	60 EI (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	85mm		
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
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%		

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Maximum Gradient Depot Connection	4%
Minimum vertical curve radius of curvature	1500m

#### 1.5. 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
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)

## 2. Definition 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 to BEML for MRS1 project. Subcontractor shall carry out the works in accordance with ERTS and ERGS with regard to Lighting System.

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- **"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 Lighting System 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 Employer appointed from time to time by the Employer.
- **"GTC"** means "General Terms and Conditions for Supply of Lighting System for MRS1 Project" issued by BEML.
- **"BEML"** means the Contractor to procure the Lighting System for MRS1 project cars.

## 2.2. Abbreviations

ATC:	Automatic Train Control
DMRC:	Delhi Metro Rail Corporation
EMC:	Electro-Magnetic Compatibility
EMI:	Electro-Magnetic Interference
FAI:	First Article Inspection
ERGS:	Employer's Requirement General Specification
GCC:	General Condition of Contract
LRU:	Line Replaceable Unit
MDBF:	Mean Distance Between Failures
MDBCF:	Mean Distance Between Component Failures
MTTR:	Mean Time To Repair
PTS:	Procurement Technical Specification
SCC:	Special Condition of Contract
SOD:	Schedule of Dimension
TCMS:	Train Integrated Management System
ERTS:	Employer's Requirement Technical Specification
N/A:	Not Applicable
TBD:	To Be Determined

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PDR: Preliminary Design

FDR: Final Design

GoA: Grade of Automation

UTO: Unattended Train Operation

For further abbreviations, please refer to ERTS APPENDIX TC.

### 3. Precedence of Documents

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

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

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

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

Order of precedence	Document Title
1	DMRC ERTS
2	DMRC ERGS
3	GTC
4	PTS

### 4. Standards


The design, manufacture and testing of the work and the materials shall conform to the latest editions of internationally recognized North American, European, Japanese standards. The standards to be used shall be as per Appendix TA of ERTS.

- General Standards: UIC, EN, BS, JIS, NF, NFPA, ASTM etc.
- Sub contractor's Standards

### 5. Requirements of Documentation

All drawings, documents and information by Subcontractor shall be prepared in English and submitted to BEML for approval.

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

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The Subcontractor shall provide BEML with the drawings of component of Lighting System in a format readable with AutoCAD 2013 (latest), CATIA V5 on CD-ROM or e-mail as requested by the BEML or DMRC's Representative

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

## 6. Qualifying Criteria for subcontractor and Vendor Approval.


### 6.1. Proven Design

The proposed Lighting system by the sub-contractor 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 different countries or in an MRTS in India.

The Subcontractor shall manufacture and supply the lighting system only from such manufacturing units that have supplied the lighting system that fulfill the proven design requirements as above (Refer ERTS clause 3.2.2).

### 6.2. Qualifying Criteria (ERTS clause 3.2.2)

- (i) The subcontractor shall meet the qualification criteria as per ERTS 3.2 Proven design.
- (ii) The subcontractor should be an OEM and should have carried out design and manufacturing of aggregates / sub-assemblies proposed for Lighting system shall be state-of-art & of proven design and shall have been in use and have established their satisfactory performance and reliability on at least three mass rapid transit systems in revenue service over a period of three years or more (in each MRTS) either outside the country of origin in three different countries or in an MRTS in India. Proposed Lighting system should have been in service during the preceding three years or more in respect of lighting system in similar metro system. To this effect, the subcontractor shall submit purchase order copies and satisfactory performance reports from the customers / Metro Corporations along with the technical offer
- (iii) Sub-systems/components used in existing rolling stock of an MRTS in India do not get automatically qualified for use unless specifically approved by the Engineer for this project. If required by the Engineer, Contractor shall provide certificate of satisfactory performance for a period of three years or more from the Metro operators. Where similar sub-systems of a different rating are already proven in service as per the above criteria then the design shall be based on such sub-systems.

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- (iv) All 'sub systems' shall be procured from the approved vendors and sourced from only such manufacturing units that have supplied the sub-systems that fulfill the proven design requirements as above. The contract envisages commencement of manufacturing only after completion of Pre-final design.
- (v) The subcontractor shall have established International Quality systems and certification like ISO 9001/ISO 14001/IRIS. The subcontractor shall submit supporting documents in this regard.
- (vi) The subcontractor shall submit Inspection & Test Plan / Quality Manual followed.
- (vii) The subcontractor shall undertake to provide support during Installation, Testing & Commissioning, service trials, revenue service and DLP period either by themselves or through sister company or a partner in India. The subcontractor shall submit detailed proposal in this regard.
- (viii) 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.
- (ix) The subcontractor shall give an undertaking to supply spares for a minimum period of 10 years from the date of taking over of last car by MRS1.

### **6.3. Vendor approval (ERTS Clause 3.2.5)**


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

## **7. Scope Of Supply**

### **7.1. Hardware**

The Subcontractor shall be responsible for the design, manufacture, supply, testing and commissioning of the Lighting as per ERTS 12.8 & 12.9. The subcontractor shall provide all components related to the Lighting, as a minimum, the followings:

- Total Number of Cars: 378 cars

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According to ERTS 12.8-“Lighting System”, ERTS 12.9-“Interior Illumination system” the Subcontractor shall provide, as a minimum, the following:

## 7.2. Lighting System

Sl. No	ITEM	Qty in Nos.			Remarks
		DMC	TC	MC	
Exterior Lights					
1	Head Light / Marker & Tail Light	2	-	-	ERTS 12.8.2
2	Flasher Light	1	-	-	ERTS 12.8.3
3	Flood Light	1	-	-	ERTS 7.3.7
4	UTO/RM Light	2	-	-	ERTS 12.9.4
5	PAD Light	2	2	2	ERTS 13.3.2
6	Outside Door indication lamp (Dual Color)	8	8	8	ERTS 12.8.4 ERTS 7.2.4.3
7	Inside Door indication lamp (Dual Color)	8	8	8	ERTS 12.8.4 ERTS 7.2.4.3
Interior Lights					
8	Driver Console Light	2	-	-	ERTS 12.9.2
9	Cab Main Light-LED (305mm)	1	-	-	ERTS 12.9.2
10	Cubicle Lights	14	12	14	ERTS 12.9.3
11	Saloon Light –LED (1302mm)	28	30	30	ERTS 12.9
12	Saloon Light –LED (690mm)	2	2	2	ERTS 12.9
13	Saloon Light (305mm)	2	4	4	ERTS 12.9
14	Gangway Light –LED	1	1	1	ERTS 12.9
15	Auto Dimmer	1	1	1	ERTS 12.9
16	Sensor	2	2	2	ERTS 12.9
17	DC/DC Converter (if required)	3	3	3	


The subcontractor shall provide all components related to the Lighting System, but not limited to, the following.

1. All components to meet the performance requirements of the Lighting system
2. Cables between equipments:

Subcontractor shall supply the cable harness (if applicable) with the heat shrink tube, protective jacket, numbering tube, bundle name-tag, strain relief bushings, ferrules for connector.

3. Mating connectors for vehicle side with all pins even if pin is not used, back shells and



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accessories. All mating connectors to be supplied by the supplier along with supplies of each light.

4. Special cable and tools should be provided by subcontractor
5. Cable Assembly instruction documents for Ethernet cables and any special cables (if applicable) etc.,
6. Name plates or Name Labels for every equipment.
7. Rubber (packing or gasket) for the water-tightness when the subsystem or components are installed on the vehicle.
8. One full set of connector and its contacts as mounted on the equipments for each car-type to carry out vehicle level voltage withstand test at BEML factory.
9. All information and contact details of the sub-suppliers shall be provided to contact the sub-suppliers after expiry of warranty.

### 7.3. Mock-up (ERTS 4.2 & appendix TB)

Sl.No	ITEM	Qty /DMC in Nos.	Remarks
1	Head Light / Marker & Tail Light	2	ERTS 12.8.2
2	Flasher Light	1	ERTS 12.8.3
3	Flood Light	1	ERTS 7.3.7
4	UTO/RM Light	2	ERTS 12.9.4
5	PAD Light	2	ERTS 13.3.2
6	Outside Door indication lamp (Dual Color)	8	ERTS 12.8.4
7	Inside Door indication lamp (Dual Color)	8	ERTS 12.8.4
8	Driver Console Light	2	ERTS 12.9.2
9	Cab Main Light –LED-305mm	1	ERTS 12.9.2
10	Saloon light -LED (1302mm)	28	ERTS 12.9
11	Saloon light -LED (690mm)	2	ERTS 12.9
12	Saloon light -LED (305mm)	2	ERTS 12.9
13	Gangway Light-LED	1	ERTS 12.9
14	Auto Dimmer	1	ERTS 12.9
15	Sensor	2	ERTS 12.9
16	Cubicle Light	14	ERTS 12.9.3
17	DC-DC Converter (If required)	3	

- (a) The mockup qty. and list is tentative and the same shall be finalized based on DMRC approval of Mock-up plan.

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(b) Only 110 V DC power supply will be provided for operation of items indicated in mock-up.

(c) Special cable and tools should be provided by subcontractor

### 7.3.1 Equipment side connectors for Di-electric test

Subcontractor shall supply one full set of connector and its contacts as mounted on the equipments for each car-type to carry out vehicle level voltage withstand test at BEML factory. Detailed list shall be decided and finalised before first supplies.

## 7.4. General Requirement

7.4.1 The subcontractor shall fully meet the requirement of ERTS & ERGS for the proposed Lighting system for MRS1.

7.4.2 The Lights shall fully meet the requirement of EMI/EMC as per ERTS 2.15, 2.16, 2.17, ERTS 15.27 (EMC Testing), ERTS Appendix: TD3 (Interface with the signaling and telecommunication contractors) and TD3.12 (EMI).

7.4.3 The subcontractor shall comply with the Noise & Vibration requirements as specified in ERTS 2.18 & 15.25.

7.4.4 The subcontractor shall comply with the RAMS requirements as specified in ERTS 2.7, 2.8, 2.9.

7.4.5 The sub contractor shall interface with TCMS for light control & fault indication.

7.4.6 All wires & Cables shall comply with ERTS 12.5 (Cables).

7.4.7 An expected power consumption of the equipments should be declared as a realistic value at the tender level and/or early design concept phase. The subcontractor shall make every effort to minimize the energy consumption of each equipment. The actual power consumption must not derate by 2% of the estimated power consumption.


7.4.8 The sub contractor shall be fully responsible for integrated testing and commissioning including Commissioning Type tests and Commissioning Routine tests of the lights at BEML works (Factory test) and at MRS1 site (Depots at Mumbai & Main line tests)

7.4.9 The sub contractor shall be responsible to maintain the DLP and commissioning spares at MRS1 site. The list of DLP and commissioning spares shall be furnished by the sub contractor for review and approval by BEML/ DMRC.

7.4.10 The sub contractor shall provide all the documents for DMRC-MRS1 project and shall also provide any other documents required by DMRC as per ERGS 2, ERGS 3, ERGS 4, ERGS 5, ERGS 6, ERGS 7, ERGS 8, ERGS 9, ERGS 10, Appendix- 4 & 6 of ERGS and ERTS 5.

a) Design documents – Preliminary, Pre-final & Final.

b) Technical Description of Lighting System with drawings.

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- c) Quality assurance plan (QAP)
- d) Type test procedure for Lighting System and aggregates
- e) Routine test procedure for Lighting System and aggregates
- f) Inspection and test plan (ITP)
- g) Factory tests , Depot tests and main line test procedures
- h) Testing and commissioning plan
- i) Interface plan
- j) Operation and maintenance manual
- k) Spare parts catalogue
- l) Special tools & Testing equipment
- m) Any other documents requested by BEML//DMRC.
- n) Type test certificates / documents and Routine test certificates / documents.

7.4.11 The supplier shall maintain the Lights and supply of spares for at least 10 years from the date of completion of the contract as per ERGS 8.12.

7.4.12 The supplier shall provide the spares of Lights as per Annexure-1 according to Cost center G.

7.4.13 The sub contractor shall provide training in operation and maintenance to BEML and DMRC staff.

7.4.14 Only 110V d.c. (+25%, -30%) would be made available on train for control power supply of Lighting system. The Lighting System shall continue to operate correctly with the car battery voltage supply range as per ERTS 9.4.7 and 12.4.13

7.4.15 Unused connectors of equipments shall be covered with protective cover plug or dummy cap to prevent dust from accumulating on the contacts.

7.4.16 The colour of the LEDs shall be white (temperature 3000K~6000K), which shall be decided which shall be decided during design stage / mockup review by the Engineer.


## 7.5. Technical Requirements

### 7.5.1 General

The subcontractor shall be responsible for meeting the entire technical requirement in PTS and shall provide all required data for lighting design.

The general requirements for Lighting shall be met to the following requirements specified in ERGS and ERTS.

1. Interface Activities
2. Quality Assurance
3. System Safety

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4. Reliability & Availability
5. Maintainability
6. Electromagnetic Compatibility
7. Noise and Vibration
8. Fire and Toxicity Standards

The system requirements for Lighting shall meet, but not be limited to, the following sections in ERTS:

1. ERTS 1 Introduction
2. ERTS 2 General Requirements
3. ERTS 3 Design and Performances Requirements
4. ERTS 4 Vehicle Body
5. ERTS 5 Bogie
6. ERTS 6 Pneumatics, Air supply And Brake System.
7. ERTS 7 Door and Door Control System
8. ERTS 10 Train Control Management Systems
9. **ERTS 12 Electrical and Control Equipments**
10. ERTS 13 Communication System
11. ERTS 14 Material and Workmanship
12. ERTS 15 Inspection, Tests and Trials
13. Appendix TA: International Standards
14. Appendix TB: Car Body Mock-ups
15. Appendix TC: Abbreviations
16. Appendix TD: Interface between rolling stock, signaling telecommunication contractors.
17. ERTS Appendix TE Drawings and Documents
18. ERTS Appendix TF Submittals
19. ERTS Appendix TG Train Withdrawal Scenarios for 6-car Trains

The subcontractor shall submit the compliance matrix showing those sections of the Technical Specification.

#### 7.6. Deliverables (as per ERTS 12.13)


Sl. No.	Clause No.	Tools/Equipment/Software	Quantity
1	12.8.1 (iv) Facility for replacement of power LED clusters	used as exterior lights.	In each depot.
2	12.8.2 (i) Facility for replacement of power LED clusters	used as head and tail lights	In each depot.
3	12.9.1 (x) Special tool for replacement of defective LEDs/	block of LEDs	Two sets to each depot.

## 8. Exterior Lights

### 8.1 Exterior Lighting (ERTS 12.8.1)

The Following ERTS Clauses to be followed:

- i. Exterior lights lens assemblies shall be sufficiently robust to resist the impacts of flying ballast.

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- ii. The IP protection shall be IP65, when fitted on the carbody.
- iii. Individual power LED clusters used as exterior lights shall be able to be replaced easily from track level. Replacement of individual cluster shall be possible in depot without disturbing the functioning of the light. In case, the change of cluster requires readjustment of complete light or component, facility for the same shall be provided in each depot.
- iv. Access for cleaning and the replacement and adjustment shall be possible.
- v. All LEDs shall conform to the minimum requirements as specified in ERTS 12.9 and its sub clauses.
- vi. Complete lighting system(s), their components shall generally conform to relevant ENs/IECs applicable for railway applications and shall be type tested.

## 8.2 Head and Tail Lights (ERTS 12.8.2)

- i. Power LED based Head- and tail-lights in watertight sealed, vermin-and-insect proof integrated housings placed at approximately 3m centres and 1.5m above top of rail datum, beneath the windscreens. The units shall be “handed”, left and right, so that the taillights are outboard of the headlights.

The two power LED based white light, with provision for dipper shall be mounted at the front of the driving end of the DM Car, to provide even illumination of the tunnel bore (if available), track bed and track side signal posts. It shall be possible to read the number plates provided on the OCS masts and other boards like pantograph lower / raised boards. The illumination level of the head light shall be as per the international norms. Replacement of individual cluster shall be possible in depot without disturbing the functioning of the light. In case, the change of cluster requires readjustment of complete light or component, facility for the same shall be provided in each depot.

- ii. Each beam shall be separately adjustable both horizontally and vertically. The On/Off and Beam controls shall be switched from the train operator’s console.
- iii. Two bi- colour power LED based marker lights (tail lights) shall be provided which may be lit in both active and non-active cab. The tail lights shall be LED type. Each LED shall be dual colour of white and red which shall be selectable from cab. Alternatively, white & red LEDs may be provided within the same block/fitting and be used accordingly. In active cab the marker lights shall be white and in non-active cab it should be of red colour. During the normal train operation, white front lights shall glow and rear shall be red. However, in case of a stationary train in siding or depot, both front and rear lights shall be red.
- iv. The taillights shall be sufficiently large and bright, to enable the lamp to be seen and acted upon by a train operator within the stopping distance of the consist travelling at maximum speed.
- v. The control of Headlight and tail light shall be based upon the direction of train movement i.e. headlight and tail light (in white colour) should glow in the cab which is in moving direction and tail light (in red colour) should glow in the cab in the non-moving direction.

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- vi. The headlights and taillights shall not be switched off when the train is passing through a neutral section.
- vii. The Contractor shall propose to suitably indicate the front end of the train while parked at depot, or stabling sidings, by illuminating two white lights either by using dimmer position of head light or using dual colour LEDs in the tail light or by other appropriate means.

### 8.3 Flasher Light (ERTS 12.8.3)

- i. In order to attract the attention of the train operator of the following train or a train approaching from the opposite direction, in emergency, a powerful flashing amber light in addition to the tail lamps shall be provided in the front panel of each driving car. This light shall be switched ON by the train operator in case of emergency and shall not be switched OFF even while negotiating neutral sections. Provision should also be there to manually switch ON the flasher light as per operational requirement of Train Operator.
- ii. Flasher light when lit and flashing shall be able to attract attention at a distance of 300m under clear sunny daylight.

### 8.4 Door Indicator Lights (ERTS 12.8.4, ERTS 7.2.4.3)- Color: Amber Yellow/Red (Dual color)

#### ERTS 12.8.4

- i. An amber indication lamp (power LED based) shall be located at an appropriate location near each door.
- ii. The lamp shall remain extinguished when respective door is fully closed and locked.
- iii. The lamp shall be illuminated when the door is in fully open condition, or when the locking mechanism has failed to register, preventing traction circuits from picking up or when the door is closed, locked and isolated.
- iv. The lamp shall flash whenever door is opening or closing; for ex: when close announcement button from the active cab is pressed. It shall continue to flash till such time the door is closed.

#### ERTS 7.2.4.3 (v)


At the centre of each door, (both exterior as well as interior) suitable dual colour LED indication lamp, duly approved by the Engineer shall be provided to indicate door status (including isolated state). The lamp shall flash yellow during opening/closing and shall glow yellow during open condition. The lamp shall glow red during isolated condition.

#### Note:

##### A) Door Indication Light Outside:

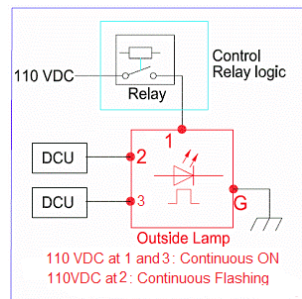
Terminal 1 : 110 VDC from car-Yellow (Continuous Lit by Light Supplier)

Terminal 3 : 110 VDC from car-Red (Continuous Lit by Light Supplier)

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Terminal 2: 110VDC from car (Flashing by Light Supplier scope)

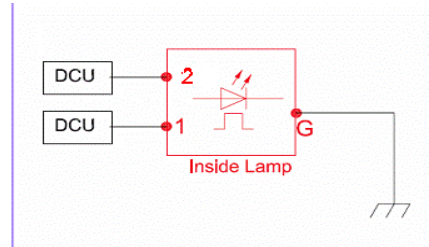
Supplier to note that Door indication light outside is with Flashing unit, and "Flashing circuit" is in Supplier scope. The sketch of the same is shown below:



**Door Indication light Outside (With Flashing)**

#### **B) Door Indication Light Inside:**

Supplier to note that Door indication light Inside is with 110V DC, 'Flashing signal' is in BEML Scope, the light shall operate continuous lit (110VDC from car) / Flashing (110VDC with 2 Hz pulse from car). The sketch of the same is shown below:



**Door Indication light Inside (Without Flashing)**


### **8.5 Call-On Light Switch (ERTS 12.8.5)**

A Call-On Switch shall be provided in the train driver's cab, to cater for Emergency Push-Out situations. Operation of the switch on a failed train, with the Mode Selector in OFF, shall cause the tail lights at the rear of the failed train to flash on and off, indicating to the train driver of the rescuing train that he may proceed to affect coupling.

### **8.6 UTO/RM indicating light (ERTS 12.9.4)**

- I. One indicating light visible from side of the train indicating UTO or Restricted Manual mode status, shall be fitted on each side of the cab end.
- II. The switch off position shall indicate UTO not being used and safety for operation and maintenance personnel to board the train and/or to carry out coupling during rescue



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operation

III. Switch ON would imply “train under UTO”.

IV. Flashing would mean Restricted Mode activated.

## 8.7 Flood light (ERTS 7.3.7)

The door status shall be interlocked with the train control circuit so that once the door is found unlocked and open:

- I. 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 Contractor shall submit detailed Proposals of the operation of the detrainment doors for review and acceptance by the Engineer.

## 8.8 Passenger Alarm Device Light (PAD Light) (ERTS 13.3.2)

When a passenger alarm device is operated, a warning sonic device shall sound in the driving console/OCC, an indication shall be given to the train operator/OCC of the location of the operated device, automatic views from surveillance cameras provided near the location of activated PEA shall be displayed in the monitors inside cab / OCC. Rolling Stock Contractor shall also ensure the following provisions:

- I. **A visual indication on the exterior of the car shall advise station staff which is the affected car.**
- II. The train operator/OCC shall acknowledge the alarm by operation of an override device in non UTO/UTO operation respectively, which shall terminate the cab sonic alarm, and simultaneously cause an indicator to illuminate at the emergency device location.  
It shall be feasible for train operator/OCC to acknowledge and isolate/reset the specific PEA from the driving console/OCC after verifying the conditions in the saloon to his satisfaction through CCTV images which shall be recorded with date, time, train ID/No., rake ID, Camera Name/Camera ID, geographical location, PAD location, event stamping etc.

Recording of image upon certain critical events shall be as per ERTS 13.9.11.

## 9. Interior Lights


### 9.1 Interior Illumination System (ERTS 12.9)

The Following ERTS Clauses to be followed:

The LED Saloon light shall generally conform to EN13272 & ERTS 12.9. The system shall be based on **power LEDs** and should meet following requirements in general:


- I. The guaranteed life of the LEDs with their control system and optics/luminary shall not



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be less than 60,000 burning hours.

- II. The specified illumination level shall be met till at the end of the life of 60,000 hours when the illumination is not less than 70% of their original illumination level.
- III. The colour of the LEDs shall be white (temperature 3000K). It shall be ensured that all LEDs are selected from same bin to avoid any difference in colour and performance.
- IV. The design of the heat dissipation arrangement shall be submitted in detail with simulated results.
- V. Colour rendering index shall not be less than 80
- VI. Complete light and energy simulation calculations shall be provided during design to prove validity of the proposed solution.
- VII. The system shall be designed to limit glare and ensure no glare by night time reflections in windows. Luminaires shall be designed to confirm relevant international standards.
- VIII. The change of chromaticity over the lifetime of the product shall be within 0.007 on CIE 1976(u',v') diagram or equivalent.
- IX. Luminaire efficiency inclusive of LEDs/control gears & optics etc. shall not be less than 100 lm/W at the working junction temperature; higher values shall be preferred.
- X. Design layout of LEDs & their strings/blocks should be such that the failure of one LED should not cause isolation of complete string/block. Similarly failure of one controller on one string/block should not adversely affect other strings/blocks. Details shall be finalized during design stage.
- XI. Cars may remain unpowered in open sun and internal temperature may go upto 70°C (ERTS 3.10). Suitable protection measures shall be taken to ensure that this does not adversely affect the performance, reliability or efficiency of the lighting system and its components. Verification/validation to the above shall be proposed by the contractor during design.
- XII. Illumination within saloon with LED luminaires shall be designed so as to ensure that the desired maximum illumination level is achieved with LEDs operating at less than 50% of its rated capacity. However, driver/control unit/optics etc. shall be designed for full rating of the LEDs.
- XIII. All luminaires shall be of LED type and fitting shall be protected and diffused. No exposed light sources will be accepted.
- XIV. LED luminaires and control gears shall be sealed to atleast IP54, BS EN 60529:1992, to prevent the ingress of dirt and foreign objects.
- XV. After one year, two year and 60,000 operation hours, the colour temperature shall be within  $\pm 5\%$ ,  $\pm 8\%$  and  $\pm 10\%$  of the initial value respectively.

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XVI. LED luminaries shall be designed to withstand switch cycles of 100,000 and test shall be conducted to prove the compliance.

XVII. The contractor shall replace all the LED lighting with a newly improved LED lighting if

- i) the total cumulative failure rate of the LED luminaries and control gears within DLP exceeds 5% with 20% of LEDs failed in a LED luminaries is constituted as a failure of the LED luminaries; or
- ii) The illumination level at floor level of any five trains drops below 90% of the initial values at the end of two-year operation but before the expiry of DLP period,

**Note:** The illumination of LED shall be designed assuming 15 hours daily operation and 365 days of operations.

XVIII. Since LED technology is fast evolving and the rolling stock supply is a long drawn process, sub-supplier shall commit to supply new generation of improved LEDs progressively and which should be compatible with the luminaries already supplied and installed. The contractor shall regularly update the engineer on this aspect during the manufacture.

XIX. Noise generated by the energized LED lighting, fixtures and ballast/control gear installed in a car shall not exceed 50 dBA when measured 1m from the equipment.

XX. LEDs manufactured by reputed manufacturers shall only be used after taking the prior approval of the Engineer during Design Review.

For indigenization of “Luminaries and Lamps” as referred in ERGS clause 1.1.8, Table 1C shall imply fitting and PCBs etc. except LEDs of the LED lights.


XXI. LED(s) shall have lumen rating as 100 lumen/LED or above.

XXII. Maximum number of LEDs which a driver/power supply can feed shall not exceed 60 LEDs.

XXIII. During commissioning and subsequently, it may be desirable to adjust the lux level to 250/200 in the saloon. Provision shall be made for adjustment of the lux level within saloon. At least three levels of adjustments i.e. 200 Lux/250 Lux/300 Lux shall be provided in the saloon illumination design as a minimum. Details shall be discussed during design review.

## 9.2 Saloon Illumination (ERTS-12.9.1)


- (i) Energy efficient, Power LED based lights, in luminaries meeting flame, smoke and toxicity requirements shall be recessed into the ceiling paneling. The light fittings shall be simple, and arranged not to trap dirt, moisture and insects. Suitable sealing protection shall be incorporated to prevent ingress of dust etc from AC ducts. The luminaries shall ensure to minimize the glare.
- (ii) All the saloon lights shall work on 110V DC.

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- (iii) The size and number of light fittings with diffuser shall be sufficient to provide a sensibly constant level of illumination of 300lux at a height of 1.0 m above floor level, along the entire length of saloon. The complete scheme for saloon lighting including gangway area shall be decided during design stage,
- (iv) Separately protected lighting circuits shall be used, such that in the event of one tripping, the others provide evenly distributed lighting throughout the saloon.
- (v) In the elevated corridors, during daytime, the illumination level shall be controlled as per clause ERTS 12.9.1(vii). 100% Saloon lights shall glow in tunnel (if available) all the time and in elevated corridor during night. The changeover shall be automatic as well as driver actuated. Saloon / Emergency light shall be supervised by TCMS. Supplier may propose an alternate proposal wherein all the LED lights may be ON but with varying intensity (current level) to match the requirement of Lux level according to ambient light condition during day and 100% intensity during night. An illumination controller would be required to be installed at car level to maintain the desired illumination level. Active dimming control with sensor count, sensor location details shall be submitted for engineer's review for approval during design stage.
- (vi) 100% of lamps, evenly distributed over the saloon area, shall remain illuminated, energized even when the train / car passes through neutral section.
- (vii) The control Logic shall ensure automatic selection, with manual over-ride, of the saloon light circuit(s) to maximize utilization of the natural light and maintain the desired illumination level. During Daytime, the interior lights shall be controlled automatically through infinite variable dimmer(s) (continuous and step less control) so as to maintain illumination level within acceptable level and reduce the energy consumption. The control of illumination level within acceptable level and reduce the energy consumption. The control of illumination intensity should be at car level with multiple light sensor input to dimmer. The subcontractor shall submit details including the number of sensors, their location, control logic etc. for review by the engineer during design stage.
- (viii) The Contractor shall submit service life of LED lamp during the design stage which shall be as per the best international practices.
- (ix) The Contractor shall submit layout of fittings and control circuit for review by the Employer.
- (x) It shall be possible to replace defective LEDs/ block of LEDs with ease and minimum need for readjustments or otherwise. Any special tool required for the purpose shall be supplied as two sets to each depot.

### 9.3 Cab Illumination (ERTS 12.9.2)

- I. The cab shall be provided with ceiling lights, providing a sensibly constant level of illumination of 200lux at 1m above floor level. It shall be operated automatically by the opening of partition door of either driving console and extinguished manually from within the cab.

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- II. Separate lightning of the train operator's console shall meet the requirements of UIC 651 or which stipulates a minimum of 60 lumens/m<sup>2</sup> measured at the driving control desk. Driving console light shall be operated manually from within the cab.

#### 9.4 Cubicle maintenance Lights (ERTS 12.9.3 )

All cubicles shall have sufficient lighting arrangement for facilitating their maintenance related works and it should be supplied from battery line, duly interlocked with door of that cubicle for maintenance related works shall be made available even after isolation of control supply of the train.

#### 9.5 Other Clauses

- (i) The Diffuser of all the light fittings shall be designed to eliminate glare and ensure that there is no glare by night time reflections in windows. Hot spots of power LED should not be visible and same to be ensured. No different colour patches shall be visible in the Light fitting/Diffuser and the light distribution shall be uniform across the diffuser. Uniform distribution of light should be maintained throughout the light fitting and also on car level. Luminaries shall be designed to conform to relevant international standards.
- (ii) Globe/ Diffuser for Passenger Saloon Light shall be made from laminated toughened glass/ Polycarbonate to be taken care as per the drawing and shall meet the Fire standards as per EN 45545-2013 HL-3. The Vendor may offer better material for the Globe / Diffuser. The same shall be discussed during design stage.
- (iii) All the capacitive components used inside the light fitting should be Ceramic type and if any other capacitor other than ceramic is used, then same shall be discussed during design stage.
- (iv) Potting shall not be provided on the PCB's. Suitable design shall be adopted to withstand Shock & vibration as per IEC 61373.
- (v) Wire Rope of suitable strength shall be provided for diffuser cover to prevent accident falling from Light fitting.
- (vi) The LED light fittings shall be as per drawing no. 525-21025 for length saloon light-1302mm, as per drawing no, 525-21026 for length of Saloon light - 690mm, 525-21027 Saloon light - 305mm and 525-21037 for Gangway Light.
- (vii) The LED light fitting and Diffuser dimension, Mounting aspects, Aesthetic appearance, Profile/Shape of Diffuser, Paint finish etc shall be finalized during Design Stage.
- (viii) Locking mechanism shall be fail safe and shall be easily accessible and operable for maintenance.
- (ix) The design of light fitting will be in such a way that no screws shall be visible from outside.

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- (x) A rubber gasket meeting the International fire standards to be provided for each LED light for mounting on the Car body.
- (xi) Paint: The applicable paint sample will be provided by BEML and vendor shall apply the approved paint shade on the fitting which shall be reviewed and finalized during design stage.
- (xii) Separate Dimmer unit for each car mountable in the cubicle along with Sensors (2 sensor/car) shall be provided for control of LED saloon Lights with the following functions:
  - a) Dimming of Lights based on Ambient light and Sensor input.
  - b) Setting of Lux level at 200,250 and 300 lux.
- (xiii) Failure of Dimmer Unit / Power Supply Unit/ Sensor shall not affect illumination of all light fitting in the car, there shall not be any black out (Complete darkness of the car) due to above cause, this will lead to train withdrawal inturn penalty will be deducted from light supplier for each such failure (Complete darkness) as this is related to train withdrawal scenario.
- (xiv) The sub contractor shall comply the relevant clauses of ERTS chapter 10 and clause 14.7, 14.8, 14.9, 14.10, 14.11, 14.12, 14.13, 14.14, 14.15, 14.16, 14.17.

## 10. Interface

The Lighting System has to be interfaced mechanically and electrically with different subsystems such as car structure, interior, exterior & cab equipment layout arrangement, interior panels, Vehicle Control Circuits, Door system, TCMS, Signalling System and Telecom system etc.,. As a result, BEML will be responsible for interface arrangement however sub-contractor shall be responsible to support BEML for interface arrangement and take lead time to time whenever needed.


The subcontractor will provide BEML with all kinds of information in order to verify the interface concerning mechanically and electrically between vehicle and the subcontractor's scope of supply.

Interface document and drawing made by the subcontractor shall include, but not limited to, the following interface information;

### 10.1 Mechanical Interface

The location of the mounting points and the design of equipment installation comprising of the Lightings shall be defined by the Subcontractor and approved by BEML in order to avoid the mechanical interference with other equipment for the vehicle. Subcontractor shall be responsible for confirming the mounting method and providing all materials for mounting the Lightings as specified in the drawings.

BEML shall be responsible for defining the technical and the design constraints and the technical requirements. The Subcontractor shall be responsible for the optimum design of

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the Lightings, the submission of design information (drawings, technical documents and 3 dimensional modeling data) and the execution of test & inspection in a timely manner without any delay.

Any changes of Lightings design shall be submitted in a timely manner to BEML for approval. The Subcontractor shall have full responsibility to declare and clarify if there is any required information or data from vehicle side and/or running/operating conditions to prevent any design defect under revenue service in the main line.

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


The following is a brief of requirements for Mechanical Interface

- Outline dimension.
- Electrical connection position.
- Fastening, point & torque.
- Demands, free space for installation and maintenance of cover.
- Weight and center of gravity.
- Earth position.
- Thickness of fitting frame & Size and distance dimension of fitting hole.
- Cooling

## 10.2 Electrical/Communication Interface

The subcontractor shall provide the interface specification Lightings and vehicle equipment including Lightings. Time to time BEML will facilitate direct face to face meeting between other sub-system either at BEML works. Subcontractor is responsible to resolve the interface issues to achieve the ERGS and ERTS requirement.

The Subcontractor shall meet the requirement for single point uploading of software and down loading of faults on unit and train basis from TCMS required on TS 10.9.5.

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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
- Cable inlet/outlet diagram.(Size for cable gland of holes)

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

### 10.3 Interface Responsibilities

10.3.1 BEML shall be responsible for defining the technical requirements and the design constraints.

10.3.2 The Subcontractor shall be responsible for the design of the Lighting system and the submission of design information and the performance of testing activities and the supply, installation and commissioning of Lighting system and the maintenance and rectification of the Lighting system during the defects liability period, etc. The Subcontractor shall be responsible for the hardware interface required by BEML. The Subcontractor shall be responsible of deputing his engineer to BEML for the technical meeting.

10.3.3 The Subcontractor shall be responsible for interface with TCMS.

10.3.4 The subcontractor shall meet the communication protocol requirements of the TCMS of interface design in accordance with the interface document requirements for Lighting system.

10.3.5 Interface with TCMS shall be Ethernet based and shall be compliant to a common standard or standards as per ERTS 10.2.1 & 10.3.3.


10.3.6 The sub contractor shall meet the requirements but not be limited to ERTS Chapter 10 with regard to TCMS interface.

### 10.4 Electrical Requirement

1) Minimum discrete input signal current

Higher than 10mA. If these signal current value is less than 10mA the contact shall be used



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the gold contacts.

## 2) Connector & Terminal

- The subcontractor shall supply all the accessories (plug, receptacle including pin, socket clamp and spare pin and socket.).
- Drawings from the Subcontractor are required to contain connector accessories (Backshell, grommet, bushing, rubber, clamp and etc) information.
- A minimum of 10 percent spare terminals shall be provided on each connector or terminal assembly **at the end of DLP period as per ERTS clause no. 12.2.12. Sufficient margin may be taken by the sub ccontractor during design so that above criteria is met at the end of DLP period.**
- The real pins shall be supplied along with plugs and receptacles for spare pin & sockets.
- Unless otherwise approved, all cable terminations shall be of the crimped type and soldered connections shall not be used.

## 3) Scope of Wire

- Other than regular cables supplied by the Car Builder, the special cables that are used for connection within the system need to be supplied by the Subcontractor.  
Ex: Speed sensor cable, antenna cable, special communication cable etc.
- If the Subcontractor supplies its product as a “ Harness System,” supplied drawing needs to clearly indicate it while personnel from the Sub Supplier directly inform BEML Engineer.

## 4) Suppressor

The transient current source (coil, magnet valve, contactor, relay and etc) shall be included in the suppressor.

## 5) Inrush Current / Power Consumption

- Subcontractor shall submit the all-electric characteristics to car builder.
- All systems shall be designed to protect against the surge and/or inrush current.

## 6) System Protection Circuit Breaker

- All systems shall be required and designed the self-protection system.
- If internal circuit breaker will be installed in system, the Subcontractor shall submit the electric characteristic information to car builder.


## 7) Paralleling for Redundancy

The contact of major components shall be paralleled for redundancy.

## 8) Control Equipment

All Control Equipment of Lightings shall comply to the requirement of ERTS 12.4



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9) All System shall be designed in accordance with Material & Workmanship in ERTS Ch. 14

10) Following requirements are applied to Lightings.

- a) Microprocessors and Software-based Equipment comply with TS 14.13 requirement.
- b) Software shall comply with ERTS 14.14 requirement.  
(PTS 15.3)
- c) Printed Circuit Board and Connectors with ERTS 14.15 requirement.  
(All PCB contact faces of connectors shall be gold plated)
- d) Integrated Circuits shall comply with ERTS 14.16 requirement.
- e) Labels shall comply with ERTS 14.17 requirement
- f) Lubricants shall comply with ERTS 14.18 requirement

## 11. Weight

The subcontractor shall submit estimated weights and center of gravity and be approved by BEML. The actual weights must not deviate by  $\pm 4\%$  of the estimated weights.

## 12. Mock-up

Mock-up shall be provided to End-user in accordance to TS Appendix-TB requirement and BEML's mock-up plan.

Drawings must be submitted AUTO CAD and CATIA V5 modeling. it can be modifiable CAD or CATIA Tool.

The subcontractor shall provide items and CAD/CATIA drawings applied to Mock-up within the required date.


The subcontractor shall supply the material inline with clause no. 7.3 (ERTS 4.2 & Appendix TB) to BEML Bangalore Works.

## 13. RAMS Requirements

The sub-contractor shall meet RAMS (Reliability, Availability, Maintainability and Safety) requirements given in the Technical Specification (ERTS) and the General Specification (ERGS). Also, the sub-contractor should provide all information related to the RAMS requirements. The sub-contractor shall comply with, but not limited to, the following requirements:

### 13.1 Reliability Analysis

The reliability data shall be based on actual operating information for the equipment. If the equipment in question has no previous operating experience, operational data from a similar piece of equipment shall be used. In this case, the reliability data shall be taken from equipment having approximately the same electrical and mechanical characteristics and operating under similar conditions. Under these circumstances, sub-contractor will use this data and must be approved by BEML.

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In the case where there is no operating experience with similar equipment, reliability data shall be estimated and provided in accordance with the latest revision of reliability data-book such as MIL-HDBK-217, NPRD, EPRD, PRISM or similar.

In addition, the sub-contractor shall submit a list of typical train withdrawal scenarios for review and acceptance by 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 as per ERTS Appendix TG should be based on the reliability analysis.

The reliability block diagrams and prediction of reliability performance shall be developed and 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 sub-contractor shall submit reliability prediction to demonstrate by quantitative methods above the achievement of the specified levels of reliability for the scope of supply.

The sub-contractor shall prepare the data source of reliability prediction, providing for MRS1 request.

### 13.2 Reliability Target

The sub-contractor shall achieve the following two reliability targets during Defect Liability Periods specified in ERTS 2.8

The MDBCF (Mean Distance Between Component Failure) per 6 car train-set shall be as follows:

Equipment	MDBCF (Train-km)
Lighting System	8,000,000

\* Operation Conditions as per ERTS 3.22

-Daily Operation Hour : 15 hours


-Annual Operation Distance : 150,000 km

The reliability performance shall be assessed by the following measure:

$$MDBCF = \frac{\sum \text{Travelled kilometer per train – set}}{\sum \text{Number of Service Failures}}$$

Where,

Mean Distance Between Component Failures (MDBCF): The MDBCF 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 trains to the total number of **relevant** failures occurring within the population identical items.

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**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 Contractor 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.

**Non-relevant Failure:** Any failure of an item not included in the definition of relevant failure, such as the following:

- A failure caused by malfunction of other equipment or subsystem that are not supplied by the Contractor;
- A failure caused by human error, except as noted in Relevant Failure above;
- A failure caused by accidents not associated with the normal operation of the item. Such as collision or striking a foreign object on the right of way;
- A failure caused by operating the equipment or sub-system outside of design or environmental specification limits.


**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 as per ERTS Appendix TG;
- A delay equivalent to or exceeding 3 minutes from the Schedule / Time table as noted at the destination station for the one way trip.

**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 predicted failure rate of the part, item or equipment. The percentage predicted rate shall be as under:

- three or more relevant Service Failures of the same replaceable part, item or equipment in same manner in identical or equivalent applications occur at a rate which is at least 20 % higher than the predicted failure rate of the part, item or equipment and / or
- at least 20 % of the same replaceable part, item or equipment in the fleet has a relevant failure in the same manner in identical or equivalent applications during a moving 18 months window starting when the reliability demonstration starts and ending at the end of the Defect Liability Period, these failures will be classed as pattern failures.

The sub-contractor shall submit 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.

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For each case of de-boarding of commuters on account of reasons attributable to the contractor, Employer may at his sole discretion impose a penalty of Rs 15,00,000 (Fifteen Lakh). Decision of Employer shall be final and binding as specified in ERTS 2.7.9

### 13.3 Maintainability Requirements

#### 13.3.1 Design requirements

The design of all components will be such that maintenance is reduced to a minimum, 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 through out 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 sub-contractor shall also comply with the maintenance requirement of ERTS 2.12.

#### 13.3.2 Maintainability Target


- 1) The LRU replacement should be less than 30 minutes
- 2) The mean time to repair (MTTR) of Lighting should be less than 1 hour.
- 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.
- 5) The Least Replaceable Units (LRU's) for the equipments/systems should not take more than 30 minutes for replacement. In order to achieve this requirement, quick release connections such as plugs and adaptor shall be provided between LRU's and the equipment

### 13.4 Life Cycle Costs

The sub-contractor shall provide equipment that has minimum total Life Cycle Cost. The sub-contractor shall submit all information for Life Cycle Cost calculation in accordance with RAMS Guideline to be provided by BEML. The Life Cycle Cost which contains preventive and corrective maintenance activities shall be in compliance with the Maintenance Manuals prepared by the Contractor.

### 13.5 Reliability and Maintainability Demonstrations

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 sub-contractor shall, at his own expense, take whatever action to meet the R&M target specified.

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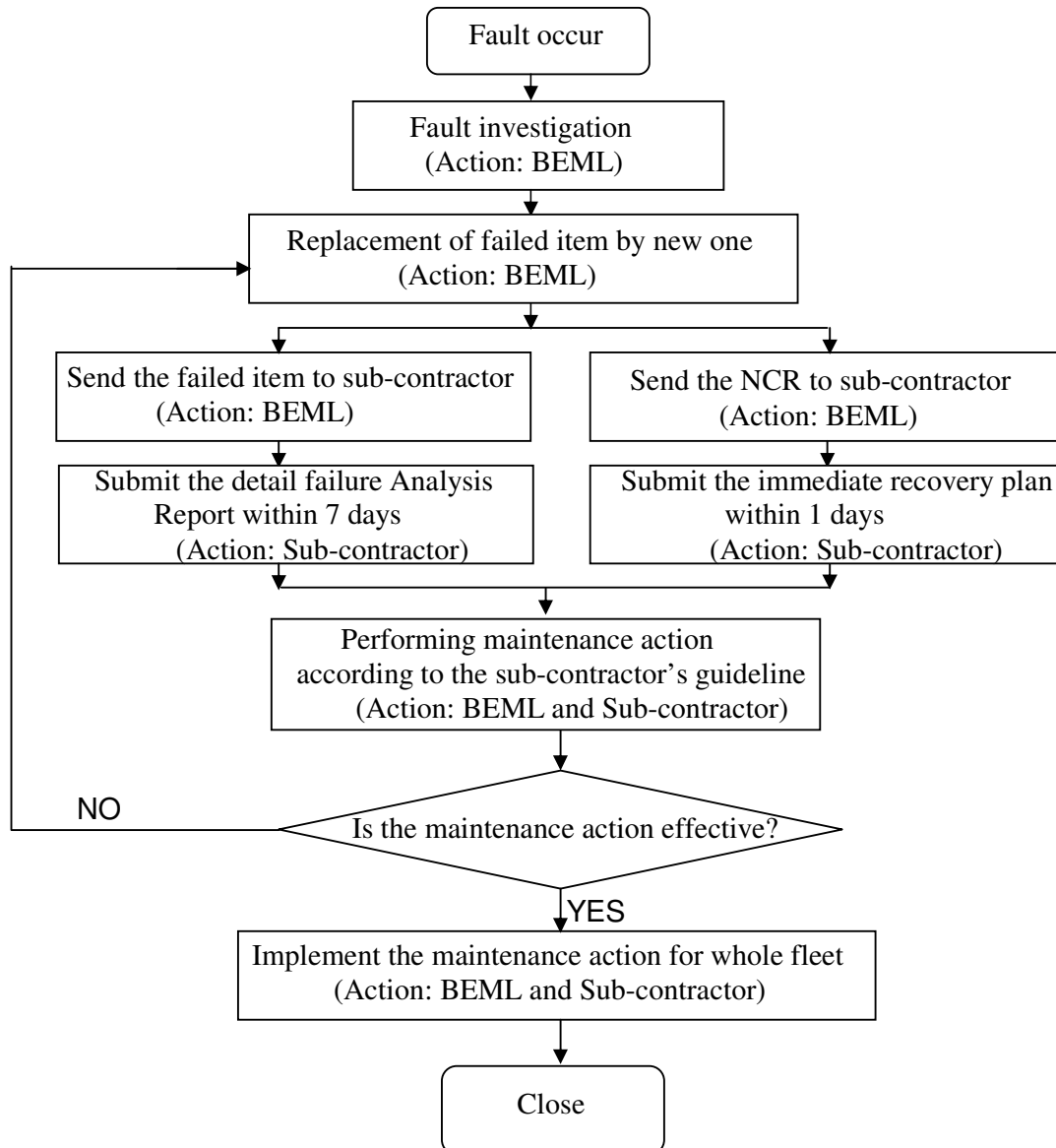



Figure 1. Maintenance Procedure of BEML Company

The sub-contractor shall support an active maintenance for high availability. The maintenance procedure of BEML is at figure1. Therefore, the sub-contractor shall comply with BEML's procedure. If some failure needs the sub-contractor support, the sub-contractor should dispatch engineer as soon as possible. Also, if the sub-contractor needs to provide some training for BEML's maintenance engineer, the sub-contractor shall perform it.

The sub-contractor shall provide sufficient spare part for high availability. The sub-contractor shall submit a spare part list and recommended quantity at the maintenance depot.

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### 13.6 Safety Requirements

The sub-contractor shall perform all system safety tasks required to meet the Technical Specification and ensure that the safety critical hazards for scope of supply shall be eliminated or reduced to the level of ALARP.

To meet the safety requirement, the sub-contractor shall submit the following documentations as a minimum;

- 1) Hazard Analysis including Subsystem Hazard Analysis, Operating and Support Hazard Analysis and Interface Hazard Analysis
- 2) FMECA (Failure Mode, Effects and Criticality Analysis)
- 3) Fault Tree Analysis (FTA) for Safety Critical Events (Including source of all failure rate employed to be indicated in the hazard analysis)

The sub-contractor shall submit the safety related documentations in fully compliance with RAMS Guideline (especially format and methodology).


### 13.7 RAMS Deliverables

The sub-contractor shall submit the following RAMS Deliverables.

- RAM Information Table and Reliability Block Diagram during pre-final design and final design stage
- Preliminary Reliability and Maintainability Analysis Report during pre-final design and final design stage
- Final Reliability and Maintainability Analysis Report during pre-final design and final design stage
- LRUs list during pre-final design and final design stage
- Hazard Analysis during pre-final design and final design stage
- FMECA (Failure Mode, Effects and Criticality Analysis) during pre-final design and final design stage
- Safety FTA during final design stage
- Life Cycle Cost during final design stage

### 13.8 Maintenance Requirement

During the design stage, the Contractor shall submit downtime and manpower requirements for the maintenance inspections, service checks and Overhaul considered necessary for maintaining the trains under normal operational conditions as below table. The service check and Overhaul sessions shall include all routine and heavy maintenance activities including inspections, minor / major overhauls and half-life overhaul. And if the equipment has half-life overhaul, the interval of the equipment shall be defined by Sub-Contractor. The subcontractor shall perform the maintainability demonstration, as applicable to his equipment, at his own expense.

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Session	Interval	Manpower and D/T Requirements	
		Downtime	Required Manpower
Daily Check	-		
A Service Check	6,000 km (15days)		
B1 Service Check	18,000 km (45days)		
B4 Service Check	72,000 km (180days)		
B8 Service Check	150,000 km (1year)		
B16 Service Check	300,000 km (2years)		
C1 Overhaul	520,000 km (3.5years)		
C2 Overhaul	1,040,000 km (7years)		
C3 Overhaul	1,560,000 km (10.5years)		
-	-		
Half-Life Overhaul	2,250,000 km (15years)		


Average mileage per year for a metro train in the range of 150,000 km.

### 13.9 Fire Safety

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

The materials used shall conform to Fire Safety requirements of EN 45545 Part 1 to 7(Category 4-A, Hazard level HL3) latest editions as a minimum or better international standards applicable for similar Metro for underground operations with front evacuation, subject to the acceptance of the Engineer as per ERTS 2.5.8 & 2.19.

1. Flammable materials shall be well contained with IP 65 protection as per ERTS 2.19.1 (iii)
2. ERTS 12.5.2: The insulation of all wires and cables including those used within equipment / subsystem shall be halogen-free flame- retardant and formulated to minimise generation of smoke, noxious emissions and corrosive fumes, in the case of overheating or fire in compliance with EN 45545 (Category 4-A, Hazard level HL3) latest edition. All Cables shall comply NF F 63-808 (for low voltages), and NF F 63-826 (for high voltages) or other international standards like EN 50264(Part 1 to 3) and EN 50306(Part 1 to 4) as approved by the Engineer.
3. ERTS 12.5.3: Fire resistant cables shall be proposed for circuits, which should survive for long periods during fire, as per applicable international standards. As a minimum, the cables and wires for Public Address System, emergency lighting, door opening and warning systems shall be fire resistant in compliant to EN 50200.
4. ERTS 10.1.11: The cables which are intended to be used in emergency circuit for alarms and communication shall have intrinsic fire resistant property in compliance with EN 50200.

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### 13.9.1 Fire Load Calculation

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

Fire load calculation for all non-metallic materials has 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.

### 13.9.2 Fire Performance Deliverables

The Fire Performance Deliverables shall be provided, but not be limited to, the following Table:

No	Deliverable	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

## 13.10 Wires and Cables


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

13.10.2 ERTS 12.5.2: 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 EN45545(Category 4-A, Hazard level HL-3)latest edition. All Cables shall comply NF F 63-808 (for low voltages), and NF F 63-826 (for high voltages) or other international standards like EN 50264(Part 1 to 3) and EN 50306 (Part 1 to 4)as approved by Engineer.

13.10.3 ERTS 12.5.6: The voltage grades shall be compliant according to IEC 60502 (1/2/4).

13.10.4 The Cable Markers provided shall be fire retardant heat shrinkable type. The cable markers shall be protected against fading by providing Fire retardant heat shrinkable clear sleeves.



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### 13.11 Paint

The paint shall be conforming to Fire Standards as per EN 45545.

## 14. EMC Requirements

### 14.1 General Requirements

The contractor shall meet all EMC requirements specified in the ERTS 2.15, 15.27 and ERTS Appendix TD: 3.12 where applicable and shall work together with BEML to assure that all electronic and electrical equipment on the rolling stock works properly without any interference.

### 14.2 EMC Control Plan

The Contractor shall submit an EMC Control Plan for the BEML's review and acceptance and it shall include an EMC analysis report including various measures to reduce conducted, induced and radiated emissions to acceptable levels as specified by the relevant international standards. The plan shall specify measures to increase immunity of the subsystems in scope of supply. All train borne equipment on the vehicle shall be designed and constructed to fulfill the requirements of EN 50121-3-2 and any standards where applicable.

### 14.3 EMC Laboratory Tests

Emission and Immunity tests for all individual equipments on vehicles shall be performed under normal operating condition according to EN 50121-3-2 and the test specification and the test report shall be provided to BEML for review and acceptance.

## 15. Operation and Maintenance Manuals and Spare Parts Catalogues

The Subcontractor shall provide the Operation/Maintenance Manuals and Spare Parts Catalogues of the Lighting System both in the hard copies and electronic format as required in MRS1 ERTS & ERGS. The requirement for Operation/Maintenance Manuals and Spare Parts Catalogues shall be provided for Approval of BEML according to the time schedule defined by BEML.


The subcontractor shall provide the following O & M manual:

- a) Volume 1 – Technical Manual
- b) Volume 2 – Operation Manual
- c) Volume 3 – Maintenance Manual
- d) Volume 4 – Fault Diagnostics Manual
- e) Volume 5 – Spare Parts Manual
- f) Volume 6 – Software Manual
- g) Volume 7 – Special Tools & Test Equipment Manual

### 15.1 Operation & Maintenance Manual

#### 15.1.1 General Requirement

The Subcontractor shall prepare the Operation Manual, the Maintenance Manual, and the Illustrated Parts Catalogue for the Lighting system.

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Thirty days before the date of commencement of test running of the first EMU train, the Subcontractor shall deliver the originals and 6 coloured copies each of the final Operation and Maintenance manuals. These manuals shall have been submitted for proof reading and training purposes prior to delivery. It is accepted that further amendments may subsequently be required. Refer section 12.1 of ERGS.

#### 15.1.2 Operation Manuals

The Subcontractor shall provide operation manuals explaining the purpose and operation of the complete system together with its component subsidiary systems and individual item of equipment. The characteristics, ratings and any necessary operating limits of the equipment and Sub-systems shall be provided. The Subcontractor shall prepare and submit to BEML/DMRC for review and approval, the Operations Manual for the System.

#### 15.1.3 Maintenance Manuals

The Subcontractor shall provide maintenance manuals showing details of all the various systems and sub-systems from a maintenance and fault finding standpoint, with particulars of operating parameters, tools for dismantling and testing, methods of assembly and disassembly, tolerances, repair techniques and all other information necessary to set up a repair and servicing programme. Refer section 12.3 of ERGS for complete details.

#### 15.1.4 Illustrated Parts Catalogue

The Illustrated Parts Catalogue shall contain exploded views, if applicable, for each assembly, subassembly, and sub-subassembly with a full parts list. All parts shown on the illustrations shall be identified by an item number and leader lines. Engineering drawings and photographs shall not be acceptable, unless specifically approved by the DMRC.


The list shall include all parts attached by means other than welding or riveting, unless welded or riveted parts are considered normally replaceable by the manufacturer.

The figures and text listings shall have the same orientation (i.e., both landscape and both portraits).

The column headings shall provide the following information (starting with the left hand column):

- (a) Figure and item number,
- (b) Part number (either the original equipment manufacturers or the Subcontractors) and part description
- (c) Original equipment manufacturers code
- (d) Provision for entry of customer stock code.

For standard electrical, electronic, pneumatic, and / or hydraulic hardware components such as nuts, bolts, resistors, lamps, valves, etc., the description shall provide sufficient detail to facilitate procurement from a generic supplier.

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#### 15.1.5 Submissions

The Subcontractor shall submit the draft of all manuals to BEML. After submission of draft maintenance manual, the final maintenance manual shall be provided within schedule approved by BEML.

### 15.2 Spares, Special Tools and Testing Equipment

The Subcontractor shall hand over the Spares, Special tools and testing equipment in accordance with the delivery schedule of BEML. **The supplier shall maintain the Lighting system and supply of spares for at least 10 years from the date of completion of the contract.**

The Subcontractor shall supply the following items of spares **(as per Annexure-1, inline with Cost centre G)**

- (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 various equipment, sub-systems in particular and the complete trains in totality

The detailed requirements are specified in ERGS 8.

The actual requirements (list & qty) are subject to DMRC/BEML approval (DMRC-MRS1 cost center 'G' contract conditions). The subcontractor shall comply with the same.


#### 15.2.1 Unit exchange Spares

The subcontractor shall supply Unit exchange spares for maintenance of all trains as per ERGS 8.2

#### 15.2.2 Consumable Spares

The Subcontractor shall supply consumable spares for maintenance of all trains during commissioning, service trails and up to completion of warranty period as per ERGS 8.3.

The consumable spares shall include lubricants, oils, grease, sealants, filter media, gaskets and any other items, whose declared life is less than one year.

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Recommended list shall be furnished by the Subcontractor as part of design submission.

### 15.2.3 Mandatory spares

The subcontractor shall supply mandatory spares as per ERGS 8.4

### 15.2.4 Recommended spares

The subcontractor shall supply recommended spares as per ERGS 8.5. Subcontractor shall provide list of recommended spares which are not covered under consumables and mandatory spares but are expected to be required during 2 years after expiry of warranty period.

### 15.2.5 Overhauling spares

The subcontractor shall supply overhauling spares as per ERGS 8.6. Subcontractor shall supply the overhauling kits for ten (10) train sets. Overhauling kits for all those equipments, systems, sub-systems of trains that will need overhauling during intermediate overhaul of the train will be included in these kits.

### 15.2.6 Special Tools, Testing and Diagnostic equipments

The subcontractor shall supply Special tools, testing & equipments as per ERGS 8.7. Subcontractor shall provide a recommended list and supply two(2) set of fixed and two(2) sets of portable and hand held special tools, testing and Diagnostic equipments for preventive and breakdown maintenance, overhauling and diagnostics of various equipment provided in the cars.

Recommended list shall be furnished by the Subcontractor as part of design submission.

### 15.2.7 Special Jigs, Fixtures and Gauges


The subcontractor shall supply special Jigs, Fixtures and gauges as per ERGS 8.8.

Subcontractor shall provide a recommended list and supply, as minimum, two (2) set of fixed Special Jigs, Fixtures and Test Benches and two (2) sets of hand held and portable tooling, measuring and diagnostic equipment and Gauges separately for preventive and breakdown maintenance, overhauling and diagnostics of various equipments provided in the cars.

Recommended list shall be furnished by the Subcontractor as part of design submission.

### 15.2.8 Commissioning and DLP Spares

The subcontractor shall supply commissioning and DLP spares as per ERGS 8.11. 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. Subcontractor shall submit the DLP/Commissioning Spares list along with technical offer. Subcontractor shall position the DLP, Commissioning spares at MRS1 Mumbai Depot at free of cost as per the approved list.

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

### **15.3 Storage, Packing Crating and Marking**

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

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

The detailed requirements are specified in ERGS 13.

### **15.4 Training**

#### **15.4.1 General**

The subcontractor shall provide the training for Employer's operating staff and maintenance staff according to the requirements specified in ERGS 9.

#### **15.4.2 Training Requirements**


The sub-contractor shall provide training to BEML/DMRC staff at Factory and MRS1 site. The subcontractor shall submit a training proposal to BEML.  
The detailed requirements are specified in ERGS 9.1.

#### **15.4.3 Training Manual**

The subcontractor shall provide one original and five colored hard copies and soft copy of the Training manual for use by the Employer for conducting in-house training. The Manuals shall cover all requirements specified in ERGS 9.  
After completion of the training, training aids and materials used shall become the property of BEML to enable and further training to take place.

#### **15.4.4 Training Location.**

Training shall be carried out in such locations as will provide the maximum benefit to the trainees. Such locations may be in India, or abroad at places of manufacture, assembly or testing or other locations as may be necessary as specified in ERGS 9.7.

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## 16 Quality Assurance Program

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

### 16.1 Quality Assurance Plan

The Subcontractor shall develop and submit to BEML QC team for review and approval a Quality Assurance Plan (QAP) based on ISO 9001 and ERGS 2.5. The subcontractor shall have the following

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

### 16.2 Quality Assurance activities

The Subcontractor shall address, as a minimum, the following activities and shall provide a means of self-correcting any shortcomings in his Quality Assurance Plan (QAP) as per ERGS 2.5.

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

### 16.3 Quality Audit


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

### 16.4 Inspection and Test Plan (ITP)

ITP shall be submitted to BEML QC team for review and approval as following no later than 30 days after purchase order by BEML. Subcontractor shall comply with ERTS 15.

**A)** The ITP includes all the major inspection and test activities planned prior and during the design, procurement and installation phases. The (ITP) will include, as a minimum, the following:

- (a) Introduction of ITP (purpose, application scope and etc)
- (b) Description of Symbols, Abbreviations and Definitions

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- (c) Sampling Procedure if it is necessary
- (d) Inspection/Test Notification procedure
- (e) General Inspection/Test process/flow
- (f) Manufacturing and Inspection/Test flow (block diagram) which describes manufacturing flows and inspection/test points.
- (g) Description of Inspection and test activity and item
- (h) Kinds of Inspection and Test such as Design Qualification verification test ( ), FAI, Routine inspection/test
- (i) Inspection/Test Level such as 100%, Sampling, 1/Lot and etc
- (j) References of the inspection/test such as specification, procedure, etc
- (k) Responsible entity of the inspections and tests
- (l) Places of the Inspection and test
- (m) Witness/hold points of BEML and/or the Customer of BEML
- (n) Description of Reports /checklists required and the Submission
  - A table format is recommended to describe the Items (g) & (n).

#### **B) Witness/Hold point of Inspection/Test**

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

- Witness point of Inspection/test

To be witnessed randomly by BEML and/or the Customer of BEML. It requires the notification of inspection/test schedule written by the Subcontractor. The subcontractor can proceed his next process without agreement with BEML and/or the Customer of BEML if there is no written answer or intention from BEML and/or the Customer of BEML to witness the notified inspection/test.

- Hold point of Inspection/test

To be witnessed by BEML and/or the Customer of BEML. It requires the notification of inspection/test schedule written by the Subcontractor to BEML. In case of hold point, Subcontractor can do the next process after acceptance of the inspection/test or waiver (or agreement) by BEML and/or the Customer of BEML. Generally, Type Test (Design verification/qualification test) are designated as the Hold Point.

#### **C) Inspection/Test Notification of Witness/Hold point**

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


## **17 Design Information**

17.1 The drawings and documents shall be submitted to BEML including preliminary, pre-final, and final design submissions, the final contract document, and all other submission both in the paper copies and electronic format.

17.2 The Subcontractor shall require the interface information, which possibly affects performance, fitting and form, which shall be provided by BEML.

### **17.1 General**

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


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

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

The subcontractor shall submit, not limit to, the following general information in accordance with the schedule.



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Document /Deliverables	Reference /Description
Testing plan	ERGS 7, ERTS14, ERTS 15
Schedule of Tests	ERGS 7, ERTS14, ERTS 15
Test procedure of Type and routine test of equipment, Type test of complete vehicles, Commissioning test of complete vehicles.	ERGS 7, ERTS14, ERTS 15
List of Spares, Special Tools and Testing and Diagnostic equipment	ERGS 8
All relevant drawings, manuals and full operation instructions for the Special Tools, Testing and Diagnostic Equipment	ERGS 8
Training Proposal	ERGS 9
Training Course	ERGS 9
Training Manual	ERGS 9
Operation and Maintenance Manuals and	ERGS 8
Spare parts catalogues	ERGS 8
All as-built drawings	ERGS 5
All tools, equipment and manuals necessary for the maintenance	ERGS 8
The requirements for the completion of Project Management Plan, Interface Management Plan, Work Plan, Quality Assurance Plan, Safety Assurance Plan and Site Safety Plan, Environmental Plan, Inspection, Test and Commissioning Plan	ERGS 2


## 17.2 DESIGN

### 17.2.1 General

The design of Lighting shall basically comply with ERTS 3, ERTS 12.5, ERTS14.12, ERTS 14.7, ERTS 13, ERTS 12.8, ERTS 12.9 and relevant specification of ERGS and ERTS.

The design submission shall be submitted to BEML according to the following three stages;

- (1) Preliminary design submission stage (refer to ERGS 5.7)
- (2) Pre-final design submission stage (ERGS 5.8)

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(3) Final design submission stage (ERGS 5.9)

The Subcontractor shall submit BEML all necessary documents and deliverables such as the detailed drawings, specifications, assumptions, calculations, back-up data, plan, procedure, reports, co-ordination & interface information which possibly affects performance, fitting for approval according to the schedule accepted by BEML.


Also, the Subcontractor shall submit the design deliverable submission schedule for acceptance within following requested due date, and resubmit it whenever updated.

The Subcontractor shall submit, but not limit to, the following design deliverables in accordance with the required schedule:


Design Stage	Document/Deliverables	Submission date required(from LOI/ contract award)
Evaluation Stage	Compliance Matrix List (Clause by Clause) including Spec. Clarification/Waiver Request	Within 2 weeks after receiving PTS.
	General Technical Description of Proposed LIGHTING SYSTEM	
	Service/Delivery History of Proposed LIGHTING SYSTEM and other required documents/information	
PDR	Project Management Plan (PMP): The Subcontractor shall resubmit, if there is any amendment of PMP, in time for acceptance of BEML.  - Illustrated project schedules, Chart, tables  - List of Submission Data,  - Configuration Management Plan	Within 2 weeks
	Schedule Plan for  - Design Deliverables/Drawing submission  - Design, Validation, Test & Inspection and Manufacturing	Within 2 weeks.  Shall update/ submit whenever any change happens.
	Compliance certification to all required Standards of LIGHTING SYSTEM	Within 2 weeks
	Concept design drawings (Dimensional Installation Drawings: AutoCAD or CATIA file)	Within 1 month

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Design Stage	Document/Deliverables	Submission date required(from LOI/ contract award)
	-General description	Within 2 weeks
	- Detailed Tech. Spec. & data of LIGHTING SYSTEM	
	- Details of LIGHTING SYSTEM construction	
	- Spec. & Life of Components for LIGHTING SYSTEM	
	- The details of Components for LIGHTING SYSTEM	
	Technical Description (incl. at least following information) : The detailed submission schedule of each item shall be submitted for approval according to required design stage.	
	Preliminary/Final Power Consumption (If applicable)	
	Constraint of Electric connection (if applicable)	
	Electrical Function description (if applicable)	
PFDR	Preliminary Design Drawings (Dimensional Assembly Drawing: AutoCAD or CATIA file)	Within 1 month
	Water-Tightness and Acoustic Improvement Method	Within 1 month
	Operating Instruction (if applicable)	Within 1 month
	Preliminary/Final 3D modeling data	Within 1 month
	Cleaning details & maintenance instruction of Equipment	Within 1 month
	Safety Analysis	Within 1 month
	Preliminary/Final Samples	Within 1 month

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Design Stage	Document/Deliverables	Submission date required(from LOI/ contract award)
	Estimated/Measured Light Transmission and Solar Heat Transmission value of LIGHTING SYSTEM	Within 1 month
	Estimated/Measured Noise attenuation data	Within 1 month
	Estimated/Measured weight of all LIGHTING SYSTEM components	Within 1 month
	Material List/Spec. & Certification for Fire safety	Within 1 month
	Surface Finish Specification (Painting to TS 14.19, anodizing, etc.)	Within 1 month
	LIGHTING SYSTEM Strength Calculation	Within 1 month
	Manufacturing tolerance of LIGHTING SYSTEM	Within 1 month
	Function Description	Within 1 month
	System block diagram (if applicable)	
	Caution Instruction for LIGHTING SYSTEM Installation	Within 1 month
	Replacement Instruction & Demonstration of LIGHTING SYSTEM	Within 1 month
	Life expectancy of major parts and LRUs	Within 1 month
	Consumables List for LIGHTING SYSTEM	Within 1 month
	Preliminary Plan/schedule for Testing & Inspection	Within 1 month
	O&M Manual, IPC submission List	Within 1 month
	Preliminary list of spares, special tools and test equipment	Within 1 month
	List of equipment identification labels	If required
FDR	Final Design Drawings (Dimensional Sub-assembly drawings: AutoCAD or CATIA file)	Within 2 month

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Design Stage	Document/Deliverables	Submission date required(from LOI/ contract award)
	The manufacturing details of all LIGHTING SYSTEM	Within 2 month
	-Compliance certificate to Standard applied for design, test & manufacture	Within 2 month
	Installation Instruction of all LIGHTING SYSTEM	Within 2 month
	Cleaning, storage and handling instruction of LIGHTING SYSTEM	Within 2 month
	Maintenance & Inspection Instructions	Within 2 month
	Detailed Test & Inspection Plan/Schedule	Within 2 month
	Type Test Procedure (incl. record sheet) & Report	Within 2 month
	Routine Test Procedure (incl. record sheet) & Report	Within 2 month
	FAI Procedure & Report	Within 2 month
	Type/Routine Test Procedure (incl. record sheet) & Report in Completed car	If required
	Commissioning Type Test Procedure & Report	If required
	Updated list of LRUs	Within 2 month
	Final List of Special Tools, Spare Parts, Test Equipment	Within 2 month
	Draft & Final O/M manuals	Within 2 month
	Draft & Final IPC (Illustrated Parts Catalogue)	Within 2 month
	Training Manuals & Materials	Within 2 month
	Details of equipment identification labels	If required
	All relevant Operation & Maintenance Information and Training Manual for Special Tools and Test Equipment	Within 2 month
	As-built drawings & List	Within 2 month
All	Monthly Progress Report including followings at minimum (Sub-contractor shall use the attached template for	Monthly

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Design Stage	Document/Deliverables	Submission date required(from LOI/ contract award)
Stages	Monthly progress report.) -. Design Progress Report (Schedule & achieved Activity) -. All Design Deliverable Submission Plan/progress Status -. Estimated/Measured Weight -. Open Items List -. Master test plan and progress -. Waiver Request/Spec. Clarification Items -. Any information required by BEML	
	Any other design data requested	During design stage

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

BEML will furnish the review comments about the submission to the subcontractor. The subcontractor shall meet with BEML to discuss the review comments. Should BEML deem the submission to be unacceptable, the subcontractor shall revise and re-submit the submission as soon as possible.


### 17.3 SEM (System Engineering Management)

The Subcontractor shall submit, not limit to, the following design information within the defined schedule:

The technical requirements of noise, vibration, fire, weight, safety, reliability, maintainability and availability shall be submitted.

The subcontractor shall submit, not limit to, the following general information in accordance with the schedule

Classification	Document/ Deliverables
Proposal , plan & prediction	Design proposal for noise, Vibration and fire
	Breakdown list and weight of each component
	Detailed prediction of the power output from the flash over

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	Fire load schedule based on fire load density of materials of components
	Material analysis on component level
	RAM data
	Hazard log & register of train failure RAM modeling & prediction, RAM Table, Hazard analysis, FMECA, FTA
Detail test procedures	Description of noise test procedure
	Description of fire test procedure
Test Reports	Report on weight measurement
	Certificate of fire tested non-metallic materials of components

## 18 Testing

### 18.1 General

#### 18.1.1 General

The subcontractor shall provide BEML with all information for the completion of Inspection, Testing and Commissioning Plan and also comply with the plan defined according to the requirements specified in ERGS 7 , ERTS14.12 and ERTS 15

The type tests for the Lighting at both the component level and complete train level, for MRS1 Operational line, shall be re-performed by the Subcontractor under BEML and DMRC participation, if DMRC want to witness the tests even though the tests were accepted by BEML.

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


All defects and shortfalls in the subcontractor's system, discovered during all tests, shall be made good and re-tested to the satisfaction of BEML and DMRC.

The subcontractor shall provide full instrumentation to conduct all tests and carry out modifications as required.

All test procedures, reports including all maintenance activities and check lists shall be submitted and approved by BEML and DMRC within the defined period.

The results of all tests shall be submitted to BEML and DMRC, who will record his conclusions as to whether or not the equipment being tested has passed satisfactorily.

The subcontractor shall produce a test report, in three copies, and in an approved format, within a defined period following the test, for acceptance by BEML and DMRC. The detailed requirements are specified in ERGS 7, ERTS14.12 and ERTS 15.

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### 18.1.2 Inspection

All the materials, fittings, equipment, manufacturing processes, and assembly workmanship shall be subject to inspection by BEML and DMRC, wherever carried out in accordance with the requirements specified in ERGS 7.1.

### 18.1.3 Inspection Hold Points

The subcontractor shall propose a set of inspection hold points in the Inspection, Testing and Commissioning Plan in accordance with the requirements specified in ERGS 7.1.

### 18.1.4 Test Procedure

Following items shall be complied

- (1) All test equipment shall carry an appropriate and valid calibration label.
- (2) The subcontractor shall sign all reports of Tests
- (3) The subcontractor shall present a comprehensive Testing and Commissioning Program.
- (4) Test procedures shall be amended, as required by the subcontractor throughout the duration of the Contract, to reflect changes in system design or the identification of additional testing requirements.
- (5) All costs including labor, supervision of testing, provision of specialized equipment and materials, and the cost of hiring Consultants and the services of other specialized personnel or independent assessors etc shall be borne by the subcontractor.
- (6) The subcontractor shall also bear any expenses incurred due to re-testing caused by defects or failure of equipment or any other account to meet the requirements of the contract. The detailed requirements are specified in GS 7.

### 18.1.5 Sequence of Tests

- (1) Routine and type test of equipment and sub-systems in accordance with relevant standard and specifications in Contractor/Sub-contractor's factories.
- (2) Factory and Site Tests of complete cars in accordance with IEC 61133.
- (3) Testing and commissioning of cars/trains in Depot in accordance with IEC 61133.
- (4) Integration Tests in conjunction with all Designated Contractors.
- (5) Instrumentation and Dynamometer Tests, and Oscillation Trials on Prototype Rakes only.
- (6) Service Trials


## 18.2 Routine and Type Tests of Equipment and Sub-Systems

### 18.2.1 Equipment Type and Routine test

The test plan and test procedures shall be submitted according to approved test schedule.

The Subcontractor shall notice BEML for the request of witness at least 1 month prior to the commencement of testing. Prior to the notification of test witness, the test procedure shall be approved. The Subcontractor shall conform to all requirements pertinent to Lightings in Relevant to TS Chapter and ERTS 20 requirements.




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Test items, applied standards and its procedures can be changed or added due to Employer's request. In case of test item addition, subcontractor shall carry out the additional test with no additional cost.

The test for lighting system shall include, but not be limited to, the followings:

Sl. No.	Test Item	Type	Routine	Requirement
1	Visual & Dimensional Inspection (Incl. weight)	O	O	Approved Test standard/spec. Any optical distortion is not allowed.
2	Insulation Resistance Test	O	O	Approved Test standard/spec.
3	Cooling test	O	-	Approved Test standard/spec.
4	Insulation resistance and Dielectric Test	O	O	Approved Test standard/spec.
5	Shock & Vibration Test	O	-	IEC 61373
6	General Starting Test	O	O	IEC 925
7	Low Temperature Test	O	-	Approved Test standard/spec.
8	Characteristic Test	O	O	Approved Test standard/spec.
9	Temperature Test 1) Dry Heat Test 2) Damp Heat Test	O	-	Approved Test standard & TS 14.12
10	Abnormality of Heat Resistance Test	O	-	Approved Test standard/spec.
11	Life Time Test	O	-	Approved Test standard/spec.
12	Supply variation Test	O	O	Approved Test standard/spec.
13	Supply interruption Test	O	-	Approved Test standard/spec.
14	Earth continuity Test	O	O	Approved Test standard/spec.
15	Surges, electrostatic discharges (ESD) & Transient burst susceptibility Tests	O	-	Approved Test standard/spec.
16	Radio Interference tests	O	-	Approved Test standard/spec
17	Salt mist test	O	-	Approved Test standard/spec
18	IP Test	O	-	Approved Test standard/spec
19	Fire Performance Test	O	-	Refer to ERTS

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				clause 2.5.8, 2.19 and 15.26
20	Other required tests	O	O	Approved Test standard/spec. according to customer's requests
21	EMI/EMC	O	-	EN 50121-3-2, EN 55011, IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-9, IEC 61000-4-10, IEC 61000-4-11, IEC 61000-4-12.

- Dimensional Inspection: This inspection shall be done with the specimen picked by a lot of product. If the result is not proper, all quantities of the lot product shall be inspected to the approved drawing.
- The sub-contractor shall submit the test procedure for Noise attenuation test for approval according to the requirement described in Noise requirement
- Separately from any other test stipulated in this PTS, all the electronic devices with PBA (PCB Assembling) shall be carried out Environmental Aging test (Temperature cycling test) according to burn-in test procedure by means of followings.

First article: 20 cycles (1 cycle: 25<sup>0</sup>, 1h ---- - 40<sup>0</sup>, 0.5h ---- 85<sup>0</sup>, 0.5h)

Mass production: 2 cycles (1 cycle: - 40<sup>0</sup>, 0.5h ---- 85<sup>0</sup>, 0.5h)


Temperature rising/falling speed: 5 ~ 10<sup>0</sup>/ min

- Above lists are indicative and sub-supplier shall be responsible to carry out any additional test required by client within the scope of ERTS, ERGS.

### 18.2.2 First Article Inspection (FAI)

The subcontractor shall perform a First Article Inspection (FAI) for the Lightings at the Subcontractor's factory in accordance with an inspection specification by BEML and/or End User prior to serial production in order to confirm that the hardware & software fully complies with the subcontractor's Lightings design and manufacturing process.

Before commencement of FAI, It might be required to conduct Quality audit by BEML

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throughout manufacturing process including PBA (PCB Assembling) line focused on subcontractor's 4M (Man, Machine, Method and Material). In case that the 4M confirmed at this stage is changed during mass production, the subcontractor shall notify and get agreement from BEML.

The subcontractor shall submit summary report for the failures that happened to similar application in the previous project, if any, so that BEML can review the reflection of them on the design and production.

At the FAI, the subcontractor shall make available all pertinent design and manufacturing process documentation, test records, material certifications, etc. Should all the requirements of the FAI not be met, then the inspection shall be considered at a Hardware Review.

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.

### **18.2.3 Static Commissioning Test (Accordance with IEC 61133)**

#### **18.2.3.1 Type commissioning Test, Complete Car, Unit and Train Tests**

The Type commissioning Test for the Lightings at the vehicle level shall be performed, with all necessary test equipment prepared by the subcontractor, at BEML by the subcontractor or at Depot/Mainline in DMRC premises. 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 End User participation.

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

Failure to achieve the successful vehicle level performance type test by sub-supplier may attract Liquidated Damage as defined in GTC.


#### **18.2.3.2 Routine commissioning Test, Complete Car, Unit and Train Tests**

The Routine Test at the vehicle level shall be performed at BEML Factory in Bangalore or DMRC Depot/Mainline in Delhi on the basis of information and with the necessary test equipment offered from subcontractor, by BEML under subcontractor's assistance for the Lightings. 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 Lightings are compliant with ERGS and ERTS.

### **18.2.4 Running Test on Main Line Track**

The Running Test on Mainline Track for the Lightings of first train set at the vehicle level shall be performed by the subcontractor, with necessary test equipment prepared by the subcontractor, at BEML Factory/MRS1 Premises. The test shall be conducted in accordance with a test procedure to be prepared by the subcontractor and approved by BEML under

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BEML and/or End User participation. Any fine tuning requirement needed by DMRC BEML, the same shall be carried out with the prior approval.

One car has to be tested by the light supplier for power consumption for LED light along with Sensor and Dimmer unit in Main Line.

#### 18.2.5 Service Trials

BEML will perform the service trial and the sub-contractor shall supply the sufficient information and assistance if necessary according to ERGS 7 and ERTS 15.

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

### 19 Submittals – Technical offer:

The sub contractor shall provide the following as part of technical offer:


- 1) **Complete Technical offer for Lighting system along with Technical description, Specification, drawing, Weight and Power Consumption details for each light.**
- 2) Complete Technical offer for Mock up of Lighting system.
- 3) **Clause wise compliance against,**
  - a) PTS - Doc no. GR/TD/4263.
  - b) Relevant Clauses of MRS1 ERGS.
  - c) Relevant Clauses of MRS1 ERTS.

in the following format

Complied: "Complied" shall be indicated by the supplier where the supplier is able to comply with the clause.

Noted: Where a clause merely provides information.

- 4) Supply details with references for same / similar design 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 support the qualification criteria as per section 6 of this document.
- 5) The list of spares as per Annexure-1.
- 6) List of DLP and Commissioning Spares.
- 7) Expected life expectancy calculation of LED and also the weakest component link in the LED light fitting / Dimmer unit.


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#### 19.1 Applicable Clauses for Exterior and interior Lights:

SL. No.	Clause Nos.	Description	Exterior Lights	Interior Lights
1	1	Introduction	O	O
2	2	Definition and Abbreviations	O	O
3	3	Precedence of Documents	O	O
4	4	Standards	O	O
5	5	Requirements of documentation	O	O
6	6	Qualifying Criteria for subcontractor and vendor Approval	O	O
7	7	Scope of Supply	O	O
8	8	Exterior Lighting	O	-
9	9	Interior Illumination	-	O
10	10	Interface	O	O
11	11	Weight	O	O
12	12	Supply of Equipment for Simulator	O	O
13	13	Mock-Up	O	O
14	14	Rams Requirements	O	O
15	15	EMC Requirements	O	O
16	16	Operation and Maintenance Manuals and Spare Parts Catalogues	O	O
17	17	Quality Assurance Program	O	O
18	18	Design Information	O	O
19	19	Testing	O	O
20	20	Submittals	O	O
21	21	List of Documents attached / drawing	O	O

#### 20 List of Documents Attached / drawings

- (i) Employers Requirements – General Specification ERGS
- (ii) Employers Requirements – Technical Specification ERTS
- (iii) Annexure-1 (List of spares)- (as per Clause 7.2.13 of this PTS)
- (iv) MRS1 GCC 5.8
- (v) Annexure 2- Submittals check list
- (vi) Annexure 3 - Vendor approval format

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Sl.No	Drawing No	ITEM
1	525-21024	Head Light / Marker & Tail Light
2	525-21033	Flasher Light
3	525-21040	Flood Light
4	525-21038	UTO/RM Light
5	525-21039	PAD Light
6	525-21029	Outside Door indication lamp
7	525-21028	Inside Door indication lamp
8	525-21034	Driver Console Light
9	525-21030	Cab Main Light-LED (305mm)
10	525-21041	Cubicle Lights
11	525-21025	Saloon Light –LED (1302mm)
12	525-21026	Saloon Light –LED (690mm)
13	525-21027	Saloon Light (305mm)
14	525-21037	Gangway Light –LED

\*\*\*\*\*

**Request for Quotation**

**TENDER ENQUIRY Ref: BR01/ RMW/DIFFUSER**

**CLOSING DATE:12.01.2025@2.00PM (IST) .**

**General Terms & Conditions**

**TENDER ENQUIRY FOR SUPPLY OF LIGHTS -MRS1 PROJECT**

Vendor's Time and Expenses: To be borne by the vendor

No representation would be entertained on any errors if found in the RFQ. However vendors to bring such errors / omissions to the notice of BEML for necessary corrective action

<b>A. Buyer (BEML LIMITED)</b>	
<b>Name &amp; Designation</b>	Mrs. PRATHIPA.K Asst. General Manager - Materials
<b>Address</b>	BEML Limited Bangalore Complex New Thippasandra Post Bangalore 560 075
<b>Email ID</b>	prathipa.k@bemltd.in
<b>Telephone</b>	+91 - 80 – 25022627
<b>Fax</b>	+91 - 80 – 25348772 / 25243137
<b>Name &amp; Designation</b>	
<b>Address</b>	
<b>Email ID</b>	
<b>Telephone</b>	
<b>Fax</b>	



**General Terms & Conditions:**

<b>Standard Terms &amp; Conditions</b>	"Standard Terms & Conditions of Purchase" of BEML Limited is legally binding on the Bidder.
<b>Eligibility of the source</b>	The source participating in the tender should enclose their latest approval by BEML with their quote.
<b>Offer Validity:</b>	Bids submitted during e-tender shall be valid for the period of <b>180 days from the date of bidding</b> .
<b>Validity of Rates</b>	<ul style="list-style-type: none"><li>▪ Bidded Price to remain firm till completion of supplies against the Purchase Order.</li><li>▪ No price variation will be entertained post procurement event.</li><li>▪ <b>Any increase in statutory levies during the course of the contract or in the event of delayed delivery beyond PO schedule will be to Vendor's account.</b></li><li>▪ The benefits of any decrease in statutory levies during the course of the contract and also in the event of delayed delivery beyond P.O. schedule to be passed on to BEML..</li></ul>
<b>Tender submission conditions</b>	<p>The bidder has to submit Quote / offers in <b>TWO bid</b> (i.e., Technical and commercial bid) to be submitted in a SEPARATE SEALED COVERS duly superscribing tender enquiry reference on the TOP of the cover &amp; same should be sent through fastest mode of courier so as to reach BEML Ltd, Bangalore complex on or before the closing date &amp; time</p> <p style="margin-left: 40px;">i. <b>Technical bid (without price):</b> Bidder to submit the following documents as a part of technical bid duly signed &amp; stamped &amp; superscribe "TECHNICAL BID on the top of the sealed cover.</p> <p style="margin-left: 80px;">a) <b>Compliance to General Terms &amp; conditions i.e, GTC to be signed &amp; stamped on all the pages &amp; uploaded along with technical bid.</b></p> <p style="margin-left: 80px;">b) <b>Any other Enclosures related to technical bid or as called in the tender and other information deemed appropriate in respect of this tender to be enclosed.</b></p> <p style="margin-left: 40px;">ii. <b>Commercial Bid:</b> Should submit only Price and applicable tax details in a separate sealed cover duly superscribing "COMMERCIAL BID" on the top of the cover.</p> <p>Both the covers i.e, Technical bid &amp; Commercial bid to be enclosed in a sealed cover &amp; to be dispatched to be below mentioned address:</p> <p style="margin-left: 40px;">To Prathipa.K AGM – Purchase BEML Limited, Bangalore complex New Thippasandra Bangalore-560075</p>
<b>Payment Terms</b>	100% payment will be made through T/T payable on 60th day from the date of shipment (Bill of lading date/Airway bill).
<b>Supply Pattern</b>	Material to be supplied as detailed in section " <b>Delivery Schedule</b> "

<b>Labeling / Marking &amp; Packing</b>	<p>The Supplier shall ensure that the item supplied meets the Labeling requirements as per Company standards with minimum following detail:</p> <ul style="list-style-type: none"> <li>▪ Name of the manufacturer</li> <li>▪ <b>BEML Part Number</b></li> <li>▪ Name &amp; Class of Material</li> <li>▪ Batch No.</li> <li>▪ And any other additional information as specified in the Purchase Order.</li> </ul> <p>The supplier should provide packing list of all items sent during the delivery. Non-submission of the same may lead to delay in payments.</p>
<b>Breach of commitment:</b>	If a bidding firm backs out after bidding, then a penalty will be levied by means of risk purchase, based on discretion of BEML.
<b>Liquidated Damages (LD)</b>	<p>The time and date of delivery of the stores stipulated in the purchase order shall be deemed to be essence of the contract and delivery must be completed not later than the dates specified therein.</p> <p>Should the contractor fail to deliver the stores or any consignment there of within the period prescribed for such delivery, BEML will entitled at their option to recover from the contractor as agreed damages, and not by way of penalty, Liquidated Damage charges will be recovered at the rate of 0.2% of total value of the amounts apportioned to the affected delivery schedule for each calendar day of delay for first 30 days and 0.5% of the total value of the amounts apportioned to the affected delivery schedule for each calendar day of delay beyond 30 days to the maximum of 10% of the affected delivery schedule of the purchase order.</p>
<b>Non performance clause:</b>	In case of non-performance of the order “ <b>Risk Purchase Clause</b> ” will be initiated. BEML will have an option to <b>take</b> alternate procurement action at your risk & cost apart from recovery of LD.
<b>Warranty</b>	All the stores supplied shall be warranted against any defect in material, workmanship, design or dimension etc., for a period of 24 months from the date of taking over of the last train i.e, 504th car after its introduction into revenue operation and the supplier shall remedy such defects at his / their own cost or replace free of charge such stores when called upon to do so by BEML and BEML shall state in writing the nature of defects of the stores.
<b>Dispatch Instructions:</b>	The supplier shall make the equipment/material ready for immediate shipment according to the delivery Schedule indicated in the purchase order and hand over the equipment/material to the freight forwarding agent nominated by BEML on F.O.B. (Free on Board) supplier’s port basis as applicable & specified in the purchase order.
<b>Short Supply:</b>	In case of shortage noticed in supplies made, the same shall be made good by the vendors on intimation by BEML.
<b>Transit Insurance:</b>	<p>In case of F.O.B. offers, insurance shall be arranged by the BEML from supplier port till BEML.</p> <p>In case of imports of the materials, although the insurance shall be paid by the BEML, any loss or damage shall be made good by the supplier at free of cost, without waiting for the settlement of insurance claim. BEML shall reimburse the payment after settlement of insurance claim to the supplier.</p>
<b>Material Acceptance / Rejection Procedure</b>	<ul style="list-style-type: none"> <li>▪ Goods not matching the Specifications mentioned in the Purchase Order are liable for rejection. Inspection carried out at BEML’s designated location on receipt of the material is final and binding for the bidders.</li> </ul>
<b>Quality Assurance Terms</b>	<p>Inspection:</p> <ul style="list-style-type: none"> <li>▪ Supplies are subject to final approval by BEML Inspection Department at BEML works.</li> <li>▪ Please co-ordinate with BEML inspection department and obtain details of test</li> </ul>

	<p>certificate to be sent along with supply and other parameters to be checked before making supplies.</p> <ul style="list-style-type: none"> <li>▪ If the supplies are received without check sheets / certificates, the same are liable for rejection. Please co-ordinate with Quality Control Department for check sheet to be complied along with the supplies if not already sent.</li> <li>▪ ALL THE RELEVANT QUALITY DOCUMENTS &amp; TEST CERTIFICATES PERTAINING TO THE MATERIAL HAS TO BE SUBMITTED AGAINST EACH OF THE SUPPLIES.</li> </ul>
<b>Rejected Material Return</b>	<p>In case, if material supplied by the vendor have been rejected through NCR (Non Confirmatory Report) /PDO (Parts Disposition Order) on account of Manufacturing defects at any stage from the date of receipt of material at BEML Ltd till completion of the warranty period, the same will be communicated to the vendor, wherein vendor is liable for rectification of defective part (or) providing replacement within 48 hours from the date &amp; time of communication on DDP (in case of foreign suppliers) / FDD (in case of Indian suppliers) without claiming any cost from BEML.</p> <p>In case, vendor fails to rectify defective part (or) supply the replacement within 48 hours, BEML is entitled to procure the same on its own and recover the cost from vendor bills including cost towards any downtime in production.</p> <p>The rejected material will be handed over to the vendor (either at BEML works/respective depots) only on receipt of replacement against rejections. Necessary arrangement for collecting the rejected materials &amp; transportation should be arranged by the vendor. Further, vendor is liable for submitting the Investigation report/failure analysis and the remedies for overcoming such failures for all other material supplied by the firm.</p>
<b>Risk Purchase clause:</b>	<p>Should the contractor fail to deliver the stores or any consignment there of within the period prescribed for such delivery , BEML will be entitled at their option to purchase elsewhere , without notice to the contractor on the account and at the risk of the contractor the stores not delivered or others of a similar description (where other exactly complying with the particulars are not in the option of BEML which shall be final, readily procurable) without canceling the contract in respect of consignment not yet due for delivery.</p>
<b>Specification Changes:</b>	<p>No change shall be made to any part of the specification by the Supplier. All the purchases are governed by the Specification(s) mentioned, unless superseded by a Revision duly authorized by the competent authority of buyer.</p>
<b>Right of Buyer</b>	<p>BEML reserves the right to partially or totally accept or reject any/all bids placed in the e-tender event without assigning any reason whatsoever.</p>
<b>Termination</b>	<p>In the event of any breach by the bidders of any condition herein or in the General Terms and Conditions of Purchase of BEML or in the event of any misconduct on the part of the bidders or on the part of his employees, BEML shall be entitled to terminate this agreement forthwith without giving any notice.</p>
<b>Jurisdiction</b>	<p>No legal proceeding to enforce any claim and no suit arising out of this contract shall be instituted except in a court of competent jurisdiction located in Bangalore, Karnataka</p>
<b>ARBITRATION:</b>	<p>In the event of any question or dispute arising under these conditions or any special conditions of contract or in connection with this contract (except as to any matters the decision of which is specially provided for by these conditions) the same shall be referred to the award of an Arbitrator to be nominated by BEML and any Arbitrator to be nominated by the contractor or in the case of such Arbitrators not agreeing, then to the award of an Umpire to be appointed by the Arbitrators in writing before proceeding on the reference and a decision of the Arbitrators or in the event of their not agreeing of the Umpire appointed by them shall be final and conclusive and the provisions of the Indian Arbitration Act 1940 and of the rules there under and any statutory modification thereof shall be deemed to apply and to be incorporated in this contract, upon every and any such reference, the assessment of the costs incidental to the reference and award respectively</p>

	shall be in the direction of the arbitrators or in the event of their not agreeing of the Umpire appointed by them.
<b>PURCHASE ORDER CANCELLATION CLAUSE</b>	In the event of any situation arising out of or caused by any act which is beyond the control of BEML, which results in change of Production Program of stoppage of production may necessitate cancellation of further deliveries by giving Three Months notice in advance to the supplier. BEML can terminate the Purchase Order without prejudice to the right of parties, accrued to the date of termination

**Authorized signatory with company seal / stamp**

**APPENDIX-B****LIST OF ITEMS WITH DESCRIPTION & QUANTITIES**

<b>Sl No</b>	<b>Part No</b>	<b>Description</b>	<b>UoM</b>	<b>Qty</b>	<b>Delivery schedule</b>
1	52521043	SALOON LIGHT DIFFUSER (1302mm) FOR MUMBAI METRO MRS1 PROJECT AS PER PTS GR/TD/4263 LATEST VERSION AND COST CENTER 'G' CONDITIONS OF MRS1 CONTRACT	NO	54	Month March'25
2	52521045	SALOON LIGHT DIFFUSER (305mm) FOR MUMBAI METRO MRS1 PROJECT AS PER PTS GR/TD/4263 LATEST VERSION AND COST CENTER 'G' CONDITIONS OF MRS1 CONTRACT	NO	7	Month March'25

**Authorized signatory with company seal / stamp**

**COMPLIANCE REPORT**  
**(To be submitted along with technical bid)**

<b>Sl No</b>	<b>Part No</b>	<b>Description</b>	<b>UoM</b>	<b>Qty</b>	<b>Complied</b>	<b>Not complied</b>	<b>Remarks</b>
1	52521043	SALOON LIGHT DIFFUSER (1302mm) FOR MUMBAI METRO MRS1 PROJECT AS PER PTS GR/TD/4263 LATEST VERSION AND COST CENTER 'G' CONDITIONS OF MRS1 CONTRACT	NO	54			
2	52521045	SALOON LIGHT DIFFUSER (305mm) FOR MUMBAI METRO MRS1 PROJECT AS PER PTS GR/TD/4263 LATEST VERSION AND COST CENTER 'G' CONDITIONS OF MRS1 CONTRACT	NO	7			

**Authorized signatory with company seal / stamp**

## APPENDIX – D

### **Land Border Sharing Declaration** **(To be submitted along with technical bid)**

**(To be submitted in the bidder's letter head & )**

In-line with Department of Expenditure's (DoE) Public Procurement Division Order  
vide ref. F.No.6/18/2019-PPD dated 23.07.2020 & 24.7.2020

Tender no. ....

Job: .....

“I/ we have read the clauses pertaining to Department of Expenditure's (DoE)  
Public Procurement Division Order (Public procurement no 1, 2 & 3 vide ref.  
F.No.6/18/2019-PPD dated 23.07.2020 & 24.7.2020) regarding restrictions on  
procurement from a bidder of a country which shares a land border with India. I/We  
hereby certify that I/ we the bidder < name of the bidder.....> is / are

a) Not from such a country and eligible to be considered for this tender.

OR

b) From such country, has been registered with the competent authority and eligible  
to be considered for this tender. (Evidence of valid registration by the competent  
authority shall be attached)

For and behalf of \_\_\_\_\_ (Name of the bidder)

(Signature, date & seal of authorized representative of the bidder)”

## APPENDIX – E

(To be submitted along with technical bid)

### DECLARATION REGARDING MINIMUM LOCAL CONTENT IN LINE WITH REVISED PUBLIC PROCUREMENT (PREFERENCE TO MAKE IN INDIA), ORDER 2017 DATED 04<sup>TH</sup> JUNE, 2020 AND SUBSEQUENT ORDER(S)

*(To be typed and submitted in the Letter Head of the Entity/Firm providing  
certificate as applicable)*

-----  
-----  
To,  
BEML Limited, Bangalore

Dear Sir,

**Sub:** Declaration reg. minimum local content in line with Public Procurement (Preference to Make in India), Order 2017-Revision, dated 04<sup>th</sup> June, 2020 and subsequent order(s).

**Ref :** 1) NIT/Tender Specification No: .....,  
2) All other pertinent issues till date

We hereby certify that the items/works/services offered by..... *(specify the name of the organization here)* has a local content of \_\_\_\_\_ % and this meets the local content requirement for ‘**Class-I local supplier**’ / ‘**Class II local supplier**’\*\* as defined in Public Procurement (Preference to Make in India), Order 2017-Revision dated 04.06.2020 issued by DPIIT and subsequent order(s).

The details of the location(s) at which the local value addition is made are as follows:

- |          |          |
|----------|----------|
| 1. _____ | 2. _____ |
| 3. _____ | 4. _____ |

...  
...  
...

Thanking you,  
Yours faithfully,

**(Signature, Date & Seal of  
Authorized Signatory of the Bidder)**

\*\* - *Strike out whichever is not applicable.*

#### **Note:**

1. Bidders to note that above format duly filled & signed by authorized signatory, shall be submitted along with the techno-commercial offer.
2. In case the bidder's quoted value is in excess of Rs. 10 crores, the authorized signatory for this declaration shall necessarily be the statutory auditor or cost auditor of the company (in the case of companies) or a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of local content.



3. In the event of false declaration, actions as per the above order necessary action will be taken against bidder.

**Authorized signatory with company seal / stamp**

**CONTACT DETAILS OF THE SUPPLIER****(To be filled and submitted by supplier along with the technical bid)****1) Contact Person details in Marketing Office**

- (a) Name :  
(b) Designation :  
(c) Telephone :  
(d) Fax :  
(e) Mobile :  
(f) Email :

**2) Head Office :****3) Complete address****including the website :****4) Details of the proposed plant from****where item is to be supplied :****5) Complete address of the Plant****including Website :****6) Contact person details in plant**

- (a) Name :  
(b) Designation :  
(c) Telephone :  
(d) Fax :  
(e) Mobile :  
(f) Email :

**7) Bank Details: (Will used during L/C Execution)**

- a) Name of the Bank :  
b) Full Address of the Bank :  
c) Suppliers Account Number and Type :  
b) IBAN No :  
e) Swift Code :