BEML LIMITED

(A Govt. of India Mini Ratna Company under Ministry of Defence)
BANGALORE COMPLEX, POST BOX: 7501, NEW THIPPASANDRA POST,
BANGALORE-560075

NOTICE INVITING TENDER

BID INVITATION NO:6300039523 **Dt:19.05.2025**

Subject: Design, Manufacture, Supply, Testing & Commissioning, Training & Manuals of PAPIS & CCTV System including CMC Spares, Tools and service activities required for 210 cars of Chennai Metro Rail Project-Phase II (ARE02A).

Quotation/offer are invited from Original Equipment Manufacturer (OEM) or authorized representatives of OEMs of **PAPIS & CCTV System** for Metro Rolling stock having experience in Design, Manufacture, Supply, Testing & Commissioning of PAPIS & CCTV System in accordance with the enclosed terms and conditions within the tender closing date.

Quotations should be submitted online (E-mode) in BEML SRM portal in Two-Bid system as below:

1) **Technical Bid**
2) **Commercial Bid**

Note: Commercial bids of only technically acceptable firms will be opened and considered for further evaluation by BEML.

Please note that bidder should be having a **valid Class-III Digital Signature Certificate** issued by authorized Certifying Authority to submit bid in our SRM e-Procurement system. Interested bidders can contact BEML through e-mail: admin.srm@beml.co.in to obtain the username & password for submitting the quotations In case of any queries, you may contact BEML SRM Team on phone no. **080-22963269**

Note: - The tender consists of 63 Nos. of pages including this page.

2. TABLE OF CONTENTS

3. General Instructions to Bidders:

1. The Bidders are advised to carefully go through, read and understand this tender document completely including terms and conditions, Annexures and Appendices etc. before submitting bids

   a. This NIT is not transferable under any circumstances.
   b. All entries in the bids, formats which would be part of bids shall be in English either typed or written legibly. Erasing, over-writings and use of correction fluids are not permitted. All cancellations and insertions should be duly signed / attested by bidder concerned.
   c. All the corresponding documents shall be attached along with the quotation/offer
   d. The bidder shall **sign each and every page of tender document** before submitting the tender. No corrections/revisions will be entertained after opening the bids.
   e. Late and/or incomplete tender shall not be considered.
   f. Canvassing in any manner including unsolicited letters and request for post tender corrections shall render offers of such parties liable for rejection.
   g. Bidder shall ensure that all the information & documents submitted by them are true & correct.
   h. In case, it comes to the knowledge of BEML that the bidder has submitted false information before awarding of contract then the offer would be rejected.
   i. In the event, it comes to the knowledge of BEML that the successful bidder has submitted false information, subsequent to the award of contract, the contract shall be cancelled/short closed by the company and shall invoke Risk purchase clause with liabilities on such bidder for the entire contract quantity. The PBG shall also be encashed as a result of consequence of breach of contract at the discretion of BEML.

2. Abbreviations used in this NIT

NIT- Notice Inviting Tender	BEML -BEML Limited
TS-Train set	CMRL -Chennai Metro Rail Limited
PTS- Procurement Technical Specification	ERTS - Employer's requirements General Specification
PO-Purchase order	DLP -Defect Liability Period
GTC- General Terms and Conditions	DNP – Defect Notification Period
CMC – Comprehensive Maintenance Contract	PBG – Performance Bank Guarantee
GeM - Government e-Marketing	SRM- Supplier Relationship Management

3. In case any person/persons, Company, firm, Associations having any litigation, arbitration cases between themselves and BEML Ltd, pending before any court of law/ Arbitrator shall not be eligible to participate in this tender.

4. Non-compliance with any of the tender conditions, incomplete offers, conditional and ambiguous offers are not acceptable and liable for rejection.

5. The bidder shall fill in all the required particulars in the blank space provided for the purpose in the tender document.

6. All the documents shall be uploaded in SRM Portal.

7. Fax/email quotations are not acceptable.

8. BEML reserves the right to accept or reject all tenders or any tender in part or full without assigning any reasons thereto, which is final & binding on the Bidder

4. DETAILS OF THE TENDER

This "Notice Inviting Tender" hereinafter referred to as the 'NIT' is designated as the tender for **Design, Manufacture, Supply, Testing & Commissioning, Training & Manuals of PAPIS & CCTV system including CMC Spares & Tools, Deliverables and service activities required for 210 cars of Chennai Metro Rail Project-Phase II (ARE02A).**

1) The tender consists of two parts as indicated below:

Sl. No.	Nature of Bid	Mode of Submission	Details
1	**Technical Bid**	**SRM Portal**	**Technical Bid (Without Price Details) shall be uploaded and submitted in the SRM Portal, wherein** only technical Bid /technical information in SRM Portal shall be uploaded
2	**Commercial Bid**	**SRM Portal**	Price details to be duly filled in specified field on SRM Portal. Evaluation is based on the total bid value of all the items & services.

2) Details of Items & Services:

Table-1.1 List of items for PAPIS & CCTV System:

Sl No	Part No	Description	UoM	Qty/car			Qty/ T.Set	Qty for 210 Cars (70 T.Sets)
				DM	T	DM		
1	5242100003	KIT of PAPIS & CCTV system- DM car	SET	1	0	1	2	140
2	5242100004	KIT of PAPIS & CCTV system- T car	SET	0	1	0	1	70

Scope shall also cover the following:

i. Testing & Commissioning activities for PAPIS & CCTV System for one Train for each of three corridors 3, 4 & 5

Corridor 3 from Madhavaram to Sipcot
Corridor 4 from Lighthouse to Poonamalle
Corridor 5 from Madhavaram to Sholinganallur

ii. Spares and consumables including Service for Defect Notification period (DNP)/ Defect Liability Period (DLP) as per ERTS requirements. Detailed BOM for DNP/DLP Spares and Consumables for warranty period to be provided by the bidder.

Table-1.2: Non-Recurring Cost (NRC)

Sl No	Description	UoM	Qty/ Project
1	Design and Submission of design Documents for PAPIS & CCTV System.	AU	1

Table-1.3 FAI Reports and Type Test & Report

Sl No	Description	UoM	Qty/ Project
1	FAI Reports and Type Test & Report for PAPIS & CCTV System	AU	1

Table-1.4 Deliverables:

Sl No	Part no	Description	UoM	Qty/ Project
1	5242100028	Deliverables as per ERTS Clause 13.7.1& 13.8.15, 13.13.3 & 13.13.10 for PAPIS & CCTV System	AU	1
2	----	Printed Circuit Boards (PCB) details asper ERTS 19.55 for PAPIS & CCTV System	AU	1
3	----	Microprocessor Details as per ERTS 19.57 for PAPIS & CCTV System	AU	1

1. Comprehensive Maintenance Contract (CMC)

Table 2.1: Spares & Tools required for CMC period

Sl No	Part No	Description	UoM	Qty/ Project
1	5242100020	Spares as per Annexure-A for PAPIS & CCTV System	SET	1
2	5242100021	Tools & Test bench for PAPIS & CCTV System	SET	1

Scope of Spares shall be as per Annexure -A and the bidder has to submit the details of Tools & Test bench in line with Annexure-IV i.e, " Scope of CMC" of NIT

2. Training & Manuals

Table 3.1: Training

Sl No	Description	UoM	Qty/ Project
1	Training on O&M to the CMRL/BEML on PAPIS & CCTV System	AU	1

Table 3.2: Manuals

Sl No	Description	UoM	Qty/ Project
1	Training Manual, System/ Technical Manuals, Software Manuals, Operation Manuals, Maintenance Manuals, Fault Diagnostic & Trouble shooting Manuals & Spares Part Catalogue for PAPIS & CCTV System	AU	1

Required Delivery Schedule: For PAPIS & CCTV System

Sl No	Part No / Description	Total Qty (Trainsets)	Schedule	No of Train Sets (3 Cars/TS)
1	Equipment with DNP/DLP	70 TS (210 cars)	Apr'26	1
			Jul'26	3
			Nov'26	3
			Feb'27	4
			May'27	4
			Jul'27	3
			Aug'27	3
			Sep'27	4
			OCT'27	3
			Nov'27	4
			Dec'27	3
			Jan'28	3
			Feb'28	3
			Mar'28	3
			Apr'28	3
			May'28	4
			Jun'28	4
			Jul'28	3
			Aug'28	4
			Sep'28	4
			Oct'28	4
3	Non-Recurring activities- Design and Submission of Design Documents	PDR: Jul-25 PFDR: Mar-26 FDR: Jun-26		
4	FAI Reports and Type Test & Report	Jun.26		
5	Deliverables as per ERTS Clause 13.7.1 & 13.8.15, 13.13.3 & 13.13.10 for PAPIS & CCTV System	Apr.26		
	Printed Circuit Boards (PCB) details as per ERTS 19.55 for PAPIS & CCTV System	Mar-26		
	Microprocessor Details as per ERTS 19.57 for PAPIS & CCTV System	Mar-26		
6	Spares for PAPIS & CCTV System	To be supplied as per BEML requirement		
7	Tools & Test bench for PAPIS & CCTV System	Dec.'26		
8	Training	Jan.'28		
9	Manuals	Jan.'28		

Note: a) Delivery schedule proposed above is tentative. However, it can be mutually discussed and agreed in line with key dates of CMRL contract.
b) CMC shall start after completion of DLP/DNP activity for 70th Trainset and shall end 15 years after the start of CMC.
c) 1 Trainset comprises of 2 DM car and 1 T car

5. SUBMISSIONS OF TECHNICAL BID

Technical Bid submission Conditions	**TECHNICAL BID (Without Price Details) shall be uploaded and submitted in the SRM Portal, wherein** only technical Bid /technical information in SRM Portal shall be uploaded as indicated below: a. Bidders should upload duly filled, signed & stamped Integrity Pact with two witnesses **[Appendix – A]**. b. Clause by Clause compliance for the BEML Procurement Technical Specification (PTS): Doc no: **PTS Doc No GR/TD/7061** (Latest rev). **[Appendix – B]** Bidders to refer "**PTS**" **(Annexure-I)** enclosed along with this tender document. Bidders should upload the following documents duly filled, signature & stamped under technical bid. Formats as per PTS also to be submitted. c. Bidder to upload enclosures related to technical & other information deemed appropriate in respect of this tender on the letter head of the company, if any.Photographs / Drawings if any, may be uploaded. d. Bidders to refer "**GENERAL TERMS AND CONDITIONS (GTC)"** (**Annexure-II)** enclosed along with this tender document and upload clause by clause compliance of GTC duly filled, signature & stamped along with the supporting documents as specified therein. **[Appendix – C]** *e.* Bidders to refer "**SCOPE OF CMC"** (**Annexure-IV)** enclosed along with this tender document *f.* Bidders to commit that they will support BEML for requirement of any additional equipment, spares, service required at the later stage ie after 1st year of taking over and up to completion of CMC period. *(***Appendix- D)** g. Bidders to upload duly filled, signature & stamped confidentiality agreement in plain paper **[Appendix – E]** h. Bidders to upload duly filled, signature & stamped Compliance to Land border sharing Clause – **[Appendix – F]** i. Bidders to upload duly filled, signature & stamped Compliance to purchase preference under public procurement policy – **[Appendix – G]** j. Bidders to upload duly filled, signature & stamped Compliance to Contact Details of Supplier/ Bidder – **[Appendix – H]** k. Bidders to upload duly filled, signature & stamped Compliance to Delivery Schedule – **[Appendix – I]** l. Based on **Annexure- V (JICA)], b**idder to upload duly filled, signed& stamped Compliance to Japanese content Stipulation i.e**[Annexure-V(a)] & [Annexure-VI]** BEML at its sole discretion reserves the right to seek the Soft/ Hard copies of the documents which are already been uploaded in SRM , through Courier / post pertaining to technical bid of this tender enquiry at a later date, if required. In such cases, only the documents uploaded in SRM Portal in original has to be couriered at the request of BEML. Any irrelevant documents furnished through courier will not be considered. **NOTE**: Please note Commercial Bid /Price details should not be indicated in TECHNICAL BID, else bid will not be considered for further evaluation.

6. SUBMISSIONS OF COMMERCIAL BID

The price bid to be submitted through SRM Portal. The following details are to be entered in the SRM Portal.

Table-1. Equipment with DNP/DLP						
Sl. No	Kit Part no	Description	UoM	Total Quantity for 210 Cars (70 T. Sets)	Unit Rate in INR	Total Quantity for 210 Cars (70 T. Sets)
1	5242100003	KIT of PAPIS & CCTV system- DM car	Set	140	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
2	5242100004	KIT of PAPIS & CCTV system- T car	Set	70	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
3		Design and Submission of design Documents for PAPIS & CCTV System.	AU	1	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
4		FAI Reports and Type Test & Report for PAPIS & CCTV System	AU	1	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
5	5242100028	Deliverables as per ERTS Clause 13.7.1& 13.8.15, 13.13.3 & 13.13.10 for PAPIS & CCTV System	Set	1	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
6		Printed Circuit Boards (PCB) details asper ERTS 19.55 for PAPIS & CCTV System	AU	1	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
7		Microprocessor Details as per ERTS 19.57for PAPIS & CCTV System	AU	1	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
					Sub total (Table 1)	
The prices are firm and fixed prices and PVC is not applicable.						

TABLE 2 Comprehensive Maintenance Contract (CMC)						
Sl. No	Part No	Description	UoM	Quantity /Project	Unit Rate in INR	Total Price in INR
1	5242100020	Spares as per Annexure-A for PAPIS & CCTV System	Set	1	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
2	5242100021	Tools & Test bench for PAPIS & CCTV System	Set	1	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
					Sub total (Table 2)	
The prices are firm and fixed prices and PVC is not applicable.						

TABLE-3 Training & Manuals					
Sl. No	Description	UoM	Qty/Project	Unit Rate in INR	Total Price in INR
1	Training on O&M to the CMRL/BEML on PAPIS & CCTV System	AU	1	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
2	Training Manual, System/ Technical Manuals, Software Manuals, Operation Manuals, Maintenance Manuals, Fault Diagnostic & Trouble shooting Manuals & Spares Part Catalogue for PAPIS & CCTV System	AU	1	**Price to be uploaded in commercial bid only**	**Price to be uploaded in commercial bid only**
				Sub total (Table 3)	
The prices are firm and fixed prices and PVC is not applicable.					

Note:

1. Bidder has to quote for all the items in SRM Portal
2. Commercial evaluation will be arrived based on grand total of all the tendered items (i.e. Equipment with DNP/DLP, Comprehensive Maintenance Contract (CMC), Training & Manuals). (i.e. Table-1+Table 2 +Table 3)
3. The commercial bids of the technically acceptable vendors only will be opened for further commercial evaluation.

4. . Acceptable Currencies as per CMRL Contract:

   a) **INDIAN RUPEE (INR)**
   b) **EURO (EUR)**
   c) **JAPANESE YEN (JPY)**

5. For the purpose of arriving the landed cost in INR, the exchange rates for EUR/JPY prevailing as on date of tender opening. (Date of Technical bid opening in case of two bid tender)
6. In case of Foreign bidders, for the purpose of arriving the landed Cost in INR, Freight charges of 4.5% shall be loaded during price evaluation.
7. Reverse auction will be conducted at the sole discretion of BEML among technically qualified Bidders and L1 status will be arrived based on total landed bid value. (i.e. Table-1+Table 2 +Table 3).

[ANNEXURE – II]

GENERAL TERMS & CONDITIONS (GTC) FOR PROCUREMENT OF MATERIALS:

1. GLOSSARY, DEFINITIONS & INTERPRETATIONS

1.

a) The Purchaser means "(include company name and address)" (A Government of India
Undertaking) incorporated under the Companies Act having its registered office at "BEML Soudha, No 23/1, 4th main, S.R. Nagar, Bengaluru – 560027" and shall be deemed to include its successors and assignee.

b) Supplier' means a person having been included in a contract as a Contractor and also means a firm or company with whom the order for supply/execution of work is placed and shall be deemed to include the supplier's successors, (approved by BEML Ltd.,) representatives, heirs, executors and administrators. The supplier may also be referred to as the supplier, Contractor or vendor.

c) Parties to the Contract' shall mean the Supplier and the Purchaser as named in the main body of the Purchase Order.

d) Tender' means and includes quotation, invitation to tender and all other documents like drawings, specifications, quality plan, etc that form part of the tender document.

e) Acceptance of Tender' Means the letter of memorandum communicating supplier, the acceptance of the Tender and includes advance acceptance of this tender.

f) Purchase Orders (PO) / Contract' means and includes the invitation to tender, instruction to Tenderers, acceptance of tender, Letter of intent / letter of award, the general terms and conditions of Purchase Order / contract, special conditions of Purchase Order /contract, particulars, descriptions, specifications, schedule of prices, quantities, quality plan, drawings enclosed and other condition specified in the acceptance of tenders and includes the repeat order which has been accepted or acted upon by / for the supplier for the supply of stores and includes an order for performance of service and includes amendments, if any, that may take place subsequent to the discussions, negotiations, mutual agreement if any.

g) Stores / Materials / Services' means the goods or services as described in Procurement Technical Specification (P.T.S.) and in the Purchase Order which the supplier has agreed to supply under the Purchase Order.

h) Specification means technical specifications of the Equipment / Material as set forth in Procurement technical specification (PTS) / technical drawings, which is part of tender. Employer(CMRL) Requirement Technical specification (ERTS) & Employer (CMRL) General Condition of contract(GCC) and Employer Particular condition of Contract (PCC)

i) End-Customer / End-user means: Chennai Metro Rail Limited (CMRL).

j) Words in singular include the plural & vice-versa.

k) Words imparting the masculine gender shall be taken to include the feminine gender and words imparting persons shall include any firm, company or associations or body of individuals whether incorporated or not.

l) The heading of these conditions shall not affect the interpretations or construction thereof
of the contract.

m) C.F.R /F.O.B / F.D.D / DAP. is to be interpreted in accordance with the provisions of INCOTERMS 2020, unless otherwise specified in this Tender Document / Purchase order.

2. **SUBMISSION OF THE TENDER:**

Tender is in TWO-BID system (Technical & Commercial Bid)

Bids should be submitted online mode only as follows:

a) Submission of Technical bid (without price):

i. The Bidder should upload all the requisite technical documents along with respective supporting documents and other information deemed appropriate in respect of the Tender.

ii. **The price details/commercial bid details should not be given in the Technical bid**. If any of the bidder have given any price/commercial details in the Technical bid, their offer is liable for rejection and will not be considered for further evaluation**.**

iii. Technical Bid will be opened on date and time of bid opening and the commercial Bids of those bidders whose technical bids are qualified (accepted) only will be opened for commercial evaluation.

b) Submission of Commercial bid:

i. The Commercial Bids of those bidders whose technical bids are qualified (accepted) only will be opened for commercial evaluation.

ii. Price details in specified field on SRM Portal to be submitted.

iii. Bidder to quote for all the items /Services.

c) General:

i. If dealers are submitting the bids in place of OEM, Dealer should submit Authorization letter from OEM.

ii. BEML reserves right to reject the tender due to unsatisfactory past performance in the
execution of a contract at any of BEML projects / units.

iii. Bidders participating in the tender should declare in their offer that whether they have
been black-listed / kept on hold for a specified period / given Business holiday for a specified period by any Public sector undertaking or Government departments. The reasons for such action with details and the current status of such hold shall be furnished to BEML.

iv. In case any person/persons, Company, firm, Associations having any litigations, arbitration cases between themselves and BEML Ltd, pending before the Court / Arbitrator or initiated litigations/arbitrations in connection with any contract / tender issued by BEML Ltd and any contractor has defaulted against the BEML's orders, they are not eligible to participate in this tender.

v. BEML may decide to scrap the tender/refloat the tender without assigning any reasons thereof before LOI/PO is committed. BEML reserves the right to accept, split, divide, negotiate, cancel or reject any tender or reject all tenders at any time prior to the award of the contract without incurring any liability to the affected tenderers or any obligation to inform affected tenderer, the grounds of such action.

vi. BEML reserves the right to verify, in its sole discretion, any information given by the bidders independently through any third-party agencies. During this process, if it is found that any of the information given by the bidder is false / misleading, offers of such bidders would be out rightly rejected.

vii. BEML also reserves the right to independently assess the capability and capacity of the bidder for execution of the order/contract. BEML's decision on any matter regarding short listing of bidders shall be final.

viii. The Tender / Notice Inviting Tender is not an offer or a contract.

ix. Bidders will not be compensated or reimbursed for the costs incurred in preparing Proposals. Proposals shall become BEML property.

x. BEML's decision is final for Evaluation of the offers which is also based on Employer's (CMRL) requirement and conditions of contract for ARE02A Project.

3. **SUPPLIERS SHARING LAND BORDER WITH INDIA**:
Land border sharing Declaration in line with Department of Expenditure's(DOE) Public Procurement Division order vide F. No. 6/18/2019-PPD dated 23.07.2020 & 24.07.2020 as amended from time to time and its subsequent Orders/Notifications issued by concerned Nodal Ministry for specific Goods/Products, shall be applicable for bidders / suppliers sharing land border with India. Bidders to upload signed & sealed compliance as per appendix attached as part of Technical Bid.

4. **PREFERENCE TO MAKE IN INDIA SUBJECT TO JAPANESE CONTENT STIPULATION AT CLAUSE 44 OF GTC:**

Purchase Preferences as per MII (Make In India Policy) and MSE Purchase Preference as Per Public Procurement Policy is Applicable in-line with revised public procurement (preference to make in india), order 2017 dated 04th June, 2020 as amended from time to time and its subsequent Orders/Notifications issued by concerned Nodal Ministry for specific Goods/Products, shall be applicable for bidders / suppliers under Purchase preferences. Bidders shall upload necessary supporting documents and to upload signed & sealed as per appendix attached as part of Technical Bid.

5. **DELIVERY TERMS:**

a) In case of foreign Supplier: F.O.B (Free on Board) to nearest port basis. The intimation for shipment should be provided 21 days prior to the delivery schedule to our nominated freight forwarder and the consignment to be handed over to our freight forwarder before the cut-off date for sailing.

b) In case of Domestic Supplier: F.O.R (Free on Road) /F.D.D. (Free Door Delivery), BEML, Bangalore Complex.

c) For CMC - Supply of Spares & Tools: F.O.R- Designated CMRL depots, Chennai

6. **PAYMENT:**

I. **SUPPLIES (Equipment)**

a) **APPLICABLE TO FOREIGN BIDDERS:**

i. TT payment -100% 60 days from the date of receipt of material at BEML stores subject to inspection clearance.

ii. All bank charges incurred in India shall be borne by BEML and all bank charges outside India shall be borne by the supplier.

b) APPLICABLE TO THE DOMESTIC BIDDERS

Terms of payment are 100% in 60 days from the date of receipt of material at BEML stores subject to inspection clearance & for MSEs in 45 days from the date of receipt of material subject to inspection clearance as per MSME act.

Bidders to indicate the category of their firm under Micro/Small/Medium industries with necessary documentary proof of evidence for purpose of evaluation and our data up dation.

II. **NON-RECURRING (NRC) AND SERVICE ACTIVITIES**:

i. **NRC:** 100% payable on 60th day after completion of NRC activities subject to acceptance by BEML R&D and for MSEs 45 days after completion of NRC activities subject to acceptance by BEML R&D

ii. **FAI Reports and Type Test & Report:** 100% payable on 60th day after completion of FAI activities and submission of FAI reports and type test reports subject to acceptance by BEML R&D and for MSEs 45 days after completion of FAI activities and submission of FAI reports and type test reports subject to acceptance by BEML R&D

iii. **Services :**100% payable on 60th day after completion of service activities subject to acceptance by BEML R&D /Depot T&C/End Customer and for MSEs 45 days after completion of service activities subject to acceptance by BEML R&D /Depot T&C/End Customer

Micro and Small enterprises (MSE) registered under UDYAM registration are eligible for the 45 days payment on submission copy of MSE certificate issued by UDYAM.

iv. TDS (Tax deducted at source) will be applicable for service purchase orders including Foreign Services and will be deducted as per law of land. SAC (Service Account code) shall be indicated by the bidder for the services that are proposed be carried out.

III. **PAYMENT FOR SPARES SUPPLY DURING CMC PERIOD AS PER MUTUALLY AGREED SCHEDULE:**

100% on 60th day from the date of receipt of material as per "Scope of CMC" in Annexure-IV at BEML stores /Chennai Depot subject to inspection clearance and based on mutually agreed delivery schedule between BEML in line with LCC of the system

Note : For Bidders not agreeing with above terms I,II&III, their prices will be suitably loaded with applicable cash credit interest while evaluation of bids.

The payment is further subject to the following:

a) The Invoice shall be compliant with GST laws.

b) GST liability is to be discharged and ensure filing of outward supply details on GSTN portal within timeline prescribed.

c) Any debit note/supplementary invoice if any, is to be raised within September month following the respective financial year of filing of annual return by BEML, which ever is earlier.

d) Any loss of tax credit due to the reason attributable to supplier shall be recovered from supplier along with applicable interest and penalty.

e) Bidders to indicate the GST and other levies applicable. GST shall be paid only after confirmation of payment of GST by vendors on GST Website.

f) Relevant TDS / TCS as applicable shall be deducted as per prevailing Income Tax / GST / GOI notifications

g) The supplier should submit the following documents for each supply:

Tax Invoice; GSTR-1 return filed with authorities with the relevant abstract

GSTR-3B return or any other form of return prescribed by the authorities.

Copy of Challans regarding deposit of GST

Certificate of Chartered Accountant

7. **PRICE BID VALIDITY:**

The Bid should be valid for 180 days from the date of tender opening. BEML's acceptance of the tender at the quoted / negotiated rates will be binding on the tenderer during the tenure of contract.

8. **FIRM PRICE FOR SUPPLY, NON-RECURRING SCOPE AND DELIVERABLES:**
The prices remain firm for the entire supplies of the purchase order and no escalation shall be entertained under any circumstances. The prices are to be firm & no increase in finalized price will be entertained after awarding contract during the period of Contract for any reasons whatsoever.

9. **INSPECTION:**
The Supplier guarantees that the delivery is of good quality and free from all defects and in the case of services rendered that they are performed by skilled personnel and that new materials are used.

The Supplier guarantees that the delivery corresponds exactly with the provisions of the agreement, the reasonable expectations of BEML regarding the characteristics, quality and reliability of delivery.

The Supplier guarantees that the delivery is suitable for the purpose for which it is intended by its very nature or which is evident from the specifications listed and from the order.

The Supplier guarantees that the delivery complies with legal requirements applicable in India and other (international) Government regulations, as applicable.

The supplier guarantees that the delivery complies with the customary norms and standards in the relevant branch of trade or industry. The supplier shall be responsible for compliance with applicable technical, safety, quality, environmental requirements and other regulations in relation to his product, packaging, and raw and ancillary materials.

10. **WARRANTY:**

a) The supplied goods/stores to the purchaser under the contract shall be of the highest grade, free of all the defects & faults in material and of the best quality, manufacture and workmanship and consistent with the established and generally accepted standards for materials of the type ordered and in full conformity with the contract specification, drawing or sample, if any and shall, if operable, operate properly throughout warranty period.

Any defect/fault & non-conformance to standards & descriptions as aforesaid, found during warranty period shall be rectified /repaired/replaced free of cost & at supplier's risk to the complete satisfaction of BEML / End user, within reasonable time at the ultimate destination.

i. Warranty for Design, Manufacture, Supply, Testing and Commissioning, NRC, Deliverables and Service activities:

The said goods/stores shall be warrantied /guaranteed for a period of 24 months from the date of taking over of last trainset by CMRL.

ii. Warranty towards Spares & Tools for Comprehensive Maintenance Contract period:

The said goods/stores shall be warrantied /guaranteed for a period of 24 months from the date of supply of goods at BEML stores/Designated Depots

b) **Defect Liability Period (DLP) / Defect Notification period (DNP):** Defect Liability Period (DLP) / Defect Notification period (DNP): Defect Liability / Notification period shall start after taking over of first train set by customer and shall end two years after taking over certificate date of 70th train set.

For detailed scope of DLP/ DNP, bidders to refer PTS document: GR/TD/7061 Latest revision attached along with tender.

If the Works or sections are not available for usage by end user (CMRL) for more than 48 hrs, then a penalty shall be paid by the supplier as applicable in same lines as per CMRL contract where the non-usage is due to vendor supply.

As per CMRL contract, "the cumulative amount shall be deducted by the Employer from the subsequent bills submitted by Contractor.

- Rolling Stock: Rs. 25,000 per day/ train

A penalty of Rs. 2 lakhs for each case shall be levied for the failure or malfunction in the Works or sections during passenger operation which interrupt metro operations in the specific corridor for more than 10 mins"

c) Extension of DLP:

i. Train/System/Sub-system level extension of DLP will be applicable in the case where reliability targets defined as per ERTS 18.6 are not met.

ii. In case of any retrofits/modifications done by the suppliers in any specific system/sub-system/function/component/software shall be subjected to 24 months warranty from the date of completion of retrofit/modification in that train spares. This specific 24-month warranty is irrespective of the train DLP/warranty

iii. There shall be no delay in start of CMC period of car, However, If the DLP / DNP extension arose on account of non-fulfilment of the Reliability Demonstration targets for subject aggregate for which the tendering is done (as defined in ERTS-RS clause 18.6), then payments against Rolling stock CMC shall be reduced by 65% by CMRL on payment to BEML. The same will be reduced in payment to the supplier on back-to-back basis.

d) **Comprehensive Maintenance Contract (CMC):**

CMC shall start after completion of DLP/DNP activity for 70th Trainset and shall end 15 years after the start of CMC

Note: In case of optional cars, CMC shall start after completion of DLP/DNP activity for 80th Trainset and shall end 15 years after the start of CMC

e) **Guarantee / Warranty replacement:**

Guarantee / Warranty replacement shall be dispatched on “DDP / F.O.R – BEML Stores / designated destination” basis for replaceable items during warranty period.

f) The provisions of this Warranty shall be without prejudice to and shall not be deemed or construed so as to limit or exclude any rights or remedies which the BEML may have against the supplier, whether in tort or otherwise.

If any defect or damage is one requiring immediate attention from safety / environmental view point / operational viewpoint, then BEML has the authority to proceed with rectification in any manner suitable and deduct such sums from the suppliers Bill or purchase order whichever is active.

11. PERFORMANCE SECURITY / PERFORMANCE BANK GUARANTEE (PBG):

Firm shall submit the following 2 Performance Bank Guarantees:

I. FOR SUPPLY OF EQUIPMENTS, NON-RECURRING SCOPE, FAI, DELIVERABLES AND SERVICE ACTIVITIES:

a) Supplier should submit Performance Bank Guarantee for amount equivalent to 10% of the Contract value for supply of equipment, Non-recurring scope, FAI, Deliverables and service activities which will be valid till issue of taking over certificate for last trainset by end customer (CMRL). The bank guarantee has to be submitted within 60 days from the date release of Purchase order from BEML but not later than 30 days before commencement of supplies pertaining to first delivery schedule indicated in the purchase order

b) In case BEML is constrained to extend the Performance Bank Guarantee to its customer (CMRL), due to the failure of aggregates attributable to the supplies made by the supplier or non-fulfilment of NRC and other activities as applicable, then the costs involved to BEML for such PBG extensions shall be borne by the supplier.

c) Performance Bank Guarantee shall be returned back only after completion of issue of taking over certificate for last trainset by end customer (CMRL) and if there is no defect /failure/negligence/complaints and /or any claims notified to BEML on part of supplier in fulfilling the supplies and activities

d) If the minor outstanding works as incorporated in the taking over certificate are not attended by the Supplier within the specified time frame, full amount of Performance Security due to the Supplier shall not be released

II. BANK GUARANTEE TOWARDS SPARES & TOOLS FOR COMPREHENSIVE MAINTENANCE CONTRACT PERIOD:

a) Supplier should submit Performance Bank Guarantee for amount equivalent to 10% of the Contract value for supply of spares & Tools for comprehensive maintenance contract period valid for entire Warranty period for CMC. The bank guarantee has to be submitted within 60 days from the date release of Purchase order from BEML but not later than 30 days before commencement of supplies pertaining Spares & tools indicated in the purchase order

b) In case BEML is constrained to extend the Performance Bank Guarantee due to the failure of aggregates attributable to the supplies made by the supplier, then the costs involved to BEML for such Performance Bank guarantee/security extensions to its customer (CMRL) shall be borne by the supplier.

c) General terms of PBG:

a) In case of foreign bank guarantees, the BGs from foreign banks, authorized /recognized by RBI to issue a Bank Guarantee, in their own letter head will be accepted. In the case of PBG/s submitted from Indian Bank, the PBG shall be furnished by Scheduled Commercial Banks authorized by RBI to issue a Bank Guarantee.

Format for PBG is attached for reference.

PBG shall be returned back only after completion of necessary Warranty /CMC Period and if there is no defect /failure/negligence/complaints and /or any claims notified to BEML on part of supplier in fulfilling the supplies and activities.

b) In the absence of performance bank guarantee to be submitted by the supplier as per contract terms, BEML will not open Letter of Credit (LC) in the cases of LC in favor of supplier pertaining to the shipment / stores to be supplied as per first delivery schedule indicated in the purchase order. Any delay in submission of performance bank guarantee by the supplier, the subsequent delay in opening in Letter of Credit by BEML and supplies to be effected by the supplier are to the account of the supplier, which attracts liquidated damage charges as per contract terms.

c) No claim shall lie against BEML Ltd., in respect of interest on cash deposits or Govt. Securities depreciation thereof.

d) BEML shall be entitled to and it shall be lawful on its part to encash the Bank Guarantee in whole or in part in the event of any default, failure or neglect on the part of the supplier in the fulfilment or performance in all respect of the Purchase Order.

e) The Bank Guarantee shall be established through **Structured Financial Messaging System (SFMS)** mode from a Scheduled Commercial Bank authorized by RBI in India as defined by RBI.

f) A separate copy of the BG has to be sent by the issuing bank to the Purchaser's bank through SFMS. The details of Purchaser's bank are as under:

STATE BANK OF INDIA
Overseas Branch, No.65,
St. Marks Road,
Bangalore – 560001
IFSC Code: SBIN0006861

g) Following codes are to be used by issuing bank for the purpose of Confirmation and amendment in Bank Guarantees:

Code	Purpose
MT760	Confirmation of Bank Guarantee
MT767	Amendment in Bank Guarantee

h) Bank Guarantee issued on the SFMS platform with any other code other than mentioned above for the purpose shall not be acceptable to the Purchaser.

The Bank Guarantee validity shall be extended as required till the completion of all contractual and warranty obligations in Full.

i) Bank Guarantee to be submitted in electronic form through NeSL platform as required by BEML

12. RIGHT TO VARY QUANTITIES &-QUANTITY OPTION CLAUSE:

a) BEML reserves the right to increase or decrease the quantity specified in the schedule of requirements without any change in the unit price or other terms and conditions within the agreed delivery schedule

b) BEML may at its discretion may advice the supplier in writing about the increase of the total quantity up to 10 complete train sets requirement of 3 cars each i.e. 30 cars. and upto additional 50% qty of spares and tools within CMC period.

c) Supplier shall be required to supply increased ordered quantities at the contracted terms & conditions and determined prices (Excluding design cost, Type test cost, FAI test

cost, Training & Manuals cost and Testing & commissioning cost) and no additional amount on account of quantity variation or escalation or any other account whatsoever payable to the supplier

d) In case of increase in quantity beyond the original bid quantity, the delivery schedule for the increased quantities shall be mutually decided at the time of exercise of quantity variation by the Purchaser

e) **CMC obligation for variation quantity**: The CMC obligation as applicable for the base order (70 trainsets of 3 car configuration) quantity shall be applicable for the respective optional trainsets also. The pricing for CMC for the optional trainsets shall be derived accordingly.

13. **LIQUIDATED DAMAGES CLAUSE:**

The time and the date of delivery of the stores stipulated in the PO shall be deemed to be the essence of the Purchase order and delivery must be completed not later than the dates specified therein. The supplier shall strictly adhere to the delivery schedule indicated in the PO. Any supplies made ahead of this schedule are liable for rejection at the discretion of BEML. Should the supplier fail to deliver the stores or any consignment thereon within the period prescribed for such delivery, BEML shall be entitled:

"To accept the delayed supply and to recover from the supplier Liquidated Damage charges at the rate of **0.1%** of total value of the amounts apportioned to the affected delivery schedule for each calendar day of delay for **first 28 days** and **0.2%** of the total value of the amounts apportioned to the affected delivery schedule for each calendar day of delays from **29th day** to the maximum of **10%** of the affected schedule of the purchase order."

The penalty / LD will be charged on the value of the affected delivery schedule excluding statutory levies, freight and insurance wherever not included in the price.

14. **RISK PURCHASE CLAUSE:**

The time and the date of delivery of the stores stipulated in the PO shall be deemed to be the essence of PO and delivery must be completed not later than the date specified therein. Shall the supplier fail to deliver the stores/services or any consignment thereof within the period prescribed for such delivery, BEML shall be entitled at their option either;

a. To purchase elsewhere, without notice to the supplier on the account and at the risk and cost of the supplier the stores not delivered or other of a similar description (where stores exactly complying with the description and readily procurable) without cancelling the PO in respect of consignment not due for delivery

or

b. To cancel the purchase order.

In the event of action being taken under clause (a) or (b) above, the supplier shall be liable for any loss, which BEML may sustain on that account but the supplier shall not be entitled to any gain or purchases made against default. As soon as it is apparent that the scheduled dates cannot be adhered to, an application shall be sent by the supplier to BEML, well before the expiry of the delivery period specified in the purchase order. Without prejudice to the foregoing rights, if such failure to

deliver in proper time as aforesaid shall have arisen from any cause which BEML may admit as a reasonable ground for an extension of the time (and their decision shall be final) they may allow such additional time as they may consider justified by circumstances of the case.

Delivery required to be made in lots shall be made in lots only and any extra deliveries involved either on account of repeated rejections or variance in supply of lots shall be liable for service charges of 5% of the purchase order value for each extra delivery.

15. **SECRECY AND CONFIDENTIALITY:**

a) All the information, know-how, technical data, specification and drawing models or specimens furnished by BEML for the purpose of or in connection with the manufacture and supply of the stores hereby tendered constitute the property of BEML and the supplier shall keep them in strict confidence and he/ she shall not divulge the same to anyone else except under the authority and for the purpose of BEML. All such documents, data, drawing, models and specimens are the property of BEML and shall be returned when done with or when demanded by BEML.

b) The supplier shall not supply the material ordered by BEML to anyone else other than BEML and shall not disclose any initiations, development or adaptations thereof to anyone.

c) BEML shall be entitled to prevent a breach of the above and claim damages in case of breach. In case of non-performance in this PO, BEML will have to take procurement action at your risks and cost apart from levy of liquidated damages.

d) Confidentiality agreement to be executed as per Appendix E.

16. **AUTHORITY OF PERSONS SIGNING DOCUMENT:**

A person signing the tender or any other document in respect of the tender shall be deemed to have power to do so on behalf of the Supplier.

17. **ACCEPTANCE OF ORDER:**

The supplier shall send Order Acceptance within two weeks from the date of LOI/LOA/Purchase Order or such other period as specified / agreed by the Purchaser. Purchaser reserves the right to revoke the order placed if the order confirmation differs from the original Purchase Order placed and the Purchaser shall only be legally bound after it has agreed explicitly in writing to be in agreement with the deviation. The acceptance of deliveries or supplies by Purchaser as well as payments made in this regard shall not imply acceptance of any deviations. The Purchase Order will be deemed to have been accepted if no communication to the contrary is received within two weeks (or the time limit as specified / agreed by the Purchaser) of receipt of the order.

18. **OTHER CONDITIONS:**

a) Refer BEML Purchase Manual (can be accessed in BEML website www.bemlindia.in) for Important terms and conditions of tender and General Terms & conditions applicable to contracts & purchase orders refer General Terms & Conditions

b) The firm shall take necessary permission for their employees to enter the factory premises and the firm shall arrange ESI & PF coverage to their employees / labourers if any from their end. The firm shall indicate ESI NUMBERS for the labourers hired or employed in advance in order to prepare work permit inside the factory.

c) BEML will not have any kind of binding towards the compensation on case of injury / death to the firms employees while working in BEML premises or other wises.

d) BEML will not have any kind of binding on damages or loss to the tools/instruments etc. brought by the firm for commissioning purpose.

19. **PRICE, INVOICING AND PAYMENT:**

a) The agreed prices are **fixed prices** for the supply, in the currency as specified in the Purchase Order. They shall include packing, forwarding, loading and carriage to the place specified by the Purchaser and are inclusive of all applicable taxes, duties etc. except for those specifically agreed between the supplier and purchaser. The method of invoicing shall be without prejudice to the parties; agreement as to the place of performance. Invoices shall be submitted bearing the Purchase Order number & date, item number / s and supporting documents as called for in the Purchase Order.

As soon as each shipment is made in line with the delivery schedule specified in the purchase order, the supplier shall send **one set of Original documents and three (3) sets of photocopies** each of the following documents to the address indicated below by courier service.

i. Commercial Invoice
ii. Delivery Challan
iii. Packing List
iv. BEML's Inspection clearance document(s), material test certificates and other applicable quality documents pertaining to the supplies.

Postal Address

The Deputy General Manager,
Metro Purchase Department
BEML, Bangalore Complex,
PB No.7501, New Thippasandra post,
Bangalore, Karnataka, India,
Postal Code - 560 075

20. **PROGRESS REPORT:**
The supplier shall regularly inform the progress of work and in such form as may be called for by the Purchaser from time to time. The submission and acceptance of such reports shall not prejudice the rights of the Purchaser in any manner.

21. **QUALITY & WORKMANSHIP:**
The stores supplied shall be of the best quality and Workmanship shall be in strict conformity with all the drawings and specifications furnished with the Purchase Orders and shall answer to the description in all respects. All supplies shall be accompanied by supplier's works inspections / test certificates duly certifying, the Stores are in strict

conformity with the drawings / specifications. However, final acceptance will be subject to inspection and approval at BEML works. Once the materials are rejected and communicated to the supplier, no request shall be entertained for re-inspection or acceptance of the stores. However, BEML reserves the right to re-inspect the stores and consider acceptance at its discretion.

22. **QUALITY, CONDITION OF DELIVERY:**

The Supplier shall guarantee that the delivery is of good quality and free from all defects and in the case of services rendered that they are performed by skilled personnel and that new materials are used. The Supplier shall guarantee that the delivery corresponds exactly with the provisions of the agreement, the reasonable expectations of Purchaser regarding the characteristics, quality and reliability of delivery. The Supplier guarantees that the delivery is suitable for the purpose for which it is intended by its very nature or which is evident from the specifications listed and from the order.

The Supplier shall guarantee that the delivery complies with legal requirements applicable in India and other (international) Government regulations, as applicable. The supplier shall guarantee that the delivery complies with the customary norms and standards in the relevant branch of trade or industry. The supplier shall be responsible for compliance with applicable technical, safety, quality, environmental requirements and other regulations in relation to his product, packaging, and raw and ancillary materials.

23. **SUPPLY OF SAMPLE: (if applicable)**

The Contractor shall produce samples of all materials and shall obtain approval before he places bulk order for the material for incorporation in the works. In respect of materials for which samples are not kept or detailed specifications is not given hereinafter, such materials shall comply with the latest relevant Indian Standard Specifications a published up to the date of issue of this tender. The Contractor shall on demand produce original receipts vouchers/invoices in respects of materials supplied by him.

24. **INSPECTION, TESTING & CONSEQUENCE OF REJECTION:**

The goods and stores shall be of approved design and each part /component may be inspected and tested by the Purchaser prior to shipment and shall fully comply with relevant requirements of purchaser.

Purchaser has the right to inspect the delivery. In the event of rejection, Purchaser shall inform the Supplier accordingly and Purchaser shall be entitled to replacement or repair at its discretion or may proceed to terminate or annul the agreement. All this does not affect Purchaser's right to compensation.

In case the goods / stores are rejected at the time of inspection at BEML or the rejections are noticed at the time of further processing the supplier will be informed of these rejections. On receipt of this information the supplier shall immediately arrange to collect the rejected items at his cost and risk and arrange for the replacement of goods within the shortest possible time. Under no circumstances the supplier shall compel the Purchaser to rework the rejected goods.

Wherever the supplier has not collected the rejected items within 60 days from the date of intimation, BEML shall have the right to dispose the goods and all cost related to the cost of material, statutory levies incurred both in procurement and disposal shall be recovered from the supplier from any of the bills that are due. The supplier shall have no claims whatsoever against the Purchaser for such disposal.

Purchaser or his authorized representative shall be entitled at all reasonable times during execution to inspect, examine and test at the Supplier's premises the material and workmanship of all stores to be supplied under the Contract, and if the part of the stores are being manufactured at other premises the Supplier shall obtain Purchaser's or his authorized representative's permission to inspect, examine and test as if the said stores are being manufactured at the Supplier's premises. Such inspection, examination and testing, if made shall not release the Supplier from any obligation under the Contract.

All costs related to inspections and re-inspections shall be borne by the Supplier. The cost of inspection staff / third party specified by the Purchaser shall be borne by Purchaser, unless otherwise specifically agreed. Whether the Contract provides for tests on the premises of the Supplier or any of his Sub-contractor/s, Supplier shall be responsible to provide assistance such as, labour, materials, electricity, fuels, stores, apparatus, instruments as may be required and as may be reasonably demanded to carry out such tests efficiently. Cost of any type test or such other special tests shall be borne by the Purchaser only if specifically agreed.

The supplier shall give the authorized representative of the Purchaser reasonable prior notice in writing of the date on and the place at which any stores will be ready for inspection / testing as provided in the Contract.

25. **RAW MATERIALS ARRANGEMENT:**

The supplier shall make his own arrangement to procure all raw materials required and BEML shall not be responsible for any assistance in such procurement or whatsoever.

26. **IDENTIFICATION OF ITEMS / PIECES:**

The supplier shall indicate / emboss / engrave, suitable identification marks (Viz. BEML stock number, supplier code number, batch no. etc.,) on each item/piece (or) on all components at convenient non-machinable place as per drawing, wherever applicable.

Also, shall indicate BEML part number, PO No. and date in all delivery documents, invoices and correspondence, wherever applicable.

27. **PACKING AND MARKING:**

a) Packing to be in such a way that it should avoid transit/storage/handling damage.

b) The supplier shall package the deliveries safely and carefully and pack them suitably in all respects considering the peculiarity of the material for normal safe transport by Sea / Air / Rail / Road to its destination suitably protected against loss, damage, corrosion in transit and the effect of tropical salt laden atmosphere. The packages shall be provided with fixtures / hooks and sling marks as may be required for easy and safe handling by mechanical means.

c) The packing, shipping, storage and processing of the delivery must comply with the prevailing legislation and regulations concerning safety, the environment and working conditions. Items packed with raw / solid wood packing material shall be treated as per ISPM – 15 (fumigation) and accompanied by Phytosanitary / Fumigation certificate. If safety information sheets exist for a delivery or the packaging, the Supplier must always supply these sheets direct (at the same time).

d) Supplier shall indicate approximate net weight, gross weight and dimension of the package to enable BEML to determine the mode of dispatch. The packing should with stand the weather conditions during transit. The packing should not damage the contents in the package while transporting and handling. The safety and handling precautions should be clearly marked on the packages. The packing should be easily transportable without any damage. Each consignment should have individual packing list.

e) Marking shall include the following information in sequence on the frame commensurate with the size of package.

To: M/s. BEML Limited, Bangalore Complex,
New Thippasandra,
Bangalore – 560075,
Karnataka State, India.

Purchase order number:
Shipper's mark:
Package number:
Identification number:
Caution marks, if applicable:
Net weight, gross weight and cubic measurement, whichever is appropriate for the shipment.

28. **APPLICABLE LAWS AND JURISDICTION OF COURTS:**

Indian laws both substantive and procedure, for the time being in force including modifications thereto, shall govern Contract. The competent Indian courts of shall have sole jurisdiction over disputes between purchaser and the Supplier.

29. **JURISDICTION**:
Courts of Bangalore alone shall have jurisdiction to decide any issue / dispute arising out of the Arbitration or this Purchase Order in exclusion of all other Courts. However, jurisdiction of any other court may be accepted by mutual discussion and agreement by and between BEML and the Supplier.

30. **ARBITRATION:**
Any disputes and differences that may arise between the parties in connection with this Agreement/Contract shall be settled by the parties amicably by way of mutual discussion / negotiation / conciliations. In case parties fail to settle the dispute amicably, then the dispute or difference shall be referred to India International Arbitration Centre for resolution. The Arbitration Tribunal shall consist of Sole / three Arbitrator /s. The Arbitrator /s shall be

appointed and Arbitration proceeding shall be conducted in accordance with the provision of India International Arbitration Centre (Conduct of Arbitration) Regulations, 2023.

During Arbitration, "Supplies under this Purchase Order, if reasonably possible, may continue by mutual agreement during the dispute / Arbitration proceedings"

31. **INTELLECTUAL PROPERTY RIGHTS; LICENSES:**

If any Patent design, trademark or any other intellectual property rights apply to the delivery or accompanying documentation, Purchaser shall be entitled to the legal use thereof free of charge by means of a non-exclusive, worldwide, perpetual license. All intellectual property rights that arise due to the execution of the delivery by the Supplier and by its employees or third parties involved by the Supplier for performance of the agreement belong to Purchaser. The Supplier shall be obligated to do everything necessary to obtain or establish the above-mentioned rights. The Supplier guarantees that the delivery does not infringe on any of the intellectual property rights of third parties. The Supplier shall also be obligated to do everything necessary to obtain or establish the alternate acceptable arrangement pending resolution of any (alleged) claims by third parties.

The Supplier shall defend and indemnify BEML against any claims, costs or expenses incurred by reason of any infringement of alleged infringement of any letters, patent, registered design, trademarks or trade name by the use of sale of the stores / goods /material and against all costs or damages which BEML may undergo in legal action for such infringement or for which the BEML may become liable in any such action.

The supplier shall at all times indemnify BEML and shall take all risk of accidents or damage which causes a failure of the supply. The supplier shall comply with the provisions of Contract Labour (Regulation and Abolition) Act, 1970 and the Contract Labour (Regulation and Abolition) Central Rules 1971 as modified from time to time wherever applicable and shall also indemnify the Company from and against any claims under the aforesaid Act and the Rules.

32. **BRIBES AND GIFTS:**

Any bribe, commission, gift or advantage given, promised or offered by or on behalf of the supplier or his partner, agent or servant or anyone on his or their behalf to any officer, servant, representative or agent of BEML or any person on his or their behalf in relation to the obtaining or to the execution of or any other contract with BEML shall in addition to any criminal liability which the supplier may incur, subject the supplier to the cancellation of the PO and all other contracts with BEML and also to payment of any loss or damage resulting from any such cancellation to like extent as is provided in case of cancellation under **Clause-15** hereof. Any question or dispute as to the committing of any offence under the present clause shall be settled by BEML in such manner and on such evidence of information as they may think fit and sufficient and their decision shall be final and conclusive.

33. **FORCE MAJEURE CLAUSE:**

Notwithstanding anything contained in the Contract, neither the Supplier nor the Purchaser shall be held responsible for total or partial non-execution of any of the contractual obligations, shall the obligation become unreasonably onerous or impossible due to occurrence of a `Force Majeure' conditions which directly affect the obligations to be

performed by the Purchaser or the Supplier. Such events include war, military operations of any nature, blockages, revolutions, insurrections, riots, civil commotions, insurgency, sabotage, acts of public enemy, fires, explosion, epidemics, quarantine restrictions, floods, earthquake, or acts of God, restrictions by Govt. authorities over which the Supplier or the acts on which the Purchaser has no control.

The party claiming to be affected by Force Majeure shall notify the other party in writing without delay, within two weeks on the intervention and on the cessation of such circumstance. Extension of time sought by the Supplier along with supporting evidence and so granted by the Purchaser for the supply / work affected, if any, shall not be construed as waiver in respect of remaining deliveries. In the case of vendor seeking force majeure then it is discretion of BEML to consider the same based on authenticate document.

Notwithstanding above provisions, Purchaser shall reserve the right to cancel the order/ Contract, wholly or partly, in order to meet the overall delivery schedule and make alternative arrangements including arrangements with third party for completion of deliveries and other schedules. Purchase may takeover partly processed material at a mutually agreed price.

34. **FALL CLAUSE:**

a) The prices charged for the stores supplied under this P.O by the supplier shall in no event exceed the lowest price at which the supplier sells the stores of identical description to any other BEML Office / Division during the pendency of this PO.

b) If at any time, during the said period, the supplier reduces the sale price of such stores or sells such stores to any other BEML Office / Division at a price lower than the price chargeable under this P.O and the price payable under this PO for the stores supplied after the date of coming into force of such reduction shall stand correspondingly reduced.

35. **NON-DISCLOSURE AND INFORMATION OBLIGATIONS:**

The supplier shall provide Purchaser with all information pertaining to the delivery in so far as it could be of importance to Purchaser. The Supplier shall not reveal confidential information to its own employees not involved with the tender / Contract & its execution and delivery or to third parties. The supplier shall not be entitled to use the Purchaser's name in advertisements and other commercial publications without prior written permission from Purchaser.

~~36.~~ **ASSIGNMENT OF RIGHTS AND OBLIGATIONS; SUBCONTRACTING:**

The supplier is not permitted to sub-contract the delivery or any part thereof to third parties or to assign the rights and obligations resulting from this agreement in whole or in part to third parties without prior written permission from Purchaser. Any permission or approval given by the Purchaser shall, however, not absolve the supplier of the responsibility of his obligations under the contract.

37. DIVISION OF PATRONAGE:

BEML at its discretion reserves to issue order 100% on L1. BEML reserves the right to avail the price offered for full quantity of the tender or part thereof or ignore the offer completely without assigning any reason whatsoever.

38. INTEGRITY PACT:

The bidder / contractor should upload duly signed & stamped **Integrity Pact** (if the tender value is more than or equal to Rs.1.00 crore) as per prescribed format (**APPENDIX- A)** on plain paper as part of technical bid.

The bidder should put their authorized signature in the Integrity pact as a Contractor / bidder with their company seal along with witness's signature, name & address. **The agreement shall be in full as per format enclosed on a plain A4 size paper duly signed & stamped on all pages**.

The Integrity Pact envisages an agreement between the prospective tenderer and the buyer committing the persons/officials of both the parties not to exercise any corrupt influence on any aspect of the contract.

For the successful bidder, the integrity pact will remain valid up to 12 months after the last payment under the contract, and for all other Bidders 6 months after the contract has been awarded.

The Central Vigilance Commission (CVC) has appointed Shri Kasi Vidyasagar & Shri Lt. Gen. Abhay Krishna as Independent External Monitor (IEM) to oversee the implementation of the Integrity Pact.

Address of IEM is as below:-

Shri Kasi Vidyasagar, IAS (Retd.)

House no. 55,

Dream valley gated community,

Manikonda, Hyderabad – 500089.

Mobile no. +91 9771407778

Email : kasividyasagar@gmail.com

Shri Lt. Gen. Abhay Krishna , (Retd.)

4A-902, Gurjinder Vihar,

AWHO Township, Sector CHI-1

Greater Noida, UP - 201310

Mobile no: +91 9871234353

Email: abhayabk@gmail.com

39. GST TERMS & CONDITIONS:

1. The Supplier is required to comply with all the applicable provisions of the GST Laws/Rules/Notifications/Circulars and to furnish required documents/details within the prescribed time limit to enable BEML to claim the benefits of GST Input Tax Credit or any other benefit.

2. The Supplier is required to furnish proper Invoice/Supplementary Invoice/Debit Note/Credit Note in the form and manner prescribed under GST Laws/Rules/Notifications/Circulars containing all the particulars mentioned therein and within the prescribed time limit as per prevailing GST Laws/Rules/Notifications/Circulars. In case of non-compliance by the Supplier, BEML shall not make any payment towards GST against such invoice until it is complied with within the timeline prescribed under GST Laws/Rules/Notifications/Circulars, and also subject to BEML being in a position to avail GST Input Tax Credit as per applicable GST Laws/Rules/Notifications/Circulars.

3. In case of discrepancy in the data uploaded by the Supplier in the GSTN portal or in case of any shortages or rejection in the supply, BEML will notify the Supplier of the same. Supplier has to rectify the data discrepancy in the GSTN portal or issue Credit note (details to be uploaded in GSTN portal) for the shortages or rejections in the supplies, within the prescribed time limit to enable BEML to avail GST Input Tax Credit.

4. In case, the availment of GST Input Tax Credit by BEML is delayed for any reason other than those attributable to BEML, interest at applicable rate as prescribed under GST Laws/Rules/Notifications/Circulars for such delays shall be recovered from the Supplier.

5. In case Supplier delays declaring such invoice in his GST Return and GST Input Tax Credit availed by BEML is denied or reversed subsequently as per GST Laws/Rules/Notifications/Circulars, GST amount paid by BEML towards such reversal as per GST Laws/Rules/Notifications/Circulars shall be recoverable from Supplier along with applicable interest.

   If BEML has not paid/short paid to the Supplier for any invoices within the time limit prescribed under GST Laws/Rules/Notifications/Circulars due to non-compliance of GST Laws/Rules/Notifications/Circulars by Supplier or any other reason attributable to Supplier and leads to any GST Input Tax Credit reversal by BEML, any losses/expenses/cost/penalty, etc., incurred by BEML shall be recoverable from the Supplier.

6. Wherever applicable, BEML will have the right to deduct “Tax Deducted at Source” at the rate prescribed under the GST Laws/Rules/Notifications/Circulars and to remit the same to the Government

7. In case of supplies made under Reverse Charge Mechanism, the Supplier needs to comply with the provisions under the GST Laws/Rules/Notifications/Circulars in terms of supply of Goods/Services and raising of invoice, so as to enable BEML to remit applicable GST to Govt., within the prescribed time limit and avail GST Input Tax Credit on the same. If the Supplier fails to comply with the above and as a result if BEML incurs any losses/expenses/cost/penalty, BEML shall be entitled to recover the same from the Supplier. Further the Supplier has to mention that “the liability of

payment of GST amounting to Rs ……. is on the Recipient of Service" in the invoice raised on BEML.

8. The Supplier is required to comply with the E-Way Bill Provisions under GST Laws/Rules/Notifications/Circulars. If the Supplier fails to comply with the said provisions and as a result if BEML incurs any losses/expenses/cost/penalty, BEML shall be entitled to recover the same from the Supplier.

9. In case of materials/goods issued to Supplier for Job Work, the Job Work Supplier is required to return the goods within the time limit prescribed in the Purchase Order. If the Job Work Supplier fails to return the goods as above, BEML will be entitled to raise a GST Supply Invoice on the Job Worker Supplier with applicable interest as per the provisions of GST Laws/Rules/Notifications/Circulars. In such cases, BEML will be entitled to recover all such GST/interest on GST /losses/expenses/cost/penalty, etc. incurred by BEML along with interest from the Job Work Supplier. Further in such cases where the GST invoice has been raised by BEML, on return of such goods after the prescribed time limit, the Job Work Supplier needs to return the same under GST invoice.

10. The Supplier have the option to give one Bank Guarantee of appropriate value after considering his estimated value of GST involved in invoices raised on BEML instead of Bank Guarantee for each Contract/Invoice. In case of payment through LC, suitable provisions/clause will be inserted while opening LC to ensure compliances of above conditions. However, if at any point of time value of such Bank Guarantee falls short of GST plus interest thereof, Supplier will have to either furnish Bank Guarantee for Differential value or such shortfall value of Bank Guarantee vis-à-vis GST plus interest thereof shall be withheld till Suppliers fulfils its obligations specified under above clauses.

    BEML will be entitled to recover all losses/expenses/cost/penalty, etc. incurred by BEML along with applicable interest from the Supplier due to reasons other than those attributable to BEML.

11. If the Supplier is a Composition/Unregistered Dealer, the Supplier needs to comply with the provisions under the GST Laws/Rules/Notifications/Circulars in terms of supply of Goods/Service and raising of invoice. In case, the Supplier fails to comply with the above and as a result if BEML incurs any losses/expenses/cost/penalty, BEML shall be entitled to recover the same from the Supplier along with applicable interest.

40. **TAX CLAUSE:**

Any tax and/or duty, which may hereafter be imposed outside India, shall be on Supplier's account. **On the other hand, any tax and/or duty, which may hereafter be imposed in India, shall be on BEML's account**. Notwithstanding the foregoing, tax on supervising fee and/or other training fees shall be on Supplier's account, however, it shall be withheld and paid by BEML in India on behalf of Supplier according to provisions of the corporation tax law, the local inhabitant tax law and convention between Republic of India and the respective Suppliers country, for the avoidance of double taxation and the prevention of fiscal evasion with respect to taxes on income.

Where the government of the supplier's country exempts goods in export from any or all of such taxes, levies, duties on imports, the supplier shall charge the purchase price, which are exclusive of and free from such taxes, levies, and duties on imports.

Any downward revision in taxes or duties imposed in supplier's country should be informed and that benefit should be passed on to the BEML.

Any increase in statutory levies during the period wherein supplier has defaulted to effect supplies as per delivery schedule indicated in contract has to be borne by the supplier.

HSN CODE/CHAPTER ID and SAC Code details are to be indicated against each item.

TDS (Tax deducted at source) will be applicable for service purchase orders and will be deducted as per law of land. SAC (Service Account code) shall be indicated for the services /NRC that will be carried out by the supplier.

41. **PROJECT IMPORT REGISTRATION:**

Customs duty on input content imported by domestic bidders to manufacture tendered items.

Chennai Metro Rail Project is eligible for the concessional rate of custom Duty under chapter 98.01 of Custom Tariff Act for Project Import registration mode. In case if an indigenous supplier imports some items from outside India, the firm has to register with customs for availing concessional rate of duty i.e. 7.5% BCD plus cess, through project import registration mode.

To avail the concessional customs duty benefit, Bill of Material (BOM) of such imported material in the prescribed template (containing part number, description, qty, price, source of supply, mode of shipment – Air/Sea, port of arrival etc.,) should be submitted by bidders to BEML within 02 months from finalization of the contract for obtaining PIR sponsoring letter from CMRL. The PIR sponsoring letter should be registered by the bidders with the concerned Customs Authorities at designated Port of Arrival.

The supplier shall submit the following documents for reimbursement of Custom Duty:

i) Bills of Entry

ii) Challan for deposit of Custom Duty

iii) Declaration that the Sub-contractors/Sub-vendors have neither claimed the deemed export benefit nor they will claim the same.

42. **INSURANCE COVERED BY BEML UPTO START OF CMC:**

BEML has insured the Material being procured and the risk Coverage under the MCE policy shall commence from the moment of the first goods/consignments are lifted, mechanically or manually or otherwise, from anywhere in the world for loading onto the transport (all modes included) and remain in force during transit up to BEML's works and designated CMRL depot available till handing over of trainset with 24 months DNP/DLP.

43. **RETENTION MONEY:**

Retention money shall be deducted at the rate of 5% against each Invoice value of PO (excluding CMC) upto cumulative value equal to 5% of the total Material PO value

excluding taxes & duties. Firm to raise Invoice for 100% value indicating that 5% of the Invoice value shall be payable by BEML only after completion of DLP/DNP period of all the trainset.

Upon the request of the Supplier, the purchaser may release the withheld retention money on submission of Bank Guarantee for an equivalent amount in respective currencies from a public sector bank (PSB) of India or Scheduled Commercial Banks in India or any Japanese Bank as listed under Schedule of Commercial Banks by The Reserve Bank of India (RBI).

Retention amount shall be released upon completion of DLP period i.e, a period of 24 months from the date of supply upto taking over of last trainset (70th trainset) by end customer, CMRL

44. JAPANESE CONTENT STIPULATION:

Chennai Metro Rail Project – Phase II (ARE02A) is funded by Japanese ODA Loans and BEML is required to stringently adhere to the Japanese Ratio of 30.069% of accepted contract value for OE Procurement.

Bidders to refer Annexure-V (JICA) of NIT for eligibility criteria and submit details of Japanese components and service of Subject item in the stipulated format as per Annexure V enclosed along with bid.

Bids from eligible sources complying to Annexure-V (JICA) and providing certificate as per Annexure-V (a) and Annexure-VI will only be considered.

45. COMPREHENSIVE ECONOMIC PARTERNSHIP AGREEMENT (CEPA) and DTAA:

Supplier should comply to CEPA agreement wherever applicable and pass on benefits arising out of CEPA agreement.

ANNEXURE – III: KEY DELIVERY DATES (CMRL)

ARE02A KEY DATE DELIVERY SCHEDULE

BANGALORE COMPLEX

PROJECT	Activities	Order Qty on Hand	2026				2027												2028												2029										
			Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Chennai Metro ARE02A	Delivery of cars @ Chennai	210	3	0	3	3	0	3	3	0	3	3	3	3	12	6	9	9	12	9	12	9	9	9	9	9	9	6	9	9	9	12	9	6							
	Testing & Commissioning of cars													3	3	3	3	3	3	3	6	9	12	9	12	6	6	9	9	9	18	9	9	6	9	9	12	9	6	9	6

CMC of 15 years will start by Oct-2031 and end by Sep-2046

Manuals delivery

Red denote Key Date

	2026				2027												2028												2029										
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov

Note

CMC: BEML is required to carry out 15 years Comprehensive Maintenance Contract (CMC) for Rolling Stock which shall commence after the TOC date of 70th Trainset and shall end after 15 years from start

DLP/RS: Shall start from the date of issuance of Takingover Certificate (TOC) for the 1st trainset and the fleet DNP / DLP ends two years after the TOC date of the 70th TS

DLP/M&P: Shall start on the TOC date of the respective equipment item and will ends two years after the TOC date of the last equipment

Total RS DLP period required spares & manpower support for 1st TS = 51 months, 70th TS = 24 months. **DLP varies from 1st TS to 70th TS**

ANNEXURE-IV: SCOPE OF CMC

1. One train set of complete PA/PIS and CCTV set including connectors to be considered as Backup spares same can be utilized as rotational spares.
2. Test Benches as applicable for one depot to be considered as per OEM recommendations.
3. One Set of Special tools, jigs, measuring devices, coding plug (If any), Lan tester, etc.. To be considered as per OEM recommendations.
4. 3no's of Maintenance terminal to be considered with 18 years of software support from OEM . BEML will buy the laptops as per OEM specifications.
5. CMC period list of mandatory Spares to be positioned at the depot in schedule manner. Delivery schedule to be discussed and finalized during techno commercial discussion. Mandatory spares to be placed at the depot after completion of DLP period as per **Annexure-A** . This particular clause for spares requirement supersedes the ERTS terms and condition for the CMC.
6. Any modifications carried out by OEM During DLP/warranty period, also to be implemented by OEM in spares supplied under this contract.
7. Training for BEML staff to be provided at OEM Factory/ depots for operational & maintenance. This is apart from the training needs to the customer as indicated in the tender line item.
8. On Train Maintenance is Under BEML scope.
9. During DLP warranty period, DLP spares to be maintained by OEM at the Chennai depot.
10. OEM to give the storage procedure for the spares supplied at the depot.

Annexure-A

(Ref document, PTS of PA/PIS & CCTV, Doc No.: GR/TD/7061 Latest Revision)

Sl.No	Item	Unit	Mandatory spares Qty	Remarks
PAPIS				
1	Set of PCB cards (Train set means DMC +TC + DMC cars)	Train Set	2	Two train set Material
2	Set of Power Module Cards(Train set means DMC +TC + DMC cars)	Train Set	2	Two train set Material
3	Set of Input Output Cards(Train set means DMC +TC + DMC cars)	Train Set	2	Two train set Material
4	Amplifier	Nos	3	One train set material.
5	Ceiling Mounted Speaker with dust cloth	Nos	24	Two train set material.
6	Exterior speaker	Nos	24	Two train set material.
7	Speaker dust cloth	Nos	24	Two train set material.
8	CCH/ Main operating Panel with Microphone/DVAU	Nos	4	Two train set material.
9	Cab loud speakers	Nos	4	Two train set material.
10	Passenger emergency activation panel along push button	Nos	12	One train set material.
11	Solid state disk(SSD card) or micro SD card, if any	Nos	6	Two train set material
12	External Destination display and train number Indicator	Nos	4	Two train set material
13	Display for advertisement	Nos	18	One train set material

14	Dynamic Route map display(DRMD)	Nos	16	Two train set material.
15	External Side Destination Indicator	Nos	6	Two train set material.
16	Internal Electronic Destination Display(IEDD)	Nos	6	Two train set material.
17	Set of all electrical items auxiliary's -All type of mating connectors for all the equipment's (male & female connectors including M12 Ethernet connector along with pin and socket, etc..) , coding plugs(If any),pins, etc. which are under vendors scope. (Train set means DMC +TC + DMC cars)	Train Set	2	Two train set Material
18	Set of Mechanical auxiliary's - Namely mounting fasteners, Mounting bolts, Washers, rubber items , etc., which are under vendors scope. (Train set means DMC +TC + DMC cars)	Train Set	2	Two train set Material
CCTV				
19	Exterior cameras PCB's	Nos	18	Three train set material
20	Saloon camera PCB's	Nos	36	Three train set material
21	Track camera PCB'S	Nos	8	Four train set Material
22	OHE Camera PCB'S	Nos	8	Four train set Material
23	Detrainment camera PCB'S	Nos	8	Four train set Material
24	Panto graph monitoring camera PCB's	Nos	8	Four trailer car material
25	All type of camera Lenses(Train set means DMC +TC + DMC cars)	Train Set	1	One train set material
26	Network video recorder(NVR)	Nos	6	Three train set material
27	Managed Ethernet switch with POE ports	Nos	6	Two train set material
28	Solid state disk(SSD card) or micro SD card, if any	Nos	6	Two train set material
29	Set of all electrical items auxiliary's -All type of mating connectors for all the equipment's (male & female connectors including M12 Ethernet connector along with pin and socket, etc..) , coding plugs(If any),pins, etc., which are under vendors scope. (Train set means DMC +TC + DMC cars)	Train Set	2	Two train set Material

30	Set of Mechanical items auxiliary's -Namely mounting fasteners, Mounting bolts, Washers, rubber items , etc., which are under vendors scope. (Train set means DMC +TC + DMC cars)	Train Set	2	Two train set Material

Note: BOM & BOM quantity after design freeze is applicable for the above.

APPENDIX- A

(*To be executed on plain paper and applicable for all tenders of value _ Rs. 1 Crore and above)*

INTEGRITY PACT

Between

BEML Limited (BEML) hereinafter referred to as "The Principal"

And

……. hereinafter referred to as "The Bidder/Contractor"

Preamble

The Principal intends to award, under laid down organizational procedures, contract/s for

...……

The Principal values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness / transparency in its relations with its Bidder(s) and / or Contractor(s). In order to achieve these goals, the Principal will appoint an independent External Monitor (IEM), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1 – Commitments of the Principal

(1) The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:

a) No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

b) The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.

c) The Principal will exclude from the process all known prejudiced persons.

(2) If the principal obtains information on the conduct of any of its employees which is a criminal offence under the IPC/PC Act, or it there be a substantive suspicion in this regard, the Principal will inform the Chief Vigilance Officer and in addition can initiate disciplinary actions.

Section 2 – Commitment of the Bidder(s)/ contractor(s)

(1) The Bidder(s)/ Contractor(s) commit themselves to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.

a) The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

b) The Bidder(s)/ Contractor(s) will not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

c) The Bidder(s)/ Contractor(s) will not commit any offence under the relevant IPC/PC Act; further, the Bidder(s) / Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or documents provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

d) The Bidder(s)/ Contractor(s) of foreign origin shall disclose the name and address of the Agents/ Representatives in India, if any. Similarly, the Bidder(s)/ Contractor(s) of Indian Nationality shall furnish the name and address of the foreign Principals, if any. Further, as mentioned in the "Guidelines on Indian Agents of Foreign Suppliers" shall be disclosed by the Bidder(s)/Contractor(s). Further, as mentioned in the Guidelines all the payments made to the Indian agent/representative have to be in Indian Rupees only. Copy of the "Guidelines on Indian Agents of Foreign Suppliers" is placed at **Appendix (A-1).**

e) The Bidder(s) / Contractor(s) will, when presenting his bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.

(2) The Bidder(s)/Contactor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

Section 3 – Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/Contractor(s), before award or during execution has committed a transgression through a violation of Section 2, above or any other form such as to put his reliability or creditability in question, the Principal is entitled to disqualify the Bidder(s)/Contractor(s) from the tender process or act as per the procedure mentioned in the "Guidelines on Banning of business dealings".

Section 4 – Compensation for Damages

(1) If the Principal has disqualified the Bidder(s) from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit/ Bid Security.

(2) If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to Section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages of the contract value or the amount equivalent to Performance Bank Guarantee.

Section 5 – Previous Transgression

(1) The Bidders declares that no previous transgressions occurred in the last three years with any other Company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprises in India that could justify his exclusion from the tender process.

(2) If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or action can be taken as per the procedure mentioned in "Guidelines on Banning of business dealings".

Section 6 – Equal treatment of all Bidders /Contractors /Sub-contractors

(1) The Bidder(s)/ Contractor(s) undertaker(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact, and to submit it to the Principal before contract signing.

(2) The Principal will enter into agreement with identical conditions as this one with all Bidders, Contractors and subcontractors.

(3) The Principal will disqualify from the tender process all bidders who do not sign this Pact or violate its provisions.

Section 7 – Criminal charges against violating Bidder(s) / Contractor(s) / Subcontractor(s)

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or of the Principal has substantive suspicion in this regard, the Principal will inform the same to the Chief Vigilance Officer

Section 8 – Independent External Monitor / Monitors

(1) The Principal appoints competent and credible Independent External Monitor for this Pact.

The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement

(2) The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. It will be obligatory for him to treat the information and documents of the Bidders/Contractors as confidential. He

reports to the CMD, BEML.

(3) The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all Project documentation of the Principal including that provided by the Contractor. The Contractor will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Subcontractor(s) with confidentiality.

(4) The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

(5) As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or take corrective action, or to take other relevant action. The monitor can in this regard submit non- binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.

(6) The Monitor will submit a written report to the CMD, BEML, within 8 to 10 weeks from the date of reference or intimation to him by the Principal and, should the occasion arise submit proposals for correcting problematic situations.

(7) If the Monitor has reported to the CMD, BEML, a substantiated suspicion of an offence under relevant IPC/PC Act, and the CMD, BEML has not, within the reasonable time taken visible action to proceed against such offence or reported it to the Chief Vigilance Officer, the Monitor may also transmit this information directly to the Central Vigilance Commissioner.

(8) The word 'Monitor' would include both singular and plural.

Section 9 – Pact Duration

This pact begins when both parties have legally signed it. It expires for the Contractor 12 months after the last payment under the contract, and for all other Bidders 6 months after the contract has been awarded. If any claim is made/lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/ determined by CMD of BEML

Section 10 – Other provisions

(1) This agreement is subject to Indian Law. Place of performance and jurisdiction is the Corporate Office of the Principal, i.e. Bangalore.

(2) Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

(3) If the Contractor is a partnership or a consortium, this agreement must be signed

by all partners or consortium members.

(4) Should one or several provisions of this agreement turn out to be invalid, the reminder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intensions.

(5) The bidder shall not approach the Courts while representing the matters to IEMs and he/ she will await their decision in the matter.

(6) In case of joint venture, all the partners of the joint venture should sign the Integrity Pact. In case of sub-contracting, the Principal contractor shall take the responsibility of the adoption of IP by the sub-contractor. It is to be ensured that all sub- contractors also sign IP.

(7) In the event of any dispute between the management and the contractor relating to those contracts where Integrity Pact is applicable, in case, both the parties are agreeable, they may try to settle dispute through mediation before the panel of IEMs in a time bound manner. If required, the organization may adopt any mediation rules for this purpose.

In case, the dispute remains unresolved even after mediation by the panel of IEMs, the organization may take further action as per the terms and conditions of the contract.

The fees / expenses on dispute resolution shall be equally shared by both the parties.

(8) In the event of any contradiction between the Integrity Pact and its Annexure, the Clause in the integrity pact will prevail

----------	----------
(For & On behalf of the Principal)	(For & On behalf of Bidder/Contractor)
(Office Seal)	(Office Seal)
Place----------	Place----------
Date ----------	Date ----------
Witness 1:	***Witness 1:***
(Name & Address)	(*Name & Address*)
----------	----------
----------	----------
Witness 2:	***Witness 2:***
(Name & Address)	(*Name & Address*)
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Appendix A-1

(Applicable Agents / Suppliers to Sign, Seal & Upload / Submit)

GUIDELINES FOR INDIAN AGENTS OF FOREIGN SUPPLIERS

1.0 There shall be compulsory registration of agents for all Global (Open) Tender and Limited Tender. An agent who is not registered with BEML LTD shall apply for registration in the prescribed Application-Form available on *www.bemlindia.in*.

1.1 Registered agents will file an authenticated Photostat copy duly attested by a Notary Public/Original certificate of the principal confirming the agency agreement and giving the status being enjoyed by the agent and the commission/remuneration/ salary/ retainer ship being paid by the principal to the agent before the placement of order by BEML LTD.

1.2 Wherever the Indian representatives have communicated on behalf of their principals and the foreign parties have stated that they are not paying any commission to the Indian agents, and the Indian representative is working on the basis of salary or as retainer, a written declaration to this effect should be submitted by the party (i.e. Principal) before finalizing the order.

2.0 DISCLOSURE OF PARTICULARS OF AGENTS/ REPRESENTATIVES IN INDIA, IF ANY:

2.1 Tenderers of Foreign nationality shall furnish the following details in their offer:

2.1.1 The name and address of the agents/representatives in India, if any and the extent of authorization and authority given to commit the Principals. In case the agent/representative be a foreign Company, it shall be confirmed whether it is real substantial Company and details of the same shall be furnished.

2.1.2 The amount of commission/remuneration included in the quoted price(s) for such agents/representatives in India.

2.1.3 Confirmation of the Tenderer that the commission/ remuneration if any, payable to his agents/representatives in India, may be paid by BEML LTD in Indian Rupees only.

2.2 Tenderers of Indian Nationality shall furnish the following details in their offers:

2.2.1 The name and address of the foreign principals indicating their nationality as well as their status, i.e, whether manufacturer or agents of manufacturer holding the Letter of Authority of the Principal specifically authorizing the agent to make an offer in India in response to tender either directly or through the agents/representatives.

2.2.2 The amount of commission/remuneration included in the price (s) quoted by the Tenderer for himself.

2.2.3 Confirmation of the foreign principals of the Tenderer that the commission/remuneration, if any, reserved for the Tenderer in the quoted price (s), may be paid by BEML LTD in India in equivalent Indian Rupees on satisfactory completion of the Project or supplies of Stores and Spares in case of operation items.

2.3 In either case, in the event of contract materializing, the terms of payment will provide for payment of the commission /remuneration, if any payable to the agents/representatives in India in Indian Rupees on expiry of 90 days after the discharge of the obligations under the contract.

2.4 Failure to furnish correct and detailed information as called for in paragraph-2.0 above will render the concerned tender liable to rejection or in the event of a contract materializing, the same liable to termination by BEML LTD. Besides this there would be a penalty of banning business dealings with BEML LTD or damage or payment of a named sum.

Signature
(For & On behalf of Bidder/Contractor)

APPENDIX B

(To be submitted along with technical bid)

COMPLIANCE REPORT FOR PROCUREMENT TECHNICAL SPECIFICATION (PTS)

Compliance to PTS GR/TD/7061, Latest Revision				
PTS Clause No	Description	Complied	Not Complied	Remarks
1. Introduction	1.1. General			
	1.2 Operations			
	1.3 Description of work			
	1.4 Sustainability			
	1.5 Carbon credits			
2. Definitions and Abbreviations	2.1 Definitions			
	2.2 Abbreviations			
3. Precedence of Documents				
4. Scope of Supply	4.1 General			
	4.2 Scope of Supply for PAPIS & CCTV system			
	4.2.1. PA System			
5. System Requirements	5.1 General requirements			
	5.2 Design life			
	5.3 Service-proven design			
	5.4 Designs for refurbishment			
	5.5 Aesthetic appearance			
	5.6 Car general characteristics			
	5.7 Clearance requirement			
	5.8 Wayside characteristics			
	5.9 Train's inter-operability requirements			
	5.10 Environmental criteria			
	5.11 Weight criteria			
	5.12. Shock and vibration			
	5.12.1 Component design criteria			
	5.12.2 Vibration generation			
	5.13 Ride quality and passanger comfort (Stability analysis)			
6. Interface Responsibilities				
7. Design Responsibilities	7.1 General			
	7.2 PA/PIS & CCTV System			
8. Design Submission & Approval Responsibilities				
	8.1 Design Information			
	8.2 Testing			

	8.3 Operation & Maintenance Manuals and Spare Parts Catalogues			
	8.4 Electronic Manuals			
	8.5 Spares, Special Tools and Testing Equipment.			
	8.6 Storage, Packing Crating and Marking			
	8.7 Training			
9. Comprehensive Maintenance during Comprehensive Maintenance Period				
	9.1 Warranty			
10. Subcontractor Responsibilities	10.1 Product and component responsibility			
	10.2 Equipment Interface Responsibility			
	10.3 Combined System Test (Integration Test) Responsibility			
11. Equipment handling				
12. Commissioning and testing				
13. Liabilities				
14. Technical Requirements	14.1 General requirements			
	14.2 Technical requirements of PAPIS & CCTV SYSTEM			
15 Project Management				
16 Interface Activities				
17 Quality	17.1 General			
	17.2 Quality Assurance Plan			
	17.3 Organization			
	17.4 Certification of Personnel			
	17.5 Evidence of Compliance			
	17.6 Certificates Of compliance			
	17.7 Calibration			
	17.8 Procedure Documents			
	17.9 Quality Assurance Activities			
	17.10 Procurement			
	17.11 Manufacturing Inspection			
	17.12 Production Conformance Testing			
	17.13 Receiving Inspection			
	17.14 Shipping Inspection			
	17.15 Ensure Inspection with Latest Revisions/ Changes			
	17.16 Identification of Items using tags etc			
	17.17 Handling			
	17.18 Non-conformance Control			
18 Quality Audit				
	18.1 Inspection and Test Plan (ITP			
18.2 System Safety				

	18.2.1 PAPIS & CCTV System Aggregates			
	18.2.2 System Safety Assurance Management			
	18.2.3 Safety Requirement			
18.3 Hazard Analysis	18.3.1 The Programme of system assurance			
18.4 Reliability & Availability	18.4.1 Reliability Target			
	18.4.2 Availability Requirements			
	Definitions			
	18.4.3 Availability targets			
	18.4.4 Availability demonstration during CMC period			
	18.4.5 Availability damage			
	18.4.6 Penalties on service failures			
18.5 Reliability and Maintainability	18.5.1 Maintainability targets			
	18.5.2 Reliability and Maintainability Demonstrations			
	18.5.3 Time required for maintenance			
	18.5.4 RAMS Deliverables			
18.6 Safety-related System Interference				
18.7 Design information	18.7.1 General			
	18.7.2 Design and Performance Requirements			
	18.7.3 Design Submission Requirements			
18.8 Software				
18.9 Weight				
18.10 Materials and workmanship				
18.11 Operation and Maintenance Manuals and Spare parts catalogues				
	18.11.1 General			
	18.11.2 Operation Manuals and technical description			
	18.11.3 Maintenance Manuals			
	18.11.4 Equipment illustrated Parts Catalogue			
	18.11.6 Submissions			
	18.11.7 Electronic Manuals			
18.12 Training				
19. Testing				
19.1 General				
19.2 Inspection	19.2.1 Hold point inspection			
	19.2.2 Test Procedure			
	19.2.3 Sequence of Tests			
19.3 Routine and type tests of equipment and sub-systems				
	19.3.1 Type Test, PAPIS & CCTV system aggregates			

	19.3.2 Routine Test, PAPIS & CCTV system aggregates			
	19.3.3 Fire Performance Test			
	19.3.4 Noise and Vibration Performance Tes			
	19.3.5 EMI/ EMC Test			
	19.3.6 Test Items (Standard) for each System			
	19.3.7 Software Verification and Testing			
19.4 Factory and Site Tests of complete cars				
	19.4.1 Type Test, Completed car, unit and Train Tests			
	19.4.2 Routine Test, Completed car, unit and Train Tests			
19.5 Testing and Commissioning of cars/trains in Depot & Mainline				
	19.5.1 Type Commissioning Tests in Depot & Mainline			
	19.5.2 Routine Commissioning Tests in Depot & Mainline			
19.6 Integration Test				
19.7 Instrumentation and Dynamometer Tests and Oscillation Trials				
19.8 Service Trials				
20 Defect Notification Period (DNP) / Defect Liability Period (DLP) / Warranty				
21 Others				
22 Submittals – Technical Offer				
23 List of Documents and Drawings attached- Appendices/Annexures				

Authorized signatory with company seal / stamp

APPENDIX – C

COMPLIANCE REPORT OF GENERAL TERMS & CONDITIONS

(To be submitted along with Technical Bid)

Bid Invitation No :

Firm :

Item details :

Sl. No.	Terms / Clause	Complied	Not Complied	Remarks
1.	GLOSSARY, DEFINITIONS & INTERPRETATIONS			
2.	SUBMISSION OF THE TENDER			
3.	SUPPLIERS SHARING LAND BORDER WITH INDIA			
4.	PREFERENCE TO MAKE IN INDIA			
5.	DELIVERY TERMS			
6.	PAYMENT			
7.	PRICE BID VALIDITY			
8.	FIRM PRICE			
9.	INSPECTION			
10.	WARRANTY			
11.	PERFORMANCE BANK GUARANTEE (PBG)			
12.	RIGHT TO VARY QUANTITIES & QUANTITY OPTION CLAUSE			
13.	LIQUIDATED DAMAGES CLAUSE			
14.	RISK PURCHASE CLAUSE			
15.	SECRECY AND CONFIDENTIALITY			
16.	AUTHORITY OF PERSONS SIGNING DOCUMENT			
17.	ACCEPTANCE OF ORDER			
18.	OTHER CONDITIONS			
19.	PRICE, INVOICING AND PAYMENT			
20.	PROGRESS REPORT			

Authorized signatory with company seal / stamp

APPENDIX – C

COMPLIANCE REPORT OF GENERAL TERMS & CONDITIONS

(To be submitted along with Technical Bid)

Bid Invitation No :
Firm :
Item details :

21.	QUALITY & WORKMANSHIP			
22.	QUALITY, CONDITION OF DELIVERY			
23.	SUPPLY OF SAMPLE (If Applicable)			
24.	INSPECTION, TESTING & CONSEQUENCE OF REJECTION			
25.	RAWMATERIALS ARRANGEMENT			
26.	IDENTIFICATION OF ITEMS / PIECES			
27.	PACKING AND MARKING			
28.	APPLICABLE LAWS AND JURISDICTION OF COURTS			
29.	JURISDICTION			
30.	ARBITRATION			
31.	INTELLECTUAL PROPERTY RIGHTS; LICENSES			
32.	BRIBES AND GIFTS			
33.	FORCE MAJEURE CLAUSE			
34.	FALL CLAUSE			
35.	NON-DISCLOSURE AND INFORMATION OBLIGATIONS			
36.	ASSIGNMENT OF RIGHTS AND OBLIGATIONS; SUBCONTRACTING			
37.	DIVISION OF PATRONAGE			
38.	INTEGRITY PACT			
39.	GST TERMS & CONDITIONS			
40.	TAX CLAUSE			
41.	CUSTOMS DUTY ON INPUT CONTENT			
42.	INSURANCE COVERED BY BEML UPTO START OF CMC			
43.	RERENTION MONEY			
44.	JAPANESE CONTENT STIPULATION			
45.	COMPREHENSIVE ECONOMIC PARTERNSHIP AGREEMENT (CEPA) AND DTAA			

Authorized signatory with company seal / stamp

APPENDIX – D

COMMITTEMENT TO SUPPLIES

(To be submitted along with Technical Bid)

This is to certify that we M/s ……. Against SRM tender No. as a Bidder commit that we will support BEML for requirement of any additional Equipment, Spares, Service required at the later stage i.e. from taking over of first trainset and up to completion of CMC by end customer CMRL for all the cars of contract Chennai Metro Rail Project-Phase II (ARE02A).

Authorized signatory with company seal / stamp

APPENDIX- E

CONFIDENTIALITY AGREEMENT
(To be typed on plain paper and submitted along with the technical bid)

This Confidentiality Agreement is made and entered into between M/s BEML, (hereinafter referred to as BEML), a Govt. of India Undertaking under Ministry of Defence, having its Registered Office at BEML Soudha, No.18/1, 4th Main, Sampangirama Nagar, Bangalore – 560 027 and M/s ---------- (hereinafter referred as XXXX) having its Registered Office at…….. . M/s. BEML, has been patronizing XXXX for components / spares listed in Annexure hereto. A need has been felt to revitalize the business relationship for mutual advantage.

1) It is mutually, therefore, agreed that the following shall form part of the terms and conditions for continued business:

- **a)** The supplier shall not divulge to anyone else except under the authority and for the purposed of BEML, all information such as technical data, specifications, drawings, models of specimens furnished / supplied by BEML for the purpose of manufacture or in connection with developmental activities, constitute the property of BEML and the supplier shall keep them in strict confidence. This has been explicitly stated in all the details to the supplier through Purchase Order / Drawings etc., released.
- **b)** The supplier shall not supply the components / spares exclusively manufactured for BEML with the Technical Data / Specifications / assistance furnished by BEML and shall not disclose my initiations, development of adaptations thereof to anyone else except with the written consent of BEML.
- **c)** BEML shall be entitled to prevent breach of the above and to claim damages in case of any breach. It is hereby mutually agreed that for breach of this agreement the Vendor shall pay, without actual proof of damages, a liquidated amount of Rs. 1.00 Crore (Rupees One Crore only).
- **d)** **ARBITRATION:** Any disputes and differences that may arise between the parties in connection with this Agreement/Contract shall be settled by the parties amicably by way of mutual discussion / negotiation / conciliations. In case parties fail to settle the dispute amicably, then the dispute or difference shall be referred to India International Arbitration Centre for resolution. The Arbitration Tribunal shall consist of Sole / three Arbitrator /s. The Arbitrator /s shall be appointed and Arbitration proceeding shall be conducted in accordance with the provision of India International Arbitration Centre (Conduct of Arbitration) Regulations, 2018.

2) BEML shall be entitled to prevent breach of the above and to claim damages in case of any breach.

3) The Signatories hereto declare that they have the sanction and power to execute and deliver this binding agreement.

IN WITNESS WHEREOF, the parties hereto have set their respective hands to this Confidentiality Agreement on …….. written in the presence of Witness.

For BEML

For M/s. XXXX

WITNESS:

1.

2.

APPENDIX -F

Land Border Sharing Declaration

(To be submitted in the bidder's letter head along with technical bid)

In-line with Department of Expenditure's (DoE) Public Procurement Division Order vide ref. F.No.6/18/2019-PPD dated 18.07.2020 & 19.7.2020 and subsequent orders

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 18.07.2020 & 19.7.2020) 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 – G

DECLARATION REGARDING MINIMUM LOCAL CONTENT IN LINE WITH REVISED PUBLIC PROCUREMENT (PREFERENCE TO MAKE IN INDIA), ORDER 2017 DATED 04TH 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 04th 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

APPENDIX –H

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 :

APPENDIX – I

(To be submitted along with technical bid)

DELIVERY SCHEDULE

Sl No	Part No / Description	Total Qty (Trainsets)	Schedule	No of Train Sets (3 Cars/TS)
1	Equipment with DNP/DLP	70 TS (210 cars)	Apr'26	1
			Jul'26	3
			Nov'26	3
			Feb'27	4
			May'27	4
			Jul'27	3
			Aug'27	3
			Sep'27	4
			OCT'27	3
			Nov'27	4
			Dec'27	3
			Jan'28	3
			Feb'28	3
			Mar'28	3
			Apr'28	3
			May'28	4
			Jun'28	4
			Jul'28	3
			Aug'28	4
			Sep'28	4
			Oct'28	4
3	Non-Recurring activities- Design and Submission of Design Documents	PDR: Jul-25 PFDR: Mar-26 FDR: Jun-26		
4	FAI Reports and Type Test & Report	Jun.26		
5	Deliverables as per ERTS Clause 13.7.1& 13.8.15, 13.13.3 & 13.13.10 for PAPIS & CCTV System	Apr.26		
	Printed Circuit Boards (PCB) details asper ERTS 19.55 for PAPIS & CCTV System	Mar-26		
	Microprocessor Details as per ERTS 19.57 for PAPIS & CCTV System	Mar-26		
6	Spares as per Annexure A for PAPIS & CCTV System	To be supplied as per BEML requirement		
7	Tools & Test bench for PAPIS & CCTV System	Dec.'26		
8	Training	Jan.'28		
9	Manuals	Jan.'28		

Note: a) Delivery schedule proposed above is tentative. However, it can be mutually discussed and agreed in line with key dates of CMRL contract. b) CMC shall start after completion of DLP/DNP activity for 70th Trainset and shall end 15 years after the start of CMC . c) 1 Trainset comprises of 2 DM car and 1 T car

ANNEXURE- JICA

SECTION V: ELIGIBLE SOURCE COUNTRIES OF JAPANESE ODA LOANS

ELIGIBLE NATIONALITY:

1. The Eligible Nationality of the Supplier(s) for procurement of all goods and services (including consulting services) to be financed out of the proceeds of the Loan shall be the following:
    a) Japan, India & OECD member Countries in the case of the prime Contractor; and
    b) All countries and areas in the case of the sub–contractors(s).

2. With regard to Section V (1) above, in case where the prime Contractor is a joint venture, such joint venture will be eligible provided that the nationality of partners is Japan and/or India and/or OECD member countries.

3. With regard to Section V (1) and (2) above,
    a) For goods and services, except consulting services:
    (i) The prime Contractor or, in the case of a joint venture, the Japanese partners shall be nationals of Japan or juridical persons incorporated and registered in Japan and have their appropriate facilities for producing or providing the goods and services in Japan, and actually conduct their business there (herein after referred to as the "**Japanese Partner**").

    (ii) Not withstanding Section V. (3) (a) (i) above, a juridical person incorporated in a country or area other than Japan that satisfies all of the following conditions can be regarded as the Japanese Partner:
    - It is a subsidiary included in the scope of consolidation and factored into the aggregated accounting figure of a consolidated financial statement of the Japanese Company made in accordance with the Financial Instruments and Exchange Act of Japan and the related ministerial ordinances; and
    - It is registered in the country or area where it was incorporated, has its appropriate facilities for producing or providing goods and services there, and actually conducts its business therein.

    (iii) The prime Contractor or, in the case of a joint venture, the Indian partners shall be nationals of India or juridical persons incorporated and registered in India, and have their appropriate facilities for producing or providing the goods and services in India, and actually conduct their business there; in the case of a juridical person, a majority of the subscribed shares shall be held by nationals of India; and the majority of the full–time directors of the company are national of India(hereinafter referred to a as the "Indian Company").

    (iv) The prime Contractor or, in the case of a joint venture, the OECD member countries partners shall be nationals of OECD member countries (here in after referred to a as the "OECD member countries").

4. Minimum 30.069%oftheContractPrice (Excluding Price Centre 'RS-CMC', Price Centre 'DM&P- CMC' and Taxes & Duties) shall be sourced from Japanese manufacturer/Companies for Goods and Services as it is mandatory requirement under this package.

5. With regard to Section V (4) above, the goods procured form the eligible local manufacturing company(ies) invested by Japanese Companies (here in after referred to as

the "Eligible Local Manufacturing Company(ies)") can be regarded and counted as Japanese origin if such Eligible Local Manufacturing Company(ies) satisy(ies) all of the following conditions:

a) Juridical persons incorporated and registered in India, and which have their appropriate facilities for producing or providing the goods and services in India and actually conduct their business there;
b) Not less than ten percent (10%) of shares are held by a single Japanese Company or juridical person stipulated in Section V.3. (a) (ii); and
c) The proportion of the shares held by the Japanese Company or juridical person stipulated in SectionV.3. (a) (ii) mentioned in(b)above (or the company having the largest share among JapanesecompaniesifmorethanoneJapaneseCompanyorjuridicalpersonstipulatedin Section V.3.(a) (ii) meet the condition stated in(b) above) is the same as or greater than that of the shares held by any company of the third country or area.

6. With regard to Section V (4) above, the goods procured form the eligible development partners' manufacturing company(ies) invested by Japanese companies (herein after referred to as the "Eligible Development Partners' Manufacturing Company(ies)") can be regarded and counted as Japanese origin if such Eligible Development Partners' Manufacturing Company(ies) satisfy(ies) all of the following conditions:
   a) Juridical persons incorporated and registered in a country or area on DAC List of ODA Recipients effective at the time of conclusion of the Loan Agreement and which have their appropriate facilities for producing or providing the goods and services in the country or area and actually conduct their business there;
   b) Not less than one-third of shares are held by a single Japanese Company or juridical person stipulated in Section V. 3. (a) (ii); and
   c) The proportion of the shares held by the Japanese Company or juridical person stipulated in SectionV.3.(a) (ii) mentioned (b) above (or the company having the largest share among Japanese companies if more than one Japanese Company or juridical person stipulated in Section V.3.(a) (ii meet the condition stated in (b) above) is the same as or greater than that of the shares held by any company of a third country or area.

7. With regard to Section V(4) above, the goods procured form the eligible manufacturing company(ies) in developed countries invested by the Japanese Companies (herein after referred to as the "Eligible Developed Countries' Manufacturing Company(ies)") can be regarded and counted as Japanese origin if such Eligible Developed Countries' Manufacturing Company(ies)satisfy(ies) all of the following conditions:
   a) It is a subsidiary in a country or area other than Japan included in the scope of consolidation and factored into the aggregated accounting figure of a consolidated financial statement of the Japanese Company made in accordance with the Financial Instruments and Exchange Act of Japan and the related ministerial ordinances;
   b) It was incorporated and is registered in country or area other than that on the DAC List of ODA Recipients effective at the time of conclusion of the Loan Agreement; and
   c) It has its appropriate facilities for producing or providing goods and services there, and actually conducts its business therein.

8. With regard to Section V. (4) above, if the major components(s) of goods is (are) substantially manufactured by an Eligible Local Manufacturing Company, such components can be regarded and counted as Japanese origin even if the goods are not

procured from Japan. Eligible Local Manufacturing Company(ies). Nor Eligible Developed countries 'Manufacturing Company(ies).

9. With regard to Section V. (4) above, if the major components(s) of goods, which is (are) procured form the Indian Company(ies), is (are) substantially manufactured by a Japanese Company(ies), the goods can be regarded and counted as Japanese origin.

10. With regard to Section V (4) above and in, the goods procured from Indian Company(ies) can be regarded and counted as Japanese origin if such goods satisfy all of the following conditions:
    a) The major component(s) is (are) substantially manufactured by a Japanese Company(ies); and
    b) Japanese Company(ies) substantially manufactures major components and substantially engage with final assembly or the final refinement/processing by the Indian Company(ies) the manners including, but limited to, technical cooperation, commissioning of manufacturing or provision of design.

11. With regard to Section V. (4) above, the services provided by the Japanese Partner(s) can be regarded and counted as Japanese origin.

12. As per Operational rules of the Japan–India Special ODA Loan for Metro and Railway Projects in India, Dated 31st May2018, the prime Contractor shall be either of the followings:
    a) Japanese Company. Specially, the company must satisfy all of the following condition:
       (i) The company is a juridical person in corporate and registered in Japan
       (ii) The company has its appropriate facilities for appropriate facilities for producing or providing goods and services in Japan: and
       (iii) The company actually conducts its business in Japan.

    b) A consolidated subsidiary of a Japanese company in a foreign country. Specifically, the company must satisfy all of the following:
       (i) The company is a subsidiary company whose financial statements are required to be included in a consolidated financial statement of a Japanese company (as a parent company) by the Financial Instruments and Exchange Act of Japan and related ministerial ordinances
       (ii) The company is incorporated and registered in a country where it is located
       (iii) The company has its appropriate facilities for producing or providing goods and services in a country where it is located; and
       (iv) The company actually conducts its business in a country where it is located

    c) An Indian company. Specifically, the company must satisfy all of the following condition:
       (i) The country is a juridical person incorporated and registered in India
       (ii) The company has its appropriate facilities for producing or providing goods and services in India
       (iii) The company actually conducts its business in India: and
       (iv) The majority of the subscribed shares of the company are held by an Indian national(s) and/or juridical person(s)

d) A joint Venture (JV) composed of a Japanese company (ies) and/or Indian company(ies) and/or
OECD member countries.

13. Only for this package, the price of procurement (purchase) from Japanese company shall be deemed as Japanese content. However, only the price of parts of Rolling Stock manufactured by Japanese company (note1) and services (including services and technology (note2)) provided by Japanese company shall be included.

(note 1) The definition of "Japanese Company" will be same as stipulated in Section V12a. and 12 b. above.

(note 2) Services and technology are assumed to include intermediary services by trading company etc and technology licensing by Japanese Company.

ANNEXURE V(a)

CERTIFICATE CONFIRMING TENDER REQUIREMENT FOR JAPANESE GOODS & SERVICES

This is to certify that we, M/s.*[Insert name of the company (Single Entity/JV)]* have carefully examined all the requirements stipulated under the Head ELIGIBLE SOURCE COUNTRIES OF JAPANESE ODA LOANS for meeting requirement of Japanese Goods & Services as required by the tied loan conditions *(excluding Price Centre RS-CMC&DM&P-CMC)*.

We, M/s. *[Insert name of the company (Single Entity/JV)]* have submitted the details including; our Name, Location and Percentage of Japanese Goods & Services Content by value as per the form: Japanese Goods and Services provided.

We acknowledge that any false declaration made by the tenderer regarding Japanese Goods &Services (including payments to be made for value addition) shall be treated as a fraudulent practice and may result in further action being taken against the tenderer or its successor company; including liability of debarring for a period of upto three years for JICA funded Projects.

We also under take to submit a certificate from a statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) to determine and verify calculations of the percentage of Japanese Goods & Services content.

Signature of the Bidder

ANNEXURE VI

FORM JAPANESE GOODS AND SERVICES

Tender No.:	
Name of the Bidder:	
Total Percentage (%) of Japanese Content proposed by the Bidder: [Derived by the sum of qualifying Goods & Services expressed as a % of the Total Contract Price applicable for supply & NRC only].	

No.	**Details of Systems, Subsystems, Parts and/or Services** [bidder should list the item categories it seeks to qualify as Japanese Goods & Services under the terms and conditions of Annexure JICA]	**Annexure Clause No.** [under which qualification is sought]	Name of Japanese Subcontractor, Supplier or Trading Partner.	Evidence to show Compliance to ESC requirements enclosed (Y/N)	Percentage (%) contribution of Japanese Goods and Services
1					
2					
3					
4					
5					

NOTE: The Table value would exclude CMC requirement as well as duties & Taxes

Authorized signatory of bidder with company seal / stamp

Statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies)

PERFORMANCE BANK GUARANTEE

Bank Guarantee No……
Dated …….
Amount …….
Valid upto …….
Claim upto ……

The General Manager (Materials- Management)
BEML
Bangalore Complex
PB No 7501
New Thippasandra
Bangalore 560075

1. This deed of Guarantee made this day of..... (Month& year) between Bank of..... (Hereinafter called the "Bank") of the one part, and BEML LIMITED (Hereinafter called "the Employer") of the other part.

2. Whereas BEML LIMITED has awarded the contract for..... (Name of work as per PO) (Hereinafter called the "Contract") to..... (Name of the Contractor) (Hereinafter called "the Contractor").

3. AND WHEREAS the Contractor is bound by the said Contract to submit to the Employer a Performance Security for a total amount of……...(Amount in figures and words).

4. Now, We the Undersigned……..(Name of the Bank) being fully authorized to sign and to incur obligations for and on behalf of and in the name of.....(Full name of Bank), hereby declare that the said Bank will guarantee the Employer the full amount of Rs. …… (Amount in figures and words) as stated above.

5. NOW THEREFORE, We hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor and we hereby unconditionally, irrevocably and without demur undertake to immediately pay to the Employer upon first written demand and without cavil or argument, any sum or sums within limits of.....(Amount of Guarantee) as aforesaid without reference to the Contractor and without your needing to prove or show grounds or reasons for your demand for the sum specified therein. The Bank shall pay to the Employer any money so demanded notwithstanding any dispute/disputes raised by the Contractor in any suit or proceedings pending before any Court, Tribunal or Arbitrator/s relating thereto and the liability under this Guarantee shall be absolute and unequivocal.

6. This Guarantee is valid till.....(The initial period for which this Guarantee will be valid must be for at least 6-months (six months) longer than the anticipated expiry date of defect liability period / Warranty period as stated in Clause **10** of Annexure IV - Notice Inviting Tenders.

7. At any time during the period in which this Guarantee is still valid, if the Employer agrees to grant a time extension to the Contractor or if the Contractor fails to complete the Works within the time of completion as stated in the Contract, or fails to discharge himself of the liability or damages or debts as stated under Para 5, above, it is understood that the Bank will extend this

Guarantee under the same conditions for the required time on demand by the Employer and at the cost of the Contractor.

8. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in no way release us from the liability under this Guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

9. The Guarantee here in before contained shall not be affected by any change in the Constitution of the Bank or of the Contractor.

10. The neglect or forbearance of the Employer in enforcement of payment of any moneys, the payment whereof is intended to be hereby secured or the giving of time by the Employer for the payment hereof shall in no way relieve the bank of their liability under this deed.

11. The expressions "the Employer", "the Bank" and "the Contractor" hereinbefore used shall include their respective successors and assigns.

12. Notwithstanding anything contained herein:

(a) Our liability under this Bank Guarantee shall not exceed Rs..... (Rs.....)

(b) This Bank Guarantee shall be valid up to.....

(c) We are liable to pay the Guarantee amount or part thereof under this Bank Guarantee only & only if you serve upon us a written claim or demand on or before

In witness whereof l/We of the bank have signed and sealed this Guarantee on the.....day of..... (Month & year) being herewith duly authorized.

For and on behalf of the .....Bank.

Signature of Authorized Bank officials.

Name :.....

Designation : .....

Stamp/Seal of the Bank.....

Signed, sealed and delivered for and on behalf of the Bank by the above named .....in the presence of:

Witness 1.

Signature.....
Name.....
Address.....

Witness 2.

Signature.....
Name.....
Address.....

Procurement Technical Specification of PA/PIS & CCTV for Chennai Metro Rail Project - Phase-2 ARE02A

Approved	26.04.2025	SADHASIVAM M	
Reviewed	26.04.2025	ARJUN V	
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0	_	_	FIRST ISSUE	26.04.2025

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1.0 Introduction

1.1 General

This document describes the requirements for **Public Address & Passenger Information System (PA/PIS) & CCTV** to be supplied for CHENNAI METRO RAIL PROJECT PHASE-2 (210 cars).

The CMRL Metro Phase – 2 Project will be approximately 118.9 km long, operating within three corridors i.e.,

- Corridor 3 from Madhavaram to Sipcot of 45.8 Km,
- Corridor 4 from Lighthouse to Poonamalle of 26.1 Km,
- Corridor 5 from Madhavaram to Sholinganallur of 47 Km

And their inter-corridor operations in the Chennai Metro Rail Phase - 2 Project. The route will be approximately 76.3 km elevated and 42.6 km underground.

The Complete network will be electrified at 25kV AC 1ϕ, 50Hz with auto tensioned Overhead Flexible catenary & contact wire system and overhead rigid catenary system. This overhead catenary system shall be available in elevated, underground, and at-grade system. The PAPIS & CCTV system should be designed accordingly.

The PAPIS & CCTV contractor should establishes the requirements for design, development, manufacture, supply, testing, delivery, commissioning and integrated testing of fully furnished modern passenger cars with microprocessor controlled 3ϕ AC asynchronous motor or latest better motor technology with variable voltage and variable frequency (VVVF) drive Control and suitable for UTO conforming to GoA4 as specified in IEC 62290 - (1, 2 & 3) and IEC 62267, including the training of operating and maintenance staff of BEML.

The trains shall be able to operate in GoA4 immediately after commissioning and from the initial stage of passenger operations. Unattended Train Operation (UTO) shall be the predominant mode of train operation. In case if BEML does not engage UTO for any reason, at any stage of passenger operation or non-passenger operation, the Train Operator will deploy staff to drive the train under ATO or Manual Mode (under ATP).

The subcontractor shall be responsible for all works required in this PTS with regard to Design, Development, manufacture, supply, testing, training, delivery, commissioning, integrated testing and comprehensive maintenance during DNP of light weight fully furnished modern passenger cars.

The rake configuration of 3-car Trainsets is of *DMC + TC + DMC* car configuration in order to achieve 67% propulsion. The Trainsets shall operate in Grade of Automation-4 (GoA4) / Unattended Train Operation (UTO).

Operation of Trainsets that are formed of 6-cars shall be achievable through two (2) possible configuration options:

(i) The future provision of a single consist trainset comprised of the rake configuration *DMC + TC + MC + MC + TC + DMC* (67% traction power).
(ii) Multi-Consist trainset comprising of two (2) coupled 3-car consists having configuration *DMC + TC + DMC* *DMC + TC + DMC* (67% traction power).

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

Where,
*: Fully automatic coupler (with electrical head)
+ : Semi permanent coupler.

The system shall also include the following requiremnets:

(i) To provide all the documentation and support material associated with the operation and maintenance of the cars as specified in the tender document (ERTS/PTS) for all the corridors.

(ii) Ongoing technical support throughout the Defect Notification Period (DNP) and Comprehensive Maintenance Contract (CMC) Period.

(iii) Training of CMRL personnel, operations & maintenance staff, providing the training materials, training kits and demonstration of the system during training.

(iv) Supply and installation of all consumables and materials required for testing, commissioning, maintenance & operation.

(v) To provide final drawings, design calculations and other documents including operations and maintenance manuals for review and acceptance by BEML.

(vi) To provide supporting information such as 3-D design models, scale models, studies and reports including samples for design development items.

(vii) Preparation of documents for obtaining approvals by BEML from the appropriate statutory authorities. The scope of work includes 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 specifications.

1.2 Operations

BEML/CMRL plans to operate 365 days a year, from approximately 4.00Hrs to 00.00Hrs Monday through Sunday during the complete fleet operation conditions.

Rakes will operate in revenue service in as 3 car trainsets initially and shall be increased to 6 car trainsets later in case of increased passenger patronage. Under normal operating conditions, trains may be coupled and uncoupled during maintenance and in rescue modes.

Based on operational requirement, rakes may have to be operated in GoA2 mode with driver / in GoA3 mode with attendant / in GoA4 (UTO). However, the Phase 2 project is planned with operations in GoA4 (UTO) from the initial passenger service inauguration itself.

The maximum allowable operating speed of the vehicles shall be 80 kmph. The maximum design speed of the train shall be 90 kmph. Minimum headway shall be 90 seconds to satisfy normal peak ridership.

During the complete fleet operation conditions of this project, the trains may travel an average of 1,50,000 km per year.
Operating Schedule Speed : The minimum average Round-trip Operating Schedule Speed shall be 32 kmph.
Declared Schedule Speed (DSSP) : The sub contractor shall propose DSSP values (in Kmph) for each load condition during the design stage. DSSP values for load conditions up to AW3 shall be greater than or equal to 32 kmph and shall meet the requirements defined in ERTS Clause 2.14.1.

The operating modes are defined as follows:
a) Normal Mode : The train shall achieve the required Operating Schedule Speed whilst driving under normal Tractive / Braking Effort characteristics with a minimum 8% of coasting and keep to timetable factoring the defined dwell times (excluding turnaround time at terminal stations). Brake blending shall utilise regenerative braking to the most extent possible. Normal mode will be used when trains are running on time and the timetable can be maintained.
b) All-out Mode : Shall be the same as normal mode except that there shall be no coasting in order to exceed the Operating Schedule Speed. All-out mode will be used to make up time when trains are running late. When the train is in UTO / ATO mode, the train will get appropriate commands from Signalling system.

1.3 Description of work

The specified work includes the Design, Manufacture, Supply, Testing & Commissioning, Training of Personnel and Comprehensive Maintenance Contract for fifteen (15) years of standard gauge metro Rolling Stock (Electrical Multiple Units) and Depot Machinery & Plant (DM&P).

1.4 Sustainability

The sub contractor shall apply the highest standards for application of sustainability (with proven design) in the design and construction of the trains to effect overall life-cycle cost savings and environmental benefits. Life-cycle analysis shall be conducted and used for rationalizing all sustainability inputs. Sustainability consideration will provide heavy emphasis on delivering energy efficiency of system and subsystems, energy conservation and regenerative braking, potential and kinetic energy conservation systems and light weightiness to effect reduced traction power energy consumption.

1.5 Carbon credits

The sub contractor shall assist BEML/CMRL in obtaining Carbon Credits by providing necessary documentation to support the amount of power / energy saved by utilizing regenerative braking and other energy efficiency features used in train.

2. Definitions and Abbreviations

The following definitions and abbreviations are applicable to the PTS.

2.1 Definitions

The following definitions and abbreviations are applicable to the PTS.

“CMRL” means the Employer for the Mass Rapid Transport System (MRTS) for Chennai

“BEML” means the Customer to procure the PAPIS & CCTV system for CMRL phase-2 contract.

“Subcontractor” means the subcontractor of PAPIS & CCTV system to BEML for CMRL phase-2 Project.

“ERTS-RS” means Employer’s Requirements Technical Specifications – Rolling Stock of CMRL phase-2 contract for CMRL Metro Project

“ERTS-DM&P” means Employer’s Requirements Technical Specifications – Depot Machinery & Plant of CMRL phase-2 contract for CMRL Metro Project

“ERTS-CMC & DNP” means Employer’s Requirements Technical Specifications – Comprehensive Maintenance Contract of Rolling Stock and Depot Machinery & Plant of CMRL phase-2 contract for CMRL Metro Project

“PTS” means BEML’s Procurement Technical Specification.

"GTC" General Terms & Conditions of BEML for the procurement of the PAPIS & CCTV system

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

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

2.2 Abbreviations

ATC: Automatic Train Control

CMRL: Chennai Metro Rail Limited

CCTV: Closed Circuit Television

CDRL: Contract Data Requirement List

CTC: Centralized Train Control

DNP: Defect Notification Period

EMC: Electro-Magnetic Compatibility

EMI: Electro-Magnetic Interference

FAI: First Article Inspection

FDR: Final Design

FMEA: Failure Mode and Effects Analysis

FMECA: Failure Modes, Effects and Criticality Analysis

FRACAS: Failure Reporting And Corrective Action System

GoA: Grade of Automation

ERTS: Employer's Requirement Technical 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

N/A: Not Applicable

PDR: Preliminary Design

PFDR: Pre-Final Design

PIS: Passenger Information System

PTS: Procurement Technical Specification

SCC: Special Condition of Contract

SOD: Schedule of Dimension

TCMS: Train Control and Management System

TBD: To Be Determined

UTO: Unattended Train Operation

3. Precedence of Documents

The PTS shall be read in conjunction with the General Terms and Conditions (GTC) of tender and ERTS-RS and ERTS-CMC & DNP. To the extent that any provision of the PTS is inconsistent with any provision of the Commercial Specification, the provisions of the General Terms and Conditions (GTC) shall prevail.

To the extent that any provision of GTC is inconsistent with any provisions of the 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	CMRL Phase-2 ERTS-RS and ERTS-CMC & DNP
2	PTS
3	GTC

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

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

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

4. Scope of Supply

4.1 General

The sub-contractor shall meet the PAPIS & CCTV requirements of ERTS-RS and ERTS-CMC & DNP for the design, development, interfacing with designated contractors, manufacture, supply, testing, delivery, commissioning and integrated testing and suitable for UTO operation, including the training of operating and maintenance staff of the Depot, for CMRL ARE02A.

The Subcontractor shall provide all the PAPIS & CCTV equipment but not be limited to as per the scope of supply given in the Cl. No.4.2 of this PTS.
Subcontractor shall design and submit to BEML the arrangement of each PAPIS & CCTV system aggregates including the internal schematics wiring in box along with description of each electrical aggregates for PAPIS & CCTV system.
The subcontractor shall provide all the necessary details of components used in the PAPIS & CCTV aggregates to BEML and if there is any problem in the aggregates of PAPIS & CCTV system, the subcontractor shall, at his own expense, take whatever action is deemed necessary, such as, rectification, readjustment or design changes to the satisfaction of BEML and CMRL.

Subcontractor shall consider ERTS-RS and ERTS-CMC & DNP of CMRL phase-2 ARE02A contract during design of the electrical aggregates of PAPIS & CCTV for achieving the desired performance.

4.2 Scope of Supply for PAPIS & CCTV system

The Subcontractor shall be responsible for the design, manufacture, supply, testing, commissioning and integrated testing of the PA/PIS & CCTV System as per ERTS 2.2.31, 6.9.22, 14.3.1, Chapter 13. The subcontractor shall provide all components related to the PA/PIS & CCTV System, but not limited to, the following.

1. All components to meet the performance requirements of the PAPIS & CCTV system
2. Complete tools, Software, Hardware, Facilities, Jigs, Fixture diagnostic etc. for whole PA/PIS & PSSS/CCTV shall be in line with contractual & Engineers Requirement.
3. Dust and Water-tightness and at least IP 65 or higher shall be ensured for all type of exterior equipment & enclosures/cubicles etc.
4. Enclosures & Mounting arrangements has to be provided by the subcontractor for the all the equipments supplied by subcontractor.
5. Cables between equipments:
    i. 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 terminal block and in case of lead cable, the brackets for fixing cable and fasteners must be supplied by the subcontractor.

ii. Cable Number/Tagging must be under transparent heat shrinkable tube and should have a life of 35 years. Same is also applicable for Name Plate or Name labels.

6. Mating connectors for vehicle side with all pins even if pin is not used, back shells and accessories. The subcontractor shall supply 10% additional pins as applicable (male/ female) to cater to damages/ loss during wiring.
7. Non-screwed and self-locking type connectors for complete system shall be ensured.
8. Cable Assembly instruction documents for Ethernet cables and any special cables etc.,
9. Unused connectors such as PTE connector shall be covered with protective cover plug (or dummy cap) to prevent dust form accommodating on the contacts.
10. Earth pad / stud and fasteners for fastening (preferably which suits to M6 and 6 sq. mm. cable)
11. Download and Review tool (and its software) for CCTV footage
12. Ethernet Jumper Receptacle and plug between two trains.
13. Harness works of Ethernet connectors for the PAPIS & CCTV (both equipment and vehicle sides)
14. Name plates or Name Labels
15. Rubber (packing or gasket) for the water-tightness when the subsystem or components are installed on the exterior of vehicle.
16. One full set of connector and its contacts as mounted on the equipments for each car-type (DM & T cars) to carry out vehicle level voltage withstand test at BEML factory.

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

4.2.1. PA System

Item	Q'ty	Spec.
(1) Communication Control Head (CCH)/Main Control Panel (MCP)/ Automatic Digital Voice Announcement System Unit (AVAS/DVAU) with loudspeaker and microphone with Push-to-talk (PTT) button (An integrated communication panel)	1 no / DMC	ERTS 13.4, 13.13
(2) Audio Recorder with expandable memory.	1 no / DMC	ERTS 13.7.2.8, 13.9.6, 13.10.9
(3) Public Address (PA) Amplifier Unit: Automatic continuous variable volume control, based on saloon background ambient noise level	1 no / car	ERTS 13.7.2, 13.7.3
(4) Cab Speaker	1 no / cab	ERTS 13.9.5
(5) Ceiling Mounted Loudspeaker with dust cloth	8 nos / car (minimum)	ERTS 13.7.5.1
(6) Passenger Emergency Intercom with Passenger Alarm Device: Push button type	4 nos / car and 1 nos/ Cab (Detrainment	ERTS 13.10

	Door)	
(7) Exterior speakers	4 nos / car	ERTS 13.7.5 / 13.7.5.4
(8) Cab-Cab jumper assy. with receptacle box (At least IP65 or higher)	1 no / DMC	ERTS 13.13.3
(9) Mating connectors for all equipments (male / female connectors along with male / female crimp contacts, etc).	1 no / car	
(10) Spare parts, Special Tools and Testing equipment	1 set	
(11) Various required Software (complete package including manual, source code, training)	1 set	ERTS Chapter 20

4.2.2. PIS System

Item	Q'ty	Spec.
(1) Destination Display and Train Number Indicator for Front - LCD with LED Backlight (regional language(s) and English and/or Tamil) - Front side display and back side maintenance - For displaying train ID	1 no / DMC	ERTS 13.7.1.15
(2) External Side Destination Indicator - LCD with LED Backlight (regional language(s) and English and/or Hindi) - Front side display and back side maintenance	2 nos / car	ERTS 13.7.1.15.1
(3) Display For Advertisement (LCD screen with LED Backlight with size of atleast 27" corner by corner and 16:9 aspect ratio.)	6 no / DMC	ERTS 13.7.1.16.1, 13.7.1.16.2
(4) Internal Electronic Destination Display (IEDD) ((LCD screen with LED Backlight with size of atleast 36" corner by corner with regional language(s) and English and/or Tamil along with other graphic)	2 nos / T car, 1 nos / DM Car	ERTS 13.7.1.14.11
(5) Dynamic Route Map Display (DRMD) (LCD screen with LED Backlight with size of atleast 48" corner by corner)	8 nos / car	ERTS 13.7.1.14.1, 13.7.1.14.2
(6) Mating connectors for all equipments (male & female connectors including M12 Ethernet connectors along with pin and socket, etc).	1 set / car	
(7) Spare parts, Special Tools and Testing equipment including user manual & certificate	1 set	
(8) Various required Software (completed package including manual, source code, training)	1 set	ERTS Chapter 20

4.2.3. CCTV System

ITEMS	**QTY./Car**			**SPEC.**
	DMC	**TC**	**DMC**	
(1) Exterior Camera (IP based with minimum 7 days of recording) with at least IP 65 FRP	2	2	2	ERTS 13.13.5

(2) Saloon camera (IP based with minimum 7 days of recording) along with SS mounting bracket	4	4	4	ERTS 13.13.4
(3) Track camera with minimum 7 days of recording	1	-	1	ERTS 13.13.5
(4) OHE camera (minimum 7 days of recording) with SS mounting bracket	1	-	1	ERTS 13.13.5
(5) Detrainment camera (Minimum 7 days of recording) with SS mounting bracket	1	-	1	ERTS 13.13.4, 6.9.22
(6) Pantograph monitoring camera (Minimum 7 days of recording) with SS mounting bracket	-	2	-	ERTS 13.13.5
(7) Network Video Recorder (NVR) with SSD (Capable of storing data of at least seven days)	1	-	1	ERTS 13.13.3
(8) Managed Ethernet Switch with PoE ports	As required	As required	As required	ERTS 13
(9) L3 Switch	1	-	1	ERTS 13
(10) Any other equipment required onboard for interfacing with the other designated Contractors viz. Signaling, Telecom and others for operation of trains, under UTO mode	As required			ERTS 13.2.1
(11) API (Application Programming Interface) / SDK (Software development Kit) documentation for necessary interface with Radio System (BBRS) / CBTC and Rolling Stock Controller (RSC).	As required			ERTS Chapter 20
(12) Various required Software (complete package including manual, source code, training)	As required			ERTS Chapter 20 ERTS 20.6.4
(13) Mating connectors for all equipments including optional cab cameras (male & female connectors including M12 Ethernet connectors along with pin and socket, etc). Quantity of M12 Ethernet connectors shall be clearly indicated by the subcontractor in the	As required			-
(14) Spare parts, Special Tools and Testing equipment including user manual & certificate	1 Set			

4.2.4. Wires & Cables

ITEMS	QTY.	SPEC.
(i) (a) The subcontractor shall supply the following cables (Minimum cross-section 0.75 Sq. mm) for car side wiring RGB between Display Controller (DCU) and TFT displays. (ii) Special multi-core cables for MCP / ACP display, if any. (iii) Special multi-core cables for CCTV monitor, if any. (iv) Any other cables other than below mentioned cables at (b). (b) Power cables (1.5 sq mm) for 110 V DC input power supply, Ethernet cables for train level wiring, multi-core shielded (2-core and 3-core 1.5 sq. mm.) cables (If required) for serial interface and fire-resistant two-core 1.5 sq. mm. shield cables for audio output for car-side wiring will be provided by BEML. (c) Specification of cables proposed by the subcontractor shall be submitted with the tender. (Cables from sources approved by CMRL only will be used.) Specification and part no. of cables, inter-car Ethernet cable jumper assy. and jumper receptacle will be discussed and finalized during design.	1 set / car	ERTS 19.44

4.2.5. Test Bench

ITEMS	QTY.	SPEC.
Test Bench for PAPIS and CCTV system	1 set	ERTS 13.8.15 and Annexure-A_ CMC Spares & Tools Requirement

4.2.6. Deliverables

S.No.	Clause No.	Tools/Equipment/Software	Quantity
1	13.8.9 of ERTS	Any additional tool hardware/software required to record and change the pre-recorded route related messages, special messages and add such recordings to all	1 Set per Depot
2	13.7.1.14.8 of ERTS	The hardwares and dedicated software etc. for editing, creating and modifying the speech and route database in line with clause 13.7.1.14.8.	1 Set per Depot

3	13.7.1.3 of ERTS	Any additional tool hardware/software required for further extensions/modifications of stations of the corridors and in case of any change in operation strategy of the train,	1 Set per Depot
4	13.13.3 of ERTS	Any additional tool hardware/software required to download video recordings of any camera from a single point in the train.	1 Set per Depot
5	13.7.1.14.8 of ERTS	Adequate tools for modifying/adding etc. the station names, addition and deletion of important places at any time.	1 Set per Depot
6	All applicable ERTS and OEM recommendations	i.) Two sets of recommended list of Special Tools, Testing and Diagnostic Equipment. ii.) Two sets of special Jigs, Fixtures and Gauges separately. For preventive and breakdown maintenance,	1 Set per Depot
7	All applicable ERTS and OEM recommendations	Any tool if required as per contract requirement	As required

4.2.7. Table : Scope of Supply/Scope of work- Project Deliverables, Training & Manuals

Sl. No.	EQUIPMENT	Quantity	ERTS / Clause ref.
1	Software for applicable equipment for the 3-Car train and PTU tools	As applicable	ERTS 13 & 20
2	Printed Circuit Boards (PCB) Details	As applicable	ERTS 19.55
3	Microprocessor Details	As applicable	ERTS 19.57
4	Equipment side connectors along with the pins for Dielectric testing jig for the items mentioned in Table 1 (Sl.no. 1 to 4).	2 Sets	
5	Deliverables for CMRL ARE02A project	As per CMRL ARE02A contract	
6	Training	As per CMRL ARE02A contract	
7	Operation & Maintenance (O&M) Manuals	As per CMRL ARE02A contract	

4.2.8. Table : Scope of Supply/Scope of work- Comprehensive Maintenance Period

Sl. No.	EQUIPMENT	Quantity
1	Spares, Special tools & Consumables for maintenance during Comprehensive Maintenance period	As per Annexure-A CMC Spares & Tools Requirement

4.2.9. Table : Scope of Supply/Scope of work- NRC, Type test and Testing & Commissioning activities at respective depots

Sl. No.	EQUIPMENT	Quantity
1	First Article Inspection (FAI), Equipment type test, documentation for design documents	As defined in PTS
2	PAPIS and CCTV system along with deputation of engineers	Required for PAPIS & TCMS combination test at TCMS supplier premises at Japan. Transportation from PAPIS and CCTV subcontractor factory to TCMS supplier factory and vice versa will be under the scope of PAPIS and CCTV subcontractor.
3	Equipment's required for Type test / routine test at BEML factory / depot / Mainline.	Necessary equipment's need to be arranged by PAPIS and CCTVf subcontractor.

4.2.10. Scope shall also include following but not be limited to:

1. Delivery of equipment and necessary test equipment for trial usage along with deputation of Engineers for Interface test between TCMS and PAPIS & CCTV at TCMS Supplier premises in Japan.
2. Any design changes of equipment arise during review, shall be reflected to mass production of the equipment.
3. All the special cable and tools shall be provided by subcontractor.
4. The subcontractor shall lead and manage the interface & integration of PAPIS & CCTV with designated STC contractor.
5. The subcontractor as manufacturer shall be responsible for overall integration of PAPIS & CCTV system.
6. Subcontractor shall provide spares and consumables including service for Defect Notification Period (DNP) / Defect Liability Period (DLP) as per ERTS requirements. Detailed BOM for DNP/DLP spares and consumables for warranty period.
7. Detailed BOM covering all categories of spares and tools for CMC periodThe above type and quantity of equipment can be modified by the proposal of subcontractor depending on how the system is considered.
8. Any design changes of PAPIS & CCTV system arising during review and FAI shall be reflected in the production supplies.

4.2.11. Message List & Voice Files

Following activities shall be covered in subcontractor's proposal and scope of responsibility.

(i) Creating scripts / revision for automated PA announcement and PIS system (Message List).
(ii) Creation of contents database, templates for LCD/TFT displays inclusing voice file using journey configuration tool.
(iii) Messages shall be recorded in the voice of professional by the Employer.
(iv) Approval for sample voice file and supply of whole voice files for PA/PIS system.
(v) Based on Engineer's comments, the subcontractor shall incorporate any changes required for contents database templates and voice recording.

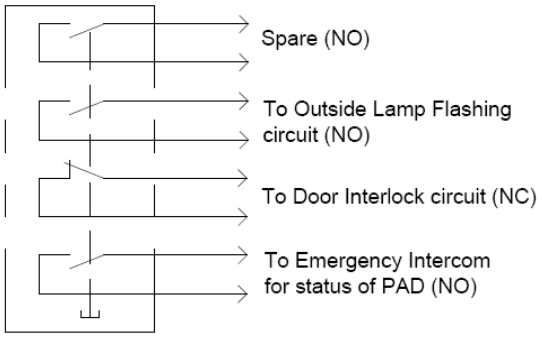
4.2.12. Equipment side connectors for Di-electric test

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

4.2.13. Passenger Alarm Device

A push button shall be provided along with add-on contact block (3 NO + 1 NC), as shown below) for Passenger Alarm Device to enable passenger communication with driver/OCC/BCC via Emergency Intercom unit in case of emergency.

Passenger Alarm Device



5. System Requirements

5.1 General requirements

This chapter establishes the performance, environmental, and design criteria for the Trainset. Included are dimensional, environmental, weight, ride quality, performance, acoustical, and electrical noise requirements, etc.

This rake as constructed, manufactured, assembled, and delivered shall fully conform to all provisions of those requirements unless otherwise specified in these provisions and shall

be furnished with components, materials, equipment, and systems that comply fully with those requirements.

The rake shall consist of a 3-Car Trainset (also able to operate in a 6-car formation comprising of two (2) coupled consists) during initial revenue operation. The possibility of conversion to a single consist six-car rake at a later date shall also be achievable within the chosen design concept.
The rake shall be a high-floor design, with level boarding from platforms. Wheelchair and mobility-impaired boarding shall not require the use of bridging or lifting devices. The horizontal gap between the passenger door thresholds and platform edge and vertical gap between the passenger door thresholds and platform edge details are mentioned in SOD (Clause 2.7.1). In no cases (including the worst operating conditions) shall the top surface of the horizontal threshold of the car be lower than the top edge of the platform.

Trainsets shall be operated bi-directionally and shall have equal performance in either direction. The details of the emergency operator desk details explained in ERTS-RS chapter 5.

Prototype Train Program: Following the successful completion of all design review activities the BEML will begin production of a Prototype Train, which consist of the manufacture of two Diving Motor Cars and one Trailer Car, which will make up a 3-Car trainset. Upon delivery, these three cars shall then constitute the Prototype Train. The Prototype Train shall be considered a "proof of design" first article after being exercised in test and simulated revenue service, and the adequacy of all aspects of the design and manufacturing activities have been substantiated. The Prototype Train program shall be conducted in three phases:

(i) Phase 1 – The first 3-car trainset shall procede all other cars in production and shall be considered the prototype train. Components and cars shall be tested according to the requirements in ERTS-RS chapter 17, as applicable. Components and cars shall also be offered for first article inspection as specified in ERTS-RS chapter 17 at the sub contractor facility or the BEML facility. All adjustments and/or changes required shall be completed prior to shipment to CMRL’s facility.

(ii) Phase 2 - Upon arrival at CMRL, the Prototype cars shall be on-site qualification tested for required functional characteristics as per ERTS-RS Chapter-RS 17.

(iii) Phase 3 - When the on-site delivery testing requirements have been satisfied, the three Prototype cars shall be united to form a Prototype Train. The Prototype Train shall then undergo operational testing as required in ERTS-RS Chapter 17 followed by proof of performance testing as a 3-Car rake. This shall include all specified system interface testing on CMRL’s property.

Any adjustments / changes found necessary during the Prototype Train program are properly documented and incorporated into the following production cars configuration at no additional charge, unless approved by the BEML/CMRL. It is intended that except where otherwise approved or required by BEML/CMRL, the Prototype Cars' manufacturing quality level after the completion of all required modifications shall be the standard for all following cars.

Automatic coupler with mechanical, pneumatic, and electrical head shall be provided at the front end of each DMC cab. For the 3-Car rake configuration, semi-permanent couplers shall be provided between the DMC and the Trailer Car. Both automatic and semi-permanent couplers shall comply the requirements specified in ERTS-RS Chapter 04. Semi-permanent mechanical, pneumatic and jumper cables shall be used between the DMC and TC for the 3-Car consist configuration shown below.
3-Car rake: *DMC + TC + DMC* (67% Traction power)

Operation of Trainsets that are formed of 6-cars shall be achievable through two (2) possible configuration options:

(i) The future provision of a single Consist trainset comprised of the following rake configuration *DMC + TC + MC + MC + TC + DMC* (67% traction power)
(ii) Multi-Consist trainset comprising of two (2) coupled 3-car consists having configuration *DMC + TC + DMC* *DMC + TC + DMC* (67% traction power)

Notes:
• The symbol * denotes a fully automatic coupler (with electrical head)
• The symbol + denotes a semi-permanent coupler.
• DMC denotes Driving Motor Car
• TC denotes Trailer car (with pantographs)
• MC denotes Motor Car
Cars shall be equipped to operate normally as a single rake. Trainsets shall be equipped for emergency towing operation without any manual intervention for coupling or any purpose.

he rake shall be designed and manufactured to operate successfully within the environments of CMRL's dedicated right-of-way.

The cars shall include a Public Address System, Interior and Exterior Passenger Information Displays, Cab-to-Cab Communications, Passenger Emergency Intercoms, Diagnostic Monitoring System, Event Recorder, Video Surveillance and CCTV, as described in ERTS-RS Chapter 13.

Environmental conditions for the equipment on board the cars shall conform to EN 50125-1.

Electronic equipment shall be designed, constructed and tested in accordance with EN 50155.

When fully mated, the connectors for internal use (i.e., fitted within car body) shall achieve a seal rated to atleast IP 53 in accordance with IEC 60529 if the sealing is not provided by the cabinet in similar. Connectors fitted externally to the car body shall achieve a seal rated to atleast IP 65.

It shall be demonstrated that all electronic equipment shall be immune to surge and transients typically expected in the Rolling Stock environment in accordance with EN 50155.

The main electrical protection of the Traction Power Supply to each car shall comply with the requirements of IEC 60077. The inductors used shall comply with the requirements of IEC 60310 (2004) or latest.

The Rolling stock and all its sub-systems functions has to meet the all the criteria defined in ERTS-RS Chapter 14.

The sub contractor shall identify and implement any design and/or interface Works required to ensure the ARE02a Rolling Stock fleet achieves the following objectives for interoperability:-

a) The fleet shall serve all three (3) corridors of the CMRL Phase-2 network.
b) Be capable of running in mixed traffic operational diagrams; alongside up to two (2) additional fleet variants of passenger Rolling Stock as well as maintenance vehicles.
c) Have limited cross-compatibility with other passenger Rolling Stock fleets (ARE03a/ARE04) to the extent that is defined by the technical requirements elsewhere in this Contract (E.g. emergency train rescue requirements).
d) Complies with any other interoperability requirements identified during the course of coordinated interface Works with other Designated Contractors (as defined in ERTS-RS Appendix-C) or as may be required to ensure the safe operation of the railway.
The Sub contractor shall comply with all the Statutory requirements and guidelines related with Research Designs and Standards Organisation (RDSO), Ministry of Railways (MoR), Commissioner of Metro Railway Safety (CMRS), Ministry of Housing and Urban Affairs (MoHUA) or any other bodies related to the sanction and operation of metro rolling stock.

All electrical and electronic components shall comply with the EMC and EMI requirements of EN 50121 (all parts), IEEE 16, EN 55011 and IEC 61000 standards or other equivalent international standards. The requirements of EMC EMI requirements referred in ERTS-RS clause 10.19 & ERTS-RS clause 2.18 of the rolling stock shall be met.

Fire properties of the materials used shall comply with EN 45545 part 1 to part 7 latest editions (Category 4-A, Hazard level HL3) as a minimum or better international standard applicable for similar Metro applications. Requirements of ERTS-RS clause 2.26 shall be met. Material requirements of all sub systems of train shall be compliant with the requirements of ERTS-RS Chapter 19.

Multi-Consist Configuration
a) The functionality of all Train subsystems shall be fully available when Trainsets are operated in a 6-car multi-consist configuration.
b) Hardware & Software of all subsystems (including but not limited to Traction system, APS system, PAPIS & CCTV system, TCMS system, Pneumatic & Brake system, Saloon Door system, VAC system, Trainlines, Signalling system, Telecommunication system, PSD system, etc) shall be automatically reconfigure as required whenever a coupling or decoupling command is initiated by OCC or the Train Operator.
c) The sub contractor shall submit the design proposal for multi-consist configuration during Preliminary design stage. All technical requirements shall be addressed during Pre-final design stage and tested at the CMRL site to the full satisfaction and approval of BEML/CMRL.

The sub-contractor shall meet completely, the system requirements for PAPIS & CCTV system in accordance with following chapters of Chennai ARE02A Section Vl A: ERTS-RS.

Chapter 1 : System Description

Chapter 2 : System Requirements

The sub-contractor shall meet completely, the system requirements for PAPIS & CCTV system in accordance with following chapters of Chennai ARE02A Section VI C: CMC of RS & DM&P.

Chapter 1 : Comprehensive Maintenance Contract (CMC) Requirements

Chapter 3 : Operation Plan

Chapter 5 : Asset Maintenance Management System (AMMS)

The sub-contractor shall submit the compliance matrix (clause by clause) showing all the sections of the Technical Specification above as a minimum.

5.2 Design life

The equipment boxes shall be designed for a service life of 35 years minimum in the Chennai environment (as defined in the specification), based on an average annual operating distance of 150,000 km per rake without requiring structural repair or replacement for any reason other than collision damage, vandalism, natural disasters, or misuse.

All other equipment shall be designed for a minimum service life of 18 years subject to routine maintenance, overhaul, or replacement. Major subassemblies and/or LRU's requiring overhaul or replacement to meet the requirements of this Chapter shall be identified at Preliminary Design Review (PDR), Pre-Final Design Review (PFDR) and Final Design Review (FDR).

Unless agreed otherwise by BEML/CMRL, the rakes shall utilize subassemblies that minimize the life-cycle costs of the car. If requested by BEML/CMRL, the sub contractor shall submit a cost-benefit analysis for review.

5.3 Service-proven design

The equipments shall conform to EN 12663:2000 or any other standard as applicable to Cars of an urban rail transport system Category P-III. Car, system and subsystem designs shall be service proven. BEML/CMRL will evaluate the applicability of "service proven" according to the risk associated with each particular design. In general, "service proven" shall mean the system, subsystem, equipment or components, etc. which shall comply with requirement's specified in Part 1 - Section III : Evaluation and Qualification Criteria of the contract document.

To establish a design's service-proven history, the sub contractor shall submit as part of the proposal specific details of the application history. The sub contractor is free to propose design improvements; provided the service proven design basis is substantially unchanged. Proposed changes to the design or method of manufacture must be supported by reasonable justifications such as resolution of obsolescence, meeting specific BEML/CMRL technical requirements or for the improvement of product reliability. Submitted change proposals must specify the reason for the proposed changes and be supported by evidence to demonstrate the risk of adversely effecting operation and

performance is mitigated. For such service proven designs, the sub contractor shall produce for BEML/CMRL review and approval test documents from the other systems/projects for which the sub contractor is providing the proven design application.
Evidence documenting service proven design shall be furnished as part of the proposal for the traction converter inverter system, traction motors, drive gear units and couplings, auxiliary converter inverter system and battery charger, TCMS and event recorder, high voltage equipments.

BEML/CMRL may waive some requirements for detailed design review and design conformance testing when service-proven equipment is provided. In general, the decision to waive design and test requirements will be based on BEML/CMRL understanding of the historical success of the equipment applications.

5.4 Designs for refurbishment

The passenger rake shall be designed to simplify future overhaul and refurbishment, including repair and replacement of all systems and their constituent parts. Removal and replacement of system equipment shall be possible without causing damage to other systems or to the car body.

It shall be possible to easily separate and move a car for the purposes of repair, overhaul, or refurbishment, with electrical connections having quick-disconnect connectors. Pneumatic connections between the cars shall use flexible hoses and quick disconnects.

Interior panels and equipment shall be of a modular design suitable for future refurbishment.

5.5 Aesthetic appearance

The rake’s exterior design shall present a smooth, sleek, and attractive appearance. A purely functional layout is not sufficient. Body side bi-parting doors shall be compliant with ERTS-RS Chapter 6.

To the greatest extent possible, consistent with regulatory requirements, safety, satisfactory performance and maintainability, equipment shall be hidden from sight.

Cover panels shall be readily removable and/or hinged for maintenance access. Hinged panels shall be provided with a means for locking in the open position. Equipment cases shall consist of a dust and damp protecting enclosure manufactured with sealing rating of IP 65 in accordance with EN 60529.

The interior design and layout of the rake shall provide an attractive appearance. The interior design shall enable the rake to be easily maintained in a clean state. The exterior and interior of the cars must be designed and equipped to aesthetically accommodate and display public advertisements, as a means for the CMRL to derive revenue for offsetting operating cost.

5.6 Car general characteristics

Passenger Capacity

(i) The following data and assumptions shall be used by the sub contractor for all normal and degraded performance requirements and calculations. For a 3-Car metro rake composition, minimum seating and standing capacity shall comply with EN 15663 and below requirements:

(ii) For a Driving Motor Car, there shall be a 1 Wheelchair provision and minimum of 44 seats longitudinally arranged along each side of the interior of the car. Seat shall be standard type bench seats with no individual/single seat mouldings. The typical width of the passenger seat spacing shall be 450mm and the depth, including leg room (as per EN 15663), shall be 670 mm. The remaining floor space shall maximize standing room for passengers for each of the loading conditions described in ERTS-RS clause 2.12.2.

(iii) For trailer cars, there shall be a minimum of 50 seats longitudinally arranged along each side of the car. Seat shall be standard type bench seats with no individual/single seat mouldings. The proposed width, height, depth, and leg room (as per EN 15663) of the seats shall be optimised to ensure maximum standing room for passengers for each of the loading conditions described in ERTS-RS Chapter The proposed design shall be subjected to CMRL approval.

	DM car	T car	M car
Seats	44	50	50
Wheelchair	1	-	-
Standees (AW3 condition)	210	210	210
Standees (AW4 condition)	280	280	280
Total capacity (3-car) AW4 condition	(44+1+280) + (50+280) + (44+1+280) = 980		
Total capacity (6-car) AW4 condition	(44+1+280) + (50+280) + (50+280) + (50+280) + (50+280) + (44+1+280) = 1970		

The general dimensions of the rake are indicated in Table 5-1. Tolerances for these dimensions shall be approved by CMRL.

Table 5-1: Car Dimensions

Dimension	Values

Length of DMC / TC / MC over coupler faces	22,600 mm
Height of car, overall	Compatible with the dynamic gauge specified in Appendix D. (4048 mm with pantograph in lockdown position)
Width of car, overall	2900 mm
Wheel dimensions: New wheel diameter Wheel wear limit	 860 mm 80 mm (on diameter)
Height of car floor above top of rail at door threshold	1,130 mm (maximum) 1,100 mm (minimum)
Spacing between bogie centrelines	14,850 ± 250 mm
Dynamic outline	Rake shall not exceed the dimensions shown in ERTS-RS Appendix D

Seats shall be arranged longitudinally to maximize the number of standing Seats shall be provided for handicapped persons as described in ERTS-RS clause 3.8.

5.7 Clearance requirement

The Kinematic Envelope of the Car shall be in accordance with Schedule of Dimensions in ERTS-RS Appendix D. The Contractor's calculations of the static and kinematic envelope of the vehicle shall be calculated in accordance with UIC 505 and/or equivalent International Standard. The vehicle and attached equipment shall be designed to operate within the Kinematic Envelope shown in ERTS-RS Appendix D, under all worst conditions of speed, passenger load, sway, roll, side play, wear, including wheel and rail wear and failures other than structural failures on level tangent track. The method and details of the calculations shall be submitted for the approval of CMRL as a separate design submission.

The clearance envelope is limited through stations by the station platform. The Contractor shall assess the reduced car clearance envelope present through stations. Interference with station platform due to lateral and vertical displacements and all conditions of passenger load, sway, roll, side play, wear of wheel, and rail and a single point failure shall be included in the assessment.

The sub contractor shall submit for approval design configuration drawings showing the static and kinematic clearance envelope for the cars, indicating compliance with ERTS-RS clause 2.7 and 2.8.

The sub contractor shall perform tests as specified in ERTS-RS Chapter 17 to demonstrate compliance with the static and kinematic clearance requirements.

The sub contractor shall ensure that the cars conform to the latest version of Schedule of Dimension (SOD) without any addition cost to CMRL.

5.8 Wayside characteristics

The Rolling Stock shall fulfil the conditions as per UIC 512 for smooth operation.

The provisions on the following pages provide the basic track and wayside limitations under which the rake shall operate in revenue passenger service. The Contractor shall be responsible for submission of any additional data for design clearance and certification by the Commissioner for Metro Railway Safety (CMRS). All interface data interchange is described in ERTS-RS Appendix C, Interfaces.

Station Platforms All underground stations will be air conditioned. The station platform edges will be equipped with Platform Screen Doors. The major dimensions of the station platform edge are given in SOD.

Track (Design Values) The cars shall be designed to negotiate all track conditions found on the CMRL system. The design geometry of the track is as defined in the ERTS-RS Appendix D (Schedule of Dimensions) and ERTS Appendix D (Alignments and Profiles).

Track Maintenance
The tolerances within which the main track will be maintained is provided in the Schedule of Dimensions in ERTS-RS Appendix D.
Table 5-2 contains information on the track design values.
Table 5-3 provides information on the track structure parameter.
Table 5-4 provides information on the track tolerances and
Table 5-5 provides information on the platform interfaces.

Table 5-2: Track Design Values

Dimension	Maximum	Minimum
Track gauge	1,435 mm (nominal)	
Horizontal curve radius: Mainline Under Ground Sections Elevated and Surface Sections Depot and Sidings at Stations	 ----- ----- -----	 200 m (minimum) 120 m (minimum) 100 m (minimum)
Dimension	Maximum	Minimum
Minimum radius of vertical curve	1,500 m	
Cant deficiency	100 mm	-----

Cant	125 mm	-----
Cant gradient	-----	1 in 440
Gradient At station At turnout Other sections in Mainline Depot	0.25 % (1 in 400) 2.5 %(1 in 40) 4 % (1 in 25) Including compensation level Level	 ----- -----
Rate of grade change	-----	1 in 440
Rail type: CWR	60E 1 Profile as per IRS T 12 – 2009 (With Latest Amendments/ Correction Slips) canted at 1 in 20	
Platform curve	1,000 m	

Track characteristics

a) The track structure parameters for At-grade, Elevated and underground sections are set out in Table 5-3.

Table No 5-3: Track Structure Parameters

Description	Elevated and At-grade sections	Underground sections
Track Laying Gauge	1435 mm ± 2 mm	
Rail Type		
Main Line	60E 1 Head hardened as per IRS T 12 – 2009 With All Amendments / Correction Slips. (1080 deleted as per latest draft no more 1080)	
Depot	60E 1 (880 Grade) as per IRS T 12 – 2009 With All latest Amendments / Correction Slips.	
Rail Profile	60 E1 Profile	
Inclination Of Rail	1 / 20	
Rail Seat spacing, Main line	Nominal 650 mm ± 5 mm	
Sleeper Spacing, depot	650 mm ± 5 mm; Inspection Lines 1000 mm	

Ballast Cushion		
Depot	Ballast less Track in Madhavaram Depot Ballasted Track in Poonamalle Depot	
Rail Panel Lengths	Continuous welded rails	
Minimum Radius of Curvature	Depot – 100 m Main line (At grade and elevated) – 120 m	200 m
Minimum Turn Out Radius. Main Line	140m	
Minimum Turn Out Depot	Madhavaram Depot: 1 in 7 R140 Poonamalle Depot: 1 in 7 R140,	
Minimum Turn Out Main line	1 in 7 R 140	
Maximum Cant Permissible in curves	125 mm	
Maximum Cant Deficiency Permissible	100 mm	
Maximum Permissible Cant Gradient	1 in 440	
Turn-out Speed : Turnout (Main line)	1 in 9 R 300 = 45 kmph; 1 in 9 R 190 = 35 kmph 1 in 7 R 190 = 35 kmph; 1 in 7 R 140 = 25 kmph	
Maximum Gradient (Main Line)	4 % Including Grade Compensation.	
Minimum vertical curve radius crest	1500 m	
Maximum track axle load (AW4)	16 tons	
Widening of track Gauge on curves	Up to 9 mm	
Structural gauge and passing clearance in straight line, in curves, in open air grade, in tunnel	As per SOD of CMRL Refer to Appendix D of the ERTS-RS document for typical Sections	
Tunnel Profile	As per SOD of CMRL Drawings showing section of cut and cover and bored tunnel in the Underground sections and details of various equipment's/cables etc located therein are mentioned in are enclosed in ERTS-RS Appendix D	
Line profile	The drawings showing the line profiles of all corridors are enclosed in ERTS-RS Appendix D of this document:	

b) The Track tolerances for At-grade, Elevated and Underground sections are set out in Table 5-4. Final track tolerances will be confirmed by CMRL during the preliminary design of the vehicle.

Table 5-4Track Tolerances

Description	Ballasted	Ballast-less (DFF)
Laying Tolerance of Vertical Alignment measured by 10m chord (Designed level)	± 4 mm	± 4 mm
Alignment (Laying) (Base 10m)	± 5mm	(±4 mm for 20 m chord as per CMRL maintenance manual)
Cross Level Laying Tolerance (Designed)	± 3mm	±2 mm
Twist (Other than transition curve)	1 mm / 250 mm	Target value not to exceed 3 mm over 3 m; isolated locations up to 5 mm over 3 m; Threshold value for speed restrictions 10 mm over 3 m.
Cross Level Difference (Maintenance)	15 mm	10 mm
Gauge measured at a point 14mm below crown of rail (laying) (with respect to 1435 mm)	±6 mm	Target value ±6 mm Threshold value for speed restrictions +20 mm / - 10 mm
Unevenness (Maintenance) – 3, m chord	3 m chord: 15 mm	Target value not to exceed 6 mm; isolated locations up to 10 mm; Threshold value for speed restrictions 15mm.
Alignment (Maintenance) (Base 7.5m)	15 mm	Target value not to exceed 5 mm; isolated locations up to 10 mm; Threshold value for speed restrictions 15mm.
Gauge variation maintenance (sleeper to sleeper)	±6 mm	(±6 mm as per CMRL maintenance manual)
Gauge (Maintenance) – Tangent track (with respect to 1435 mm)	- 10mm to + 20 mm	Target value ±6 mm Threshold value for speed restrictions +20 mm / - 10 mm

Gauge (Maintenance) - >500m radius (with respect to 1435 mm)	+20 mm / - 10 mm over widened gauge	+20 mm / - 10 mm over widened gauge
Gauge (Maintenance) - <500m radius (with respect to 1435 mm)	+20 mm / - 10 mm	+20 mm / - 10 mm over widened gauge
Gauge Face Wear	8mm	8mm

c) Platform interfaces are set out in Table 5-5

Table 5-5: Platform interfaces

Particulars		**Measurements**
Length		136 m (6 coaches)
Width: Island type		8.0 to 12.0 m
Width: Side type		4.0 to 6.0 m
Particulars		**Measurements**
Height above Top of Rail level	Ballasted Track	1090 mm ± 5 mm
	Ballast-less Track	1080 mm ± 5 mm
Distance between track centre and platform edge		In underground: 1510 mm – 1515 mm In Elevated and At grade: 1515 mm – 1520 mm
Minimum horizontal curvature at platform		1000 m
Structural gauge and passing clearance in platform		Refer to Appendix D of this document

5.9 Train's inter-operability requirements

Metro passenger trains of this contract shall be designed for operation in all corridors of CMRL Phase 2 network.

All the requirements of Interface suggested in ERTS-RS Appendix C shall be taken care during the design of the Rolling stock.

Trains shall be able to be maintainable & stabled in all the depots of CMRL Phase 2 network. Hence all the related interface with various depot machines and track systems suggested in ERTS-RS Appendix C – Section 6, Section 10, Section 11 shall be achieved.

Trains shall be compatible with combined operation with other type of trains in CMRL Phase 2 network. Hence all the related interface with other Rolling stock systems suggested in ERTS-RS Appendix C & Section 14 shall be achieved.

All the requirements of interface suggested in ERTS-RS Appendix C shall be taken care during the design of rolling stock.

5.10 Environmental criteria

Environmental conditions for the on-board equipment shall conform to EN 50125-1. The rake shall be capable of being operated, stored, and maintained at specified performance levels within the environmental conditions of the Chennai area as shown in Table 5-6.
Note: The details mentioned above are tentative and it shall be sub contractor responsibility to confirm these values from relevant resources.

Table 5-6: Environmental Conditions of Chennai Area

Condition	Maximum	Minimum
Climate	Tropical Wet, Dry, and humid	
Ambient temperature	45 °C	16 °C
Monsoons	October through December	
Rainfall	1333 mm average annual. (Very heavy/continuous with heavy lightning discharges).	
Relative humidity	100 % saturation during rainy season which may be as long as 3 ~ 4 months. Other times, 82 % humidity.	
Atmosphere during hot season	Extremely dusty	
Maximum wind speed	130 kmph	
SO_2 level in atmosphere	5 ~ 40 micro g/m^3	
NOx level in atmosphere	10 ~ 40 micro g/m^3	
Respiratory Suspended Particles Matter in atmosphere (RSPM)	45 ~ 100 micro g/m^3	
Total Suspended Particles Matter in atmosphere (TSPM)	150 ~ 320 micro g/m^3	
Altitude	Sea Level	

Conditions in stations	All underground stations will be A/C. Above ground stations will have A/C for certain designated rooms only.

The temperature of stationary rake exposed to sun for long periods may go as high as 70°C. The equipment shall not be adversely affected in any way due to exposure to such high temperatures.

As the Chennai Metro lines will have elevated and underground portions, there may be sudden change in the ambient temperature to rolling stock. The equipment shall be designed to take care of such thermal shocks.

The Traction Equipment mounted on the under-frame shall be designed to permit propulsion of the train at 10 km/h through water up to a depth of 75 mm above rail level (with maximum allowable wheel and rail wear). Traction equipment shall be made splash proof in accordance with International Standards.
The rakes shall be continuously exposed to highly corrosive, salty atmosphere along with industrial pollutants.

With maximum allowable wheel and rail wear, the rake must be able to operate successfully under the above conditions with no entry of moisture or other contaminants into any compartment, component, or device that could cause equipment on the rake to malfunction or be damaged; that could increase maintenance requirements; or that could cause premature wear or failure.

The Water used in Chennai for washing is likely to have a high level of dissolved matter which may aid corrosion.

5.11 Weight criteria

The distribution of equipment on a particular car shall be arranged to maintain an even weight balance and shall be tested in accordance with IEC 61133 to the extent that it applies to electric multiple units.

Each passenger weight shall be assumed to be 65 kg.

For design and performance purposes, the weight of each car of a rake shall be as defined below. Alternatively, the weight of each car of a rake may be taken as that defined in the UIC standards subject to prior approval by CMRL for the particular application.
a) AW0: Empty rake operating weight, ready to run,
b) AW1: Fully seated passenger load, plus AW0
c) AW2: Normal load rake weight at 4 passengers / m2 plus AW1
d) AW3: Crush load car weight at 6 passengers / m2 , plus AW1
e) AW4: Exceptional Crush Load weight at 8 passengers / m2 , plus AW1.
f) AW5: Car Structure design load at 10 passengers / m2 , plus AW1.

The rake shall not exceed an axle loading of 16 tonnes under AW4 conditions.

CMRL prefers a rake design that minimizes weight while maintaining the required structural strength.

The sub contractor shall submit the weight details of all the equipments.

5.12. Shock and vibration

5.12.1 Component design criteria

All car equipment shall be designed to operate without damage or degradation of performance when subjected to vibration and shocks encountered during normal service.

Equipment design and mounting arrangements shall be based on the specific location of the equipment on the rake and shall take into account the influence of adjacent components as well as the effect of normal car operation. It shall be the car supplier's responsibility to assure that the operating environments specified below are not exceeded.

The sub contractor shall ensure that equipment will withstand all normally occurring random shock and vibration magnitudes transmitted through the car axles and suspension, and present at the support points for each piece of equipment.

The mounting of under-body equipment shall be designed to ensure that breakage or loss of any of the mounting arrangement shall not cause the under-body equipment to fall on to the track.

Under-body equipment shall not be supported by bolts under tension unless otherwise approved by the BEML/CMRL.

All mechanical, electrical and electronic equipment fitted to the rake shall operate without damage or suffer any reduction in reliability when subjected to the shock and vibration occurring in normal service for the Service Life of the equipment.

To demonstrate compliance with this requirement , each equipment shall have been subjected to a series of shock and vibration tests, or simulations, representing the real environment. In the case of a proven design component/equipment which has been previously tested, the sub contractor may submit the previous test results for BEML/CMRL review and approval, and not have to re-conduct the shock and vibration test.

Where acceptable results from prior testing are not available for any item of equipment, tests shall be performed in accordance with IEC 61373 or EN 12663.
The equipment design and mounting arrangements for testing shall be based on specific mounting locations on the rake and shall take into account the influence of adjacent components when mounted in-situ.
In cases where components are mounted in a partially sprung environment, the sub contractor shall be responsible for defining the environment to avoid failure of the components.

5.12.2 Vibration generation

The vibration of traction motors shall be assessed using the methodology contained in IEC 60349 and shall not exceed the limits defined in IEC 60034-14. Following ISO 2631-4 standards, vibration frequencies shall be outside of the maximal sensibility range.

3.2.2 For a stationary car, equipment and auxiliaries mounted at any position on the car or bogie shall not cause vibration on any portion of the car floor, side-walls, ceiling panels, stanchions, handholds, seat frames, doors, electrical cabinets and their panels, windows, any passenger seating or holding components in excess of 2.0 mm peak-to-peak amplitude for the frequency range from 1.4Hz to 20Hz, and in excess of 0.8 mm per second peak vibration velocity for the frequency range above 20Hz.
All equipment's, sub-assemblies and components listed above shall be capable of withstanding shock and vibrations of the rolling stock satisfactorily such that they do not fail prematurely on this account earlier to the designed life. To establish this requirement, all of equipment's, sub-assemblies and components shall be subjected to shock and vibration testing as per standards mentioned above.

5.13 Ride quality and passanger comfort (Stability analysis)

All cars in the rake shall be dynamically stable throughout the maximum design speed range of 90 kmph. This ride performance shall be achieved under all Loading Conditions, when travelling throughout the range of operating speeds and cant deficiencies prevailing in normal passenger service for the Service Life of all suspension components. The sub contractor shall submit a ride performance stability analysis.

The Sperling ride index of the rake at 80 kmph shall not exceed 2.50 in both vertical and horizontal directions in inflated condition of secondary suspension and 3.0 in deflated condition for both vertical and horizontal directions.

The oscillation trials shall be conducted with tare and fully loaded cars in both inflated and deflated conditions up to maximum design speed of 90 kmph starting from 40 kmph in the incremental order of 10 kmph for inflated condition and up to 80 kmph for deflated conditions.

Any vibration emitted by the rake, caused by the operation of any equipment or machines (compressor set, blowers, electromagnetic equipment, circuit breakers, motors etc.) shall not be a source of discomfort to the passengers or the Driver.

6. Interface Responsibilities

The location of mounting points and the design of equipment installation comprising of the PA/PIS & CCTV system shall be defined by the Subcontractor and approved by BEML in order to avoid the mechanical interference with other equipment for the vehicle. The Subcontractor shall be responsible for the equipment and material to be supplied and recommended installation method and procedures.

BEML shall be responsible for defining the technical requirements and the design constraints.
The Subcontractor shall be responsible for the design of the PA/PIS & CCTV system and the submission of design information and the performance of testing activities and the supply, installation and commissioning of PA/PIS & CCTV system and the maintenance and rectification of the PA/PIS & CCTV 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.

The Subcontractor shall be responsible for interface with TCMS, ATC, BBRS / CBTC and Train Radio as per below table.

S/N	Subsystem contractor	Interface Responsibility	
		PA/PIS Subcontractor	Other subsystem contractor / Designated contractor
1	Signaling & Telecommunications	Δ	O
2	Train Radio	Δ	O
3	Train Control Management System	Δ	O

S/N	Subsystem contractor	Interface Responsibility	
		CCTV system Subcontractor	Other subsystem contractor / Designated contractor
1	Train Control Management System	Δ	O
2	Broad Band Radio System (BBRS) / CBTC	Δ	O

O – Leader Δ - Support

The subcontractor shall meet the communication protocol requirements of the leader of interface design in accordance with the interface document requirements for PAPIS & CCTV system.
Interface with TCMS shall be Ethernet based communication system and shall be compliant to a common standard or standards as per ERTS 14.2.3.
The sub contractor shall meet the requirements but not be limited to ERTS Chapter 2 & 14 with regard to TCMS interface.
Interface of PA/PIS with ATC shall be either through TCMS or directly based on service proven communication system such as RS485 / Ethernet / MVB protocol which shall be decided during design stage.
The sub contractor shall meet the requirements but not be limited to ERTS 14.4.9, Chapter 14 & Appendix C with regard to ATC interface.
Interface of PA/PIS with Train Radio shall be tentatively based on RS422/RS485 communication for triggering of pre-recorded announcements, PA and PEA communication from OCC/BCC. PA/PIS shall be provided with one PA audio input line, PAD audio input & output lines, digital input for PA enable and digital output for Radio loudspeaker mute signals; which shall be finalized during interface design stage.
Interface of CCTV with Broad Band Radio System (BBRS) / CBTC for CCTV image transmission on demand / event actuated through CBTC/CCTV communication link on real time basis shall be based on open standards such as ONVIF interface which shall be finalized during design stage.

Sub-contractor must ensure Integration, Testing, Interface requirement/details etc. with respect to following system

- Track Monitoring System

- Catenary Monitoring System
- Pantograph camera
- Video Analytic Tool

Finalization of ICD for complete system covering all aspects of Engineer's Requirement, Operating principle including OCC/BCC etc. shall be in the scope of work of sub-contractor.
Following 110V DC hardwire digital inputs would be provided though potential free contacts from train side relay/pushbutton as minimum for PA/PIS & CCTV system.

- Active Cab signal
- Door close announcement signal
- Door open left/right signal
- Door close left/right signal
- All door close signal
- Zero Speed signal
- Emergency Front door open signal
- Front Obstacle Detection device signal
- Emergency CCTV transmission input signal

Supplier shall provide parallel interface through dry contact with TCMS for indication of fault in PA/PIS and CCTV system.

7. Design Responsibilities

7.1 General

The subcontractor shall be responsible for meeting all the technical requirements in PTS, ERTS and submission of required data for PA/PIS & CCTV system design.

The general requirements for PA/PIS & CCTV system shall be met to the requirements specified in ERTS.

- Interface Activities
- Quality Assurance
- System Safety
- Reliability & Availability
- Maintainability
- Noise and Vibration
- Fire and Toxicity Standards
- Electro-Magnetic Compatibility

7.2 PA/PIS & CCTV System

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

- ERTS 1 System Description

- ERTS 2 System Requirements
- ERTS 3 Vehicle Body
- ERTS 5 Emergency Operators Desk
- **ERTS 6 Passenger Doors**
- ERTS 9 Auxiliary Electrical Equipment
- **ERTS 13 Communication System**
- **ERTS 14 Train Control Management System (TCMS)**
- ERTS 15 System Support
- ERTS 16 Management Program
- ERTS 17 Test Program
- ERTS 19 Material and Workmanship.
- ERTS 20 Software Management Requirements
- ERTS Appendix A1 Detailed Software Development V-Cycle
- ERTS Appendix A2 Description of the Software Development Phases
- ERTS Appendix A Abbreviations
- ERTS Appendix B International Standards
- **ERTS Appendix C Interfaces**
- ERTS Appendix D Guidelines and Drawings
- ERTS Appendix G Documentation and CAD Drawing Requirements
- ERTS Appendix H Deliverables List
- ERTS Appendix I Train Withdrawal Scenarios for 3-car Trains

Sections underlined above are brief of PA/PIS & CCTV system requirements for a quick reference. The proposed PA/PIS & CCTV system shall meet the requirements of the following clauses of ERTS (Section 2, 6, 13, 14 & Appendix C but not limited to).

2.2.31 Multi-Consist Configuration

b) **Hardware & Software of all subsystems (including but not limited to Traction system, APS system, PAPIS & CCTV system**, TCMS system, Pneumatic & Brake system, Saloon Door system, VAC system, Trainlines, Signalling system, Telecommunication system, PSD system, etc) shall be **automatically reconfigure as required whenever a coupling or decoupling command** is initiated by OCC or the Train Operator.

2.4.3 Service-Proven Design

b) Evidence documenting service proven design shall be furnished as part of the proposal for the
following systems and components:
a) Car body Structure
b) Coupler and Draft Gear
c) Traction converter inverter system
d) Traction Motors
e) Drive Gear Units and couplings
f) Pneumatic and Brakes Control system
g) Door system and Controls
h) VAC System
i) Bogies
j) Wheels and Axles
k) Auxiliary converter inverter system and Battery Charger
l) TCMS & Event Recorderm) Batteries
n) High Voltage equipment's
o) **Audio visual Passenger Information System and CCTV**

5.9 Closed Circuit Television (CCTV)

5.9.1 CCTV display screen shall be provided in the **emergency operator's desk** as part of the **Communication Control Head (CCH)** as defined in clause 13.4 to view the live footages of interior saloon and exterior cameras of train. The related control electronics and associated power supply shall also be installed in emergency operator's desk.

5.9.2 All the exterior and interior surveillance cameras shall function **continuously in day and night times in all operating locations and timings** of CMRL service operation. Suitable latest camera technology and latest network technology shall be proposed by the Contractor. The requirements of clause 13.13 shall be adhered..

6.9.22 Dual Mode Detrainment Door

When an attempt is made to operate the door actuating mechanism, or it is unstowed / unlatched the supervised interlock circuits shall trigger the following chain of events:

a) Emergency brakes are applied on the train.
b) An alarm is sent to OCC / BCC / DCC requesting permission (Unlock Command) for the Detrainment Door so it can be fully deployed.
c) Driving console light, Head lights and Flasher lights are automatically lit, **and CCTV cameras shall automatically focus on this area.**
d) **Automatic Switching ON onboard CCTV to high-speed mode shall occur.**
e) **Appropriate audio & video messages though PAPIS system shall be broadcasted on the train speakers and displays to guide the passengers.**
f) Video messages shall be descriptive enough for a passenger to understand the operation of the detrainment door & ramp. These messages shall show the

direction towards the operated detrainment door to the passengers. These video messages shall be submitted to CMRL for approval.

g) Provide the train location in the CMRL section to OCC, BCC & DCC for further action by them.

h) Such an event shall be logged in TCMS and shall be communicated to RSC consoles of OCC, BCC & DCCs as audio visual alarms.

i) **The detrainment process shall be monitored with CCTV cameras of the train**. One CCTV camera dedicated to the detrainment process shall be provided. Flasher light shall automatically turn ON when detrainment door is open.

j) Provide an alert and Communication with the nearest station controller about the de-boarding of passengers, switch ON tunnel lights, elevated lights and switch ON suitable tunnel ventilation fans to enable proper ventilation to passengers in tunnel..

13. COMMUNICATION SYSTEM

13.2 General

13.2.1 The Contractor shall conform to applicable international standards and best practices for communications requirements and shall be responsible for design and interface coordination, installing and testing the entire train communications system.

13.2.2 The system components shall be modular and shall be removable for servicing, without affecting other functions or devices.

13.2.3 The communications system shall include the following major components:

a) Communications Control Heads (CCH) system
b) Public Information System (PIS),
c) Public address system with automatic announcements
d) Exterior and interior message displays
e) Private operator's desk-to-desk Intercom (during special situations)
f) Passenger Emergency Intercom from OCC and TCMS
g) Interior and Exterior Video Surveillance and CCTV

13.2.4 The Contractor shall verify through testing that all required inter-car communications are totally functional through the car-to-car jumper cables of a 3-car train. Provisions shall be made for the conversion to future 6-car train and/or multi consist train.

13.2.5 All electrical materials, components, and installation methods used in the fabrication of the communication system, including wire, cable, printed circuit boards and circuit protective devices, shall conform to the requirements of Chapter 19.

13.2.6 The Contractor shall submit data sheets and/or specification sheets for all communications system components.

13.2.7 Structured programming techniques, as specified in Chapter 20 shall be used for all software driven communications subsystems.

13.2.8 All communications equipment shall be operable when train auxiliary supply is ON and shall also be functional with battery supply alone.

13.2.9 Sufficient extra cable length shall be provided to allow at least three re-terminations at each end of all the cables inside Jumper cable conduits, at terminal block connections, under frame connections, roof connections, saloon interior connections.

13.2.10 Each main communication system shall be operated and inhibited independently in case of failure. This inhibition shall be possible from Train TCMS, OCC, BCC and DCCs.

13.2.11 The components of communication system shall be installed such that the mounting hardware is readily accessible for ease of service and maintenance. Exposed hardware is not permitted.

13.2.12 Not used.

13.2.13 A single point failure in the communication system shall not impact the complete train communication system. Hence sufficient redundancies shall be incorporated.

13.2.14 Not used.

13.2.15 All memory storage system shall be Solid State Disk (SSD) or Micro SD card or other latest technology available subject to CMRL approval.

13.2.16 The Contractor shall provide suitable space, mounting provisions, wiring and separate circuit protection for the communication equipment including power supplies. The power supplies shall be fed from the low voltage power supply and emergency storage battery circuit. The Contractor shall use best practices for equipment wiring and network wiring as per the relevant international standards.

13.2.17 The Contractor shall refer to Chapter 3, Chapter 5 and Appendix C for fitment of communication and interface equipment within operator's desk and in train.

13.2.18 The Communications System shall comply with BS EN 60268.

13.2.19 The Communications System functions has to meet the all the criteria defined in Chapter 14.

13.2.20 All electrical and electronic components shall comply with the EMC and EMI requirements of EN 50121 (all parts), IEEE 16, EN 55011 and IEC 61000-4 standards or other equivalent international standards. The requirements of EMC EMI in Clause 10.19 & 2.18 shall be met.

13.2.21 Fire properties of the materials used shall comply with EN 45545 part 1 to part 7 latest editions (Category 4-A, Hazard level HL3) as a minimum or better international standard applicable for similar Metro applications. Requirements of clause 2.26 shall be met.

13.2.22 Material requirements of Chapter 19 shall be compliant.

13.3 Power Supply

13.3.1 All communication equipment shall be powered from the low voltage power supply and storage battery with voltage ranges as defined in Chapter 9.

13.3.2 The communications system shall be configured with a separate circuit breaker for each major component. Failure of one component shall not affect the functionality of other major components.

13.4 Communications Control Head

13.4.1 A Communications Control Head (CCH) shall be installed in the Driver Desk at both ends of the train. Communications Control Head is a touch screen display which shall be operable by authorized Operation / Maintenance personnel with a unique login detail. The Contractor may propose any emergency control buttons on operator's desk apart from control from CCH console.

13.4.2 The CCH shall provide the Operator with a control interface to the entire communications system, except for the Diagnostic Monitoring System (DMS) and event recorder.

13.4.3 The CCH shall interface with all audio and visual communication equipment and shall provide the following functions:

a) Control and reset any passenger emergency intercom of the train.
b) Select and control operator's desk-to-desk communications
c) Control PIS announcements
d) Play independent and automatic route related audio & visual announcements

13.4.4 The status indications, operation, control and isolation of the features mentioned in clause 13.4.3 shall be provided from CCH console inside the operator desk. The console shall contain all the communication equipment status indications.

13.4.5 The communication system shall remain operational even if one of the two CCHs in a train has failed.

13.4.6 The Contractor shall submit communication system functional descriptions, display layout of functions in CCH console, control scheme and block diagrams of the CCH and associated communications components.

13.4.7 A Train operator microphone, complying with EIA-SE-103, shall be provided on each emergency driver desk. This microphone shall be used for non-automatic PA announcements, and for communication through operator's desk-to-desk and PEI. During UTO / GoA4 operations, this microphone shall be sealed inside the operator's desk panel in a safe manner without damage during operator's desk panels open or closing function. Suitable design of operator's Mic shall be suggested by the Contractor.

13.4.8 Automatic Touch screen calibration shall be incorporated within the in CCH display during train restart activity. The touch screen sensitivity shall be suitable for industrial applications and Rolling stock applications. Train operator or maintainers shall not feel discomfort in operating the touch screen.

13.4.9 Driver Desk Speakers

13.4.9.1 A speaker system shall be installed on each driver desk to ensure train radio and intercom systems communications between the driver and OCC, driver and passengers, and other radio functions required.

13.4.9.2 Speaker output shall be adjustable to the minimum required audible output level specified in clause 13.7.2.9.

13.5 TETRA RADIO SYSTEM

The TETRA radio system shall be supplied by the Tele-Communications Contractor shall ensure communications between train operator and control room. The TETRA radio is for operations, maintenance and voice communications and data applications in connection with data of the TCMS systems.

13.5.1 The TETRA radio system shall consist of exterior antennae, console-mountable, standard type radios and radio power supply units together with all installation materials and cables required for installation. The RS Contractor shall install and connect these antennae on the train roof, one radio in the console of each cab desk and one radio power supply in each cab desk.

13.5.2 Detailed dimensional, weight and power requirement information shall be presented for CMRL approval at the time of Preliminary Design Review.

13.5.3 The RS Contractor shall provide suitably space, mounting provisions, wiring and separate circuit protection for the radio power supplies. The radio power supplies shall be fed from the low voltage power supply and emergency storage battery circuit.

13.5.4 The RS Contractor shall provide and install cable from the radios to the corresponding antenna, using removable connectors at each end of the cable. The cable impedance shall match the output impedance of the radio.

13.5.5 The Contractor shall submit the above said (i.e., 13.5.1 to 13.5.4) for CMRL approval.

13.5.6 The antenna-to-radio connection shall be kept as short as possible and shall have no angle connections unless otherwise approved by CMRL.

13.5.7 The Contractor shall use gaskets to make the installation of the antennas weatherproof and resistant to damage from the carwash service areas. Sealant shall not be permitted for fixing of roof / exterior mounted equipment.

13.5.8 The Contractor shall submit for approval, during design review, detailed information on radio equipment interfaces, mounting, and wiring.

13.6 NOT USED

13.7 Public Information System

The Public Information System (PIS) shall consist of both visual and audible

announcements, train information, advertisements that comply with “The Rights of Persons with Disabilities Act, 2016” both inside and exterior of the vehicle. The PIS shall interface with the TETRA radio system and Signaling system to allow full-duplex two-way communications between passengers and the OCC, BCC & DCCs and vice versa.

13.7.1 Passenger Information Displays

13.7.1.1 The passenger information displays shall consist of exterior information displays and interior information displays. Control of these displays shall be integrated into the overall communications system.

13.7.1.2 In general, these displays shall include, but shall not be limited to information on the current running route, route destination station, next station stop, skip station, door opening side, connecting station information as well as further secondary messages to be determined by CMRL during design stage.

13.7.1.3 In case of any further extensions/modifications of stations of the corridors and in case of any change in operation strategy of the train, there shall be a requirement of additions / deletions / modifications of these route related messages in future. Also, there shall be a requirement to modify the special/emergency announcements in train. Hence a provision shall be provided to CMRL to increase/decrease/modify/update these messages independently using the Contractor-supplied Software tools. These tools shall be provided during the first train taking
over by CMRL.

13.7.1.4 The information displays shall allow maximum visibility to all seated and standing passengers.

13.7.1.5 Control of all displays in a train shall be possible from the TCMS, OCC, BCC and DCCs.

13.7.1.6 The displays shall be all-electric, alphanumeric, and completely self-contained. The display shall be capable of displaying both in Tamil and English languages.

13.7.1.7 The character font and size of the messages shall be designed for proper readability for all passengers inside the train.

13.7.1.8 All passenger information displays shall comply with “The Rights of Persons with Disabilities Act, 2016”.

13.7.1.9 The displays shall be readable in direct sunlight or complete darkness and all degrees of light in-between.

13.7.1.10 All the displays shall be LCD displays with LED backlit or any other latest better technology displays. The viewing angle for the displays shall be minimum 178 Deg.

13.7.1.11 Not Used.

13.7.1.12 The displays shall not require any external mask between pixels and shall not require any framing or support structure between characters that would give a discontinuous appearance.

13.7.1.13 The Contractor shall submit for approval information on the design, specifications and location of the interior and exterior displays in design stage.

13.7.1.14 Dynamic Route Map Displays (DRMD)

13.7.1.14.1 The saloon of each car shall have a total of eight (8) DRMD screens. The screen locations shall be proposed by the Contractor during PDR stage and is subject to CMRL approval. (Also refer to clause 2.2.15)

13.7.1.14.2 Each DRMD unit shall be a single display screen with a stretched aspect ratio. The minimum dimensions shall be 965mm x 183mm. The minimum screen size shall be at least 48" corner to corner. The use of multiple screens joined together shall not be accepted.

13.7.1.14.3 Screens shall be LCD (with LED backlight), however, a later / better technology of display may also be proposed for CMRL's review and acceptance.

13.7.1.14.4 There shall be no glare from the mounting frame or from the interior of the vehicle that could impair the display's readability.

13.7.1.14.5 It shall be possible to read route related messages and all details of route map from at least one of the displays from any location within the passenger compartment. The font and size of the details shall be suitably provided.

13.7.1.14.6 The Electronic route map shall show at-least the following information:

a) Destination station
b) Current station
c) Next station
d) Distance for reaching the next station.
e) Expected time of Arrival for Destination station
f) Real time clock and date
g) Door side opening / closure status
h) Door opening information.
i) Skip station information, etc.
j) Network map, Route map & Current route
k) Any ambient information like speed, temperature, humidity etc.
l) Interlinking metro stations with places of importance to be highlighted.
m) Any special announcements from OCC / Train operator
n) Scrolling of route related announcements

13.7.1.14.7 Provision shall be available for OCC, BCC & DCC to broadcast messages on these displays during rescue operation, during UTO operation etc.

13.7.1.14.8 Route maps of Different corridors shall be shown in different colors. Interchanging stations and important places (Malls, hospitals, Bus station, Rail station, Airport, etc.) in the route shall be highlighted while showing the routes. The addition and deletion of important places at any time shall be possible. The Contractor shall provide necessary tools and software to CMRL for updating the information on route maps independently.

13.7.1.14.9 Route information on the display shall align to the train running direction on both left and right sides of the saloon. Station names shall be displayed in English and Tamil languages.

13.7.1.14.10 Not Used

13.7.1.14.11 Internal Electronic Destination Display (IEDD)

There shall be displays on both ends of non-driving cars and at gangway end of driving cars just above the gangway of the Car. The programmable display shall be capable of displaying the next station destination in Tamil & English language along with other graphic. The minimum size of the display screen shall be 36" corner to corner. The display location and specification shall be submitted for CMRL approval.

13.7.1.15 Exterior Displays

13.7.1.15.1 LCD with LED backlit displays or any latest better technology displays shall be provided at both ends of the train above the windshield and side displays shall be provided on each side of the carbody (each covering a full window length) to indicate the destination station and route information. The message shall be displayed in both English and Tamil simultaneously.

13.7.1.15.2 The brightness of the display shall be adjusted automatically according to the brightness of the sunlight so that passengers shall be able to read information on Exterior display at all times.

13.7.1.15.3 In addition to the destination station name, the Train ID details shall be displayed on it. Train ID shall be displayed duly getting location and direction information derived from signaling system and also an independent Rolling stock vehicle locator system

13.7.1.15.4 The exterior display size shall be approved by the CMRL during design stage.

13.7.1.16 Displays for advertisement Purpose

13.7.1.16.1 6 no’s of LCD with LED backlit displays or any latest better technology displays of size not less than 65 cm x 40 cm shall be provided inside each coach at an appropriate location. (or superior technology) shall be provided inside each coach. Screens shall be at least 27" corner to corner and 16:9 aspect ratio. The display location and specification shall be submitted for CMRL approval.

13.7.1.16.2 These displays shall support for broadcasting advertisements in video and picture formats, CMRL promotional videos and route related information.

13.7.1.16.3 By default, this display shall show the route related information similar to Electronic route maps. Provision shall be made available for CMRL to switch over these displays into commercial mode for broadcasting advertisements from single point in the train.

13.7.1.16.4 The Contractor shall provide necessary storage devices for enabling CMRL to upload the video & Picture files from a single point in train to broadcast on all the train’s

displays.

13.7.1.16.5 Necessary interfaces shall be provided for broadcasting advertisements in a logical manner such as broadcasting multiple videos one after other or broadcasting a single video for a specified period, broadcasting advertisements at a specific location or station, etc.

13.7.1.16.6 During the Emergency/ rescue operation these displays must show the necessary instructions for the passenger to operate detrainment door. This control shall be done from TCMS, OCC & DCC.

13.7.1.16.7 Adequate protection shall be ensured to protect the displays from vandalism.

13.7.2 Public Address System

13.7.2.1 The PA system shall operate with uniform audio quality throughout a train and shall be designed to inhibit audio feedback or echo.

13.7.2.2 The Contractor shall submit for approval an audibility analysis for the PA system, including the location of each speaker in the car. The minimum acceptable Speech Transmission Index must be better than 0.5

13.7.2.3 The PA system shall be muted when not in use.

13.7.2.4 The PA system shall enable the train Operator and OCC/BCC operator, using the CCH microphone, to make announcements from the operating desk to passengers throughout the train and to persons on station platforms (using train's exterior speakers).

13.7.2.5 A switch matrix shall be used to select the PA speakers on the inside of the train, on the outside of the train (independently for left or right side), or both inside and outside the train (with both sides active) during operation and testing purposes.

13.7.2.6 The PA system shall operate without a loss of audio quality on the maximum-length of train.

13.7.2.7 All controls of the PA system shall be located on the CCH.

13.7.2.8 All the announcements being broadcasted using CCH microphone shall be recorded and the recordings shall be available in the train for up-to 7 days.

13.7.2.9 Audio levels of all the announcements in the train shall be automatically adjustable based on both the train speed and dynamic passenger loading in the train. The Contractor shall provide to CMRL, volume control settings at various dB levels which can be selected and followed during train commissioning stage itself suiting to the requirements of passengers.

13.7.2.10 All PEI communication with OCC & train operator, DCC & Train operator shall be two way and full duplex type. The sound of communications shall be free from background noise and shall be free from disturbances.

13.7.3 Power Amplifier

13.7.3.1 Power amplifiers shall meet the requirements of EIA-SE-101 or any latest applicable standards.

13.7.3.2 The power amplifiers shall be capable of delivering a minimum of 50 Watts configured as a constant voltage distribution system at not more than 1% total harmonic distortion in the range of 100 Hz to 8 kHz.

13.7.3.3 The frequency response shall be within ±1 dB from 100 Hz to 8 kHz, with provision for a roll-off of 6 dB per octave below 100 Hz.

13.7.3.4 The signal-to-noise ratio of the amplifier below the compression threshold shall be at least 65 dB

13.7.3.5 Each amplifier shall be stable, with no oscillation present during any normal operation.

13.7.3.6 Amplifier controls shall be equipped with a locking mechanism to prevent inadvertent adjustments and shall be accessible only for maintenance or service.

13.7.3.7 The Contractor shall ensure in the design that in case of failure of Power Amplifier in a car, under such condition, at least 50% of the speakers shall be fed from the adjoining car. To ensure that in the event of a single failure, at least half of the speakers are still operative in the car.

13.7.4 Speaker General Requirements

13.7.4.1 All interior speakers shall be of transportation grade, direct radiating, axial-free, permanent magnet type and shall comply with EIA-SE-103 or any latest applicable standards.

13.7.4.2 The interior speakers shall have an axial-free field sound pressure level (SPL) of 95 dB referenced to 2 x 10-11 N/mm² at a distance of 4 ft [1220 mm] from the speaker.

13.7.4.3 Off-axis coverage between any two adjacent speakers shall not be greater than 6 dB below the on-axis SPL for uniform sound distribution.

13.7.4.4 The enclosure and the speaker shall be removable from the vehicle as a complete unit.

13.7.5 Interior Speakers and Exterior Speakers

13.7.5.1 Interior speakers shall be evenly spaced longitudinally in passenger seating areas.

13.7.5.2 Metal covers or plastic enclosures shall protect the interior speakers from dust, moisture, and vandalism.

13.7.5.3 The frequency response shall be ±5 dB from 300 Hz to 8kHz, with a gradual roll-off of response above 7 kHz.

13.7.5.4 The exterior speakers shall be similar to the interior speakers except that they shall be suitable for outdoor use and have suitable IP 65 protection.

13.7.5.5 Exterior speakers shall be placed such that, they shall not be closed behind the permanent panels of station Platform Screen Doors (PSD).

13.7.5.6 The connecting cables of the exterior mounted speakers shall be protected using cable glands.

13.8 Automatic Announcements

13.8.1 Automatic announcements shall include, but shall not be limited to, station arrival, Door opening side, current running route, route destination station, next station stop, skip station, door opening side, connecting station information as well as further secondary special and emergency messages to be determined by CMRL during design stage. The announcement control unit shall be an integral part of the CCH or, alternatively, the Passenger Information System (PIS).

13.8.2 Announcements from the OCC Operator / Train operator / BCC operator / DCC operator shall always override automatic announcement.

13.8.3 The announcements shall be broadcasted automatically when the train moves between the stations.

13.8.4 The automatic announcement function shall use locally stored predefined digital messages and shall broadcast these messages to passengers automatically at designated track locations by means of location and direction information derived from signaling system and also an independent Rolling stock vehicle locator system. Overriding automatic messages by manual message triggering by the operator shall also be possible.

13.8.5 Provision shall be available for the operator of train / OCC / BCC / DCC to enter the route related information manually into communication system for the purpose of enabling automatic announcements.

13.8.6 The digitally recorded messages shall be broadcast over the PA system. Text messages shall be displayed on the passenger information display units.

13.8.7 The audible and text messages shall be synchronized with each other on the displays and speakers to provide audible and visible information compliant with “The Rights of Persons with Disabilities Act, 2016”.

13.8.8 A pre-recorded announcement or tone, advising passengers while the doors are opening and when doors are closing shall be broadcasted. These announcements shall be broadcasted by the communications system, triggered by signals from the door control system and signaling door information.

13.8.9 It shall be possible for CMRL to record and change the pre-recorded route related messages, special messages and add such recordings to all trains. Necessary tools and software shall be provided by the Contractor to CMRL to perform this function.

13.8.10 The preferred method of message storage is by internal storage which can be updated via the network, or by programmable memory cards.

13.8.11 Messages shall be recorded using a professional recording studio, or alternative method, subject to CMRL's approval.

13.8.12 The Contractor shall provide a detailed description of the message recording and transfer process at the time of PDR. The recording and transfer process and methodology shall be subject to CMRL approval.

13.8.13 All the announcements shall be stored in two languages, Tamil and English.

13.8.14 During the operation time, CMRL may run the trains in multiple combination of routes within the corridors 3, 4 & 5 which may subject to change during the operation stage. Hence the Contractor shall design the communication system such a way that automatic announcements shall work in trains within any route operated by the CMRL.

13.8.15 Implementation of the automatic route related announcement system of trains shall be functioned by using signaling variables as a main function. Rolling Stock Contractor shall interface with Signaling Contractor for this information. The Rolling stock Contractor shall also have an independent automatic route related announcement system in trains for redundancy purpose only. This redundant system shall be functional in all UTO, non-UTO and degraded modes of train operation and shall be designed to have all the functions of the Automatic Passenger announcement system. RS Contractor shall provide PAPIS test bench with one display of each type and one audio speaker specific to interior and exterior of train. The purpose of the test bench is to check the audio-visual modifications in the PAPIS software before loading in the train.

13.8.16 Manual Pre-Recorded announcements

13.8.16.1 There shall be a provision to store pre–recorded voice messages in the communication system
by CMRL.

13.8.16.2 These pre-recorded messages shall be broadcasted by the train operator from the driver desk
Communications Control Head (CCH) in all non-UTO modes and degraded modes of operation.

13.8.16.3 RSC consoles in OCC, BCC & DCC shall have the provision to select pre-recorded messages
remotely and to broadcast in any train.

13.8.16.4 Addition and deletion of pre-recorded messages shall be possible by CMRL. The Contractor shall provide necessary software/ tools to CMRL.

13.9 Operators Desk-To-Desk Communications

13.9.1 Communications equipment shall be provided to permit two-way full-duplex voice communications between the active Driver desk and the non-active driver desk in a train.

13.9.2 The Operator shall accomplish desk-to-desk communications by selecting this mode on the CCH and using the microphone.

13.9.3 The sound quality of desk-to-desk communications shall be of the same quality as the PA as detailed in clause 13.7.2.

13.9.4 The maximum permissible variation in sound levels shall not exceed 5 dB. (Standard to check).

13.9.5 Desk-to-desk communication shall not be broadcasted in the saloon speakers. A dedicated speaker near to the Driver desk shall be installed for this purpose. This speaker shall have a provision for volume adjustment.

13.9.6 The desk-to-desk conversation shall be recorded in the train and the recordings shall be available for up-to 7 days in the train.

13.10 Passenger Emergency Communications

13.10.1 A two-way full-duplex emergency intercom shall be provided to enable passengers to initiate hands-free communications with the train Operator in non-UTO mode and with RSC console of OCC, BCC & DCCs in UTO mode. All the PASSENGER EMERGENCY INTERCOM (PEI) communication with RSC console of OCC, BCC & DCCs and train operator shall be two way and full duplex type in both UTO mode and non-UTO modes of operation. The communications shall be free from background noise and shall be free from disturbances.

13.10.2 When a pushbutton on the PEI is depressed, an audible and visible annunciation shall be provided on the Train′s CCH and in RSC console of OCC, BCC & DCCs based on the mode of operation. The Contractor shall present for CMRL approval during design review the pushbutton type, which should minimize unwarranted activation by passengers. The push-buttons for this purpose shall be flushed mounted with the car interiors.

13.10.3 A press-to-reset soft button shall be available at the CCH to permit the Operator to reset any activated PEI. Provision in RSC console of OCC, BCC & DCCs shall also be available to reset any activated PEI in UTO mode of operation

13.10.4 The press-to-latch button at the PEI station shall illuminate when activated. The illumination shall turn off when the intercom is reset.

13.10.5 In each car four (4) numbers of PEI shall be provided. Also the two detrainment doors shall be provided with PEI to facilitate emergency commination with passengers during train detrainment process. The PEI locations shall be finalized in consultation with CMRL.

13.10.6 The PEI shall be easily accessible to wheelchair patrons and shall be compliant to ″The Rights of Persons with Disabilities Act, 2016″ and shall have Braille instructions which explain the process of operation of Passenger Emergency communication device.

13.10.7 The Contractor shall submit for approval information on the design and location of

PEI stations.

13.10.8 Not Used

13.10.9 All the conversation (Audio and Video) between passenger and train Operator / OCC operator / BCC operator shall be recorded in the train and shall be downloadable. These recordings shall be available for at least 30 days.

13.10.10 Suitable signage shall be provided in both English and Tamil at the PEI location.

13.10.11 Not Used.

13.10.12 PEI devices shall include microphones, loud-speakers and an alarm button. A low level /forward facing CCTV camera (tamper proof type) shall be located near to each PEI device to deter misuse. The car CCTV System shall automatically select cameras within the specific area of an alarm activated PEI device and display images in OCC, BCC, DCC and on TCMS screens.

13.10.13 Upon activation of PEI, there shall be an audio & visual alarm in OCC / BCC with the details of train.

13.10.14 TETRA Contractor shall furnish RS Contractor with the interface required between the TETRA radio system and the on-train public address system/other suitable system of RS to allow onboard PEI call point mic of RS to be used for silent listening of saloon voice through TETRA by OCC. The identifier of the PEI device (which call point in which car of the train) shall be communicated by the on-board TETRA system to the RS system for selecting the mic of that call point to be used for this feature. There shall not be any indication on the PEI call point or any other location on the train, visible for passengers, denoting the silent listening mode activation. RS Contractor shall interface with TETRA Contractor and shall provide necessary hardware and software interface as described above.

13.11 Not Used

13.12 Not Used

13.13 Video Surveillance System (CCTV)

13.13.1 Each car shall be equipped with a video surveillance system to observe passengers and equipment inside and outside the saloons. The CCTV system shall consist of video cameras, operator monitor screens (TCMS DDU), and digital video storage including the control electronics, and associated power supply & network. The video broadcasting in CCH and video recordings shall be available at a frame rate of 30 fps or more. The picture quality shall be minimum level E, at 100% Rotakin measured, according to EN50132-7.

13.13.2 Each car shall be pre-wired to provide power to the video system from a dedicated circuit breaker.

13.13.3 Each car shall be provided with conduit to be able to connect each video camera

to the central video recorder (one in each operator′s desk of a train). Central Video Recorder shall be redundant to each other. The connection between the cars of a train shall be by jumper conduit with weather-proof quick disconnects at both ends. The memory of each central video recorder shall support to store seven full days of video recordings of all the interior & exterior cameras of the train. After seven days the video recordings shall be overwritten on First in First out (FIFO) basis. Provision shall be available to download video recordings of any camera from a single point in the train. Necessary software for downloading video recordings shall be provided to CMRL.

13.13.4 The Contractor shall propose an interior video surveillance system, including the appropriate number of cameras, to provide adequate coverage of the passengers in the coaches, all saloon doors, PEI, Emergency Egress Devices, Wheel chair area, Driver Desk and detrainment door. There shall not be any blind spot for video surveillance in the car.

13.13.5 In addition to the cameras provided inside the saloon, the Contractor shall install cameras outside the saloon to monitor the track, OHE, pantograph and platforms of each station. External mounted cameras of each coach shall clearly cover platform to coach passenger ingress-egress for all the doors of coach. These cameras shall be specific to each coach side. Passenger obstacle detection at any door of train shall be clearly identifiable through these external mounted CCTV camera footages. All external mounted cameras shall have Ingress Protection with IP 65 rating. All interior and exterior cameras of train shall be vandal resistance with IK 10 rating and shall operate in all exterior temperature and humidity conditions of Chennai mentioned in Table 7-1 and Table 2-6. They shall operate during all passenger service modes including commissioning. All cameras of train shall be compatible with EN 50155. The recordings from these cameras must be clear in dark, daytime, night-time and in all hours of operation even in case of non-availability of any exterior lighting. All the train cameras shall be Infra-red type or latest better type. The Contractor shall submit CCTV camera locations for both inside and outside the coach for CMRL approval.

13.13.6 All the interior and exterior cameras shall support for a video resolution of minimum 1920x1080 HD and minimum 30 frames per second, minimum illumination of 0.3 lux (color), iris control, minimum 90 dB wide dynamic range (WDR) and Power Over Ethernet (POE) compliant. Cameras shall be of proven design in railway applications. The recordings from these cameras must be clear in dark, daytime, night-time and in all hours of operation even in case of nonavailability of any exterior lighting. All the train cameras shall be Infra-red type or latest better type. Camera and Recorder shall comply CCTV Industry standards like onvif. The Visual images from each camera shall be recorded in non-volatile memory without any limitation of repetitive writing of the data. Each camera shall have recording capacity for at least 7 days. The records shall be easily downloadable.

13.13.7 The exterior camera view shall be continuously streamed in a separate CCTV monitoring screen in OCC, BCC & in DCCs of all depots. However, provision shall be available for the operator to remotely view any train′s specific interior / exterior camera′s live recording from the corresponding train′s CCH, from OCC console, from DCC console and from any Station Control Room (SCR) console (within one station vicinity of the train on either ends). RS Contractor shall interface with Signaling Contractors for this requirement.

13.13.8 In case of activation of PEI in any of the car by passenger, the camera recording focusing the PEI shall be displayed on the CCTV monitoring screen available in OCC, BCC & DCC and also in TCMS of the specific train. The cameras shall have inbuild zoom function. It shall be possible to filter, zoom and select images in off line mode for investigation purpose. The images shall be with time stamping and it shall be possible to link them with respective location of train.

13.13.9 Similarly, critical events like opening of detrainment door, Fire & smoke inside saloon, opening of driver console desk, obstacle detection by saloon doors, track / catenary / infrastructure events shall also be displayed automatically on the CCTV monitoring screen (TCMS DDU) in train as well as in CCTV screens in OCC, BCC & DCCs. The Contractor shall propose any further list of critical events for this function to occur. Events and logic of automatic popping up of CCTV images of the above events in OCC, BCC DCC and CCH screen in operator's desk shall be submitted for CMRL approval. The Contractor shall submit the above said (i.e., 13.13.1 to 13.13.9) for CMRL approval.

13.13.10 Provision shall be available on demand to remotely view live OCC, BCC, DCCs and in SCR live CCTV streaming directly from Cameras / NVR recordings of any train as per clause 13.13.7. Necessary CCTV display devices in OCC, BCC, DCCs and in SCR for this function shall be provided by the STC Contractor. Provision shall be available to live stream, play-back download video recordings of any train from a single point in the OCC, BCC & DCCs. Necessary software for remote downloading of CCTV video recordings shall be provided to CMRL RS division. RS Contractor shall interface with the STC Contractor as per Appendix C requirements.

13.13.11 The Rolling Stock Contractor shall provide the suitable means for the transmission of video recordings generated by the On-Board CCTV to OCC, DCC and SCR consoles. Necessary hardware for transmitting videos to STC Network shall be provided and installed by Rolling stock Contractor inside the train.

13.13.12 Detailed dimensional, weight and power requirement information for CMRL approval shall be submitted at the time of Preliminary Design Review.

13.13.13 The Contractor shall provide suitable space, mounting provisions, wiring and separate circuit protection for the communication equipment including power supplies. The power supplies shall be fed from the low voltage power supply and emergency storage battery circuit. The Contractor shall use best practices for equipment wiring and network wiring as per the relevant international standards.

13.13.14 The Contractor shall provide and install cables from the communication equipment to the corresponding antennae, using removable connectors at each end of the cable. The cable impedance shall match the output impedance of the equipment. The Contractor shall submit for CMRL approval.

13.13.15 The Contractor shall design the installation of antennae as weatherproof and capable of resisting the carwash. Sealant shall not be permitted.

13.13.16 It shall be possible to remotely download the train CCTV footages from OCC, BCC & from DCCs even when the train is in operation.

13.13.17 Cameras, NVR, Video management software's etc. shall implement band width optimization techniques like multicast transmission, modern codecs (e.g. H.265 or higher) for the efficient and reliable use of wireless network bandwidth available

13.14 UTO Operation

13.14.1 The design of Communications system and its relevant components in train shall support for the UTO / GoA4 in the CMRL Phase 2 corridors defined in Chapter 1. Trains shall be operated in GoA4 / UTO mode from the initial stage of commissioning and revenue operations. Hence all the feed-backs, information and train controls which are available on TCMS screen shall also be available in OCC (operational control Centre) and DCC (Depot Control Centre) for smooth operation of passenger service. The Contractor shall submit the details of controls to be
provided in OCC & DCC for review and approval of CMRL.

Appendix-C 2.3 Train Operating Modes

2.3.11 Identification: Train Operating Mode, Train Description and Next Station Information, etc. a) Positive train Identification (PTI) – The Signalling Contractor shall take the lead to develop a common PTI. The PTI shall be able to be entered by the OCC operator or by Train driver in manual modes, through the HMI in train. The PTI shall include as a minimum the following:

i. Train identification number (Train ID)
ii. Physical car numbers
iii. ATC number
iv. Crew number
v. Passenger destination
vi. Service number
vii. Schedule number Communication between the ATS and Train shall be identified through
this number.
viii. Operating corridor with details of start station and destination station.

b) STC Contractor shall provide Train Identification Number (Train ID) to RS Contractor. This Train ID shall indicate and identify a destination station, originating corridor, destination corridor, door operating platform details of all stations and the service. Train ID shall be allocated to train at suitable place and shall be maintained until it finishes its service. It shall be possible by CMRL to amend and/or modify the Train ID, subsequently, to suit the operational requirements. STC and RS Contractors shall provide necessary equipment and means for the same. RS Contractor shall provide suitable arrangement for Train Operator to view this information displayed on the Frontal display provided on front and other display information inside the train from the operator's emergency desk.

c) Route related passenger information and announcement system:
STC Contractor shall provide below mentioned information to RS system during RM, ATP, ATO, DTO, UTO modes of operation, as a minimum not limited to, about

i. The starting station
ii. The destination station/destination code

iii. Not used.
iv. The train number.
v. Corridor number of operation
vi. Corridor of start station
vii. Corridor of Destination station
viii. The current station
ix. The next station
x. Current station Platform number
xi. Next station platform number
xii. Distance to the next station
xiii. Distance travelled from the current station
xiv. Skip station info.
xv. Next station door opening side.
xvi. Information for RS door inhibition announcement and display.
xvii. Non-passenger train
xviii. End of the trip
xix. Advance information for door opening warning lamp (in ATO/UTO)
xx. Advance information for door closure warning lamp (in UTO)
xxi. Dwell time of each current station
xxii. Cumulative Distance travelled from start station to destination station
xxiii. Corridor 3 - Corridor 5 put together can work as a circular loop. Circular operation is envisaged in this loop along with other linear operations. **The On-board PAPIS system** and the interface provided by the signalling system shall be designed to cater for the circular operation of trains. The strategy for displaying unambiguous information for the train borne passengers shall be proposed jointly by the Contractors to CMRL for NoNO. The strategy for linear operation (with destination concept) and the strategy for circular operation shall be distinct and shall meet the passenger requirement of comprehensive, real time and unambiguous information
xxiv. Service loop is provided between C5 and C4 near Karambakkam station and Valasaravakkam Station (Refer the track alignment). This service loop will be used for the movement of Rakes as well as for the movement of passenger trains**. The On-board PAPIS system** and the Interface provided by signalling system shall be designed to cater for this inter-corridor operation of trains. The strategy for displaying unambiguous information for the train borne passengers shall be proposed jointly by the Contractors to CMRL for NoNO The RS Contractor shall accordingly use the relevant above mentioned information and provide audio and visual information to the passengers which includes exterior displays, saloon displays, indication lights, announcements etc.

Implementation of the automatic route related announcement system of trains shall be functioned by using signalling variables available in train as a main function. Rolling Stock Contractor shall interface with Signalling Contractor for this information. Rolling stock Contractor shall design the software for passenger information announcements such that it shall be possible by CMRL to conduct any changes in the software for change in route or additional information or new sections or new announcements. RS Contractor shall provide necessary equipment and means for the same.

The Rolling stock Contractor shall also have an independent automatic route related announcement system in trains for redundancy purpose. This redundant system shall be functional in all UTO, non-UTO and degraded modes of train operation and shall be designed to have all the functions of the Automatic Passenger announcement system in all the sections of all the corridors 3, Corridor 4 & corridor 5 of CMRL Phase 2 project. It shall

be possible by CMRL to modify the parameters in this announcement system to suit the requirements of passenger operations and new passenger information required.
d) RS and STC Contractors shall exchange information identifying the effective mode, the active or non-active status of each cab, the door status etc. The inputs shall be categorised as vital and non-vital. The levels and form of these inputs shall be coordinated between the two Contractors.
e) RS Contractor shall provide necessary inputs to the STC Contractor identifying the required mode and status of active cab etc. The levels and form of these inputs shall be coordinated between the two Contractors.
f) RS system shall automatically record the log each time the mode is changed using the onboard Signaling
g) In By-pass / Cut-out Mode, immobilization mode or any other mode, external indication light shall flash or occult (in distinct and distinguishable manner). Details shall be finalized during design stage.
h) For UTO & ATO operation, the necessary train command digital inputs signals shall be provided by the STC Contractor. The ATP/ATO/UTO initiated signal demands shall be redundant. The redundancy shall also be provided on TCMS side by RS Contractor. The form of these inputs shall be coordinated between RS and STC Contractors.

Appendix-C 2.4 Interface Requirements

C 2.4.7 There shall be 3 separate radio systems for communication between Train and wayside. The system will broadly cater to Train Radio (TETRA), CBTC Radio and CCTV Radio (Non-CBTC Radio). The radio system (TETRA) for Train Radio traffic shall be provided by the TETRA Contractor primarily for voice communication and for limited system alarms and controls. CBTC radio is for train control functionalities as well as for certain remote-control facilities of the train with ATS which shall be provided by STC Contractor. CCTV traffic is for video streams, alarms and status to ATS as well as for RTR-DMS. CCTV radio shall be provided by STC Contractor. The design of the respective wireless networks, its antennas, its relative positions, other wireless network parameters etc shall take the influence of other radios into consideration.

C 2.4.33 RS Contractor shall supply and install the hardware and software for Rolling Stock Controller (RSC)'s workstation in OCC, BCC and in DCC of each depot in CMRL Phase 2 as a part of Real Time Remote Diagnostic Monitoring System (RTR-DMS). This workstation is in addition to the Rolling Stock work stations to be provided as a part of ATS system and ATS-CCTV system by the STC Contractor. This RSC display shall provide the access for viewing of all train related real time remote fault diagnostic data & RSC display shall also provide the access for controlling of all train related functions in real time during UTO mode as described in Section VI A Chapter 14.11 & 14.13 of RS contract. The GUI of this RSC display shall be similar to the Train TCMS-DDU. Operating related safety signals of train shall be controlled through Signalling system ATS Work station. This shall not be directly controlled through RTRDMS work station.

C 2.4.39 RS Contractor shall provide CCTV cameras in the trains which will cover cab, saloon, front of train, rear view camera, area for passenger-initiated alarm, detrainment door, track, OHE, pantograph and platforms of each station etc. The CCTV cameras video shall be recorded in suitable NVR on board train for a minimum seven continuous days of recording.

C 2.4.40 SIG Contractor shall provide the Communication Infrastructure to Transfer and

display of CCTV streams from on-board to work stations at OCC, BCC, DCC & SCR (within one station vicinity of the train on either ends).

C 2.4.41 RS Contractor and STC Contractor shall interface for control and data transfer of CCTV images from the train to OCC, BCC, DCC & SCR (within one station vicinity of the train on either ends), on the ATS terminal and Large Video Screen. The hardware/software interface shall be furnished and installed by RS Contractor. The CCTV signal shall be provided by RS Contractor at a suitable port on board to STC Contractor for transmission.

C 2.4.42 Predefined /operator defined camera views shall be continuously streamed in OCC & DCC SCR (within one station vicinity of the train on either ends) consoles. The CCTV workstations provided by the STC Contractor shall be capable of live streaming camera feeds in sequence modes of switching between the cameras, manual selection of camera, as well as auto popup facility based on the onboard as well as any way-side trigger.

C 2.4.43 It shall be possible to select any camera on-board and perform the following activity at CCTV terminal/workstation at OCC, BCC, DCC & SCR.
a) Live view
b) Play back of recorded video
c) Export/Download recorded video to the workstation.

C 2.4.44 RS and STC Contractors shall interface to ensure that at least but not limited to following emergency / Operational conditions should result in the event based auto popup of CCTV images of a camera or a predefined set of cameras via CCTV network on OCC, BCC, DCC & SCR (within one station vicinity of the train on either ends). The detail implementation shall be finalized during interface with the approval of CMRL. The utilization of bandwidth of CCTV network shall be managed dynamically.

a) PEI activation
b) Detrainment Door Activation
c) Bogie's Obstacle Detection Device activation
d) Train Side Door Obstacle detection
e) Fire/Smoke Detection inside or outside the train.
f) CCTV Emergency Button Activation
g) Driving console cover open
h) Withdrawal of train from mainline
i) Train to train coupling in mainline
j) Passenger to OCC communication or during Vice versa operation.
k) Door Open - Long stop request operated by any passenger from inside the train (with Long
stop request, increase in the dwell time shall be implemented)
l) Pantograph integrity/obstacle detection
m) Permissive door button activation
n) Derailment alarm
o) Unplanned stoppage of trains owing to on-board or way-side failure.
p) Long stoppages in between stations
q) Trains scheduled to depart to depot/siding from passenger platform for stabling.
r) Mismatch between Train door and PSD door working.

C 2.4.45 The integrated CCTV system shall support transmission of video streams (from

multiple cameras / NVR live or recorded) from train and shall support for changing the video frame rate and resolution for good image quality and in limited bandwidth available for CCTV transmission (80 to 95 mbps approximate). Recording of CCTV footages in train's NVR shall be at minimum 1920 x 1080 and minimum 30 frames per second.
Live Streaming : Dynamically allocated based on the viewing requirement from OCC SW

C 2.4.46 The Levels and protocols for this interface shall be proposed by the STC Contractor and agreed by the RS Contractor in compliance with open interoperability standards in CCTV industry (e.g.: ONVIF). The onboard and wayside equipment of this interface (Cameras, NVR, video management software's etc) shall implement band width optimisation techniques like multicast transmission, modern codecs (e.g. H.264 or higher) for the efficient and reliable use of wireless network bandwidth available.

Appendix-C 2.5 Integrated Testing and Commisioning:

C 2.5.1 RS, STC, Telecom and PSD Contractors shall jointly setup an integrated test bed at CMRL premise to arrange for the integration testing of various subsystems, as a minimum but not limited to ATS, ATO, on-board CCTV management system by signalling Contractor, On-board passenger information system, on-board driver display units, TCMS, On-board NVR, RTRDMS by RS Contractors, station passenger information systems etc of the Telecom Contractors. The test bed shall have provision for testing the actual software over the actual hardware. Necessary train running mimicking simulator shall be provided by the SIG Contractor to simulate a train running. RS Contractors shall provide necessary simulators to simulate various failure and operational scenarios in the TCMS pertaining to the Interface data.

C 2.5.5 RS, STC, Telecommunications & PSD Contractors shall perform static and dynamic mainline Joint Integration Test and tests shall include but not limited to traction and braking control, precision stopping, turn back, jog function, door operation, PSD, train wake up and PAPIS functioning test, remote command & control for Rolling Stock monitoring & troubleshooting from OCC to train and safety related test etc. All Contractors shall jointly produce a protocol document for Integrated Testing and Commissioning..

C 2.5.12 For UTO and other non-UTO modes of operation, the Joint Integration test between the Rolling Stock, Signaling & Train Control, Telecommunications and PSD Contractors shall include tests on mainline to confirm below minimum features:
a) realization of demanded acceleration rate, deceleration rate, Jerk in all UTO and non-UTO modes of operation;
b) train stopping accuracy in stations, wet rail conditions / adhesion levels,
c) synchronization with PSDs;
d) automatic train operation with all the train controls from OCC / DCC of all depots;
e) Train RTR-DMS data transmission to OCC server and display of fault information at OCC and Depot controller console;
f) Verification of alarms and other vital information transmission from train to OCC and vice versa;
g) Passenger to OCC communication and vice versa;
h) OCC triggering of automatic passenger announcement messages (via Train Radio) and manual PA announcements by OCC staff
i) Pre-recorded and manual announcement from OCC
j) Streaming of CCTV videos of train in OCC & DCC

k) Automatic route related passenger announcements in train

C 2.13 INTERFACE- Division of Responsibility

C 2.13.1 RS Contractor shall coordinate with STC Contractors in order to achieve the functional and operational requirements of the system. The roles and activities of the Contractors shall
broadly include minimum but not limited to those mentioned in table below. Apart from the below table, RS and STC Contractors shall also adhere to all the requirements of Appendix C and their referred sub-clauses of Section VI A ERTS-RS mentioned in this Appendix C.

S. No	*Item*	*STC Contractor*	*RS Contractor*
5	Antennae for CBTC, CCTV including special cables etc.	To supply the equipment to the RS Contractors Works.	To provide space in the vehicle design for fixing and installation at the manufacturer's facility, by the RS Contractor, under the supervision of STC Contractor. To provide train lines and Ethernet Connection as per STC Contractors requirement. To provide CPS to STC Contractor.
6	Train lines/Ethernet connection	Furnish the requirement To review the Cable Principle Scheme (CPS). To Verify the installation at RS Contractor manufacturing premises before dispatch the train.	
11	On board next station information to the passengers	Shall provide necessary signals on-board to RS Contractor.	Shall provide for necessary hardware interface, display for on-board P.A and PIS system inside the cars.
16	The polling cycle and delay times assessment between OCC / BCC and on-board VATC / CCTV	The STC Contractor shall assess and furnish to RS Contractor the polling cycle time, data transmission time(rate) between OCC / BCC and onboard VATC / CCTV under best and worst case scenarios for both CBTC and CCTV networks.	The RS Contractor to provide TCMS to VATC / CCTV interface requirements to STC Contractor to comply with functionality as specified in the Rolling Stock contract.
25	Transmission of CCTV footages from Train to OCC, BCC, DCC & at SCR(within one station vicinity of the train on either ends)	STC Contractor shall transmit these footages online to OCC, BCC, DCC and at SCR(within one station vicinity of the train on either ends).	RS Contractor shall store the CCTV footages of train within central video recorder (NVR) in each train.

The subcontractor shall also comply the ERTS Clauses 2.2.31. 2.4.3, 5.9, 6.9.22, 13.2, 13.3, 13.4, 13.7, 13.8, 13.9, 13.10, 13.13, 13.4, 13.7, 13.8, 13.9, 13.10, 13.13, 13.14, Appendix C clauses 2.3.15, 2.4.7, 2.4.33, 2.4.39, 2.4.40, 2.4.41, 2.4.42, 2.4.43, 2.4.44, 2.4.45, 2.4.46, 2.5.1, 2.5.5, 2.5.12, 2.13.1.

Hardware/Software applicable to PA/PIS & CCTV system as per **ERTS-RS Appendix C 2.5 shall be considered.**

During Neutral section Opening/Closing, all system PA/PIS & PSSS functionality will not be affected/ disturbed.

The subcontractor shall fully meet the requirement of ERTS for the proposed PA/PIS & CCTV system for CMRL contract.

The PA/PIS & CCTV system shall fully meet the requirement of EMI/EMC as per ERTS 2.2.29, ERTS 10.19 (EMI and EMC) and ERTS Appendix C 2.12 (EMC/EMI Interface).

All the equipment must comply clause 2.13.1 (a) of ERTS i.e. No degradation of performance shall be permissible during the tests.

The subcontractor shall comply with the Noise & Vibration requirements as specified in ERTS 2.13

The subcontractor shall comply with the RAMS requirements as specified in ERTS 18.5, 18.6 and 18.7.

The sub contractor shall interface with all other aggregate suppliers such as TCMS, ATC, Train Radio, BBRS / CBTC & PSD etc.

It shall be possible to transmit images of on-board CCTV to OCC, BCC via Broadband Radio System (BBRS) / CBTC. Appropriate connectivity (switch /router) for BBRS / CBTC system to cater the above requirement shall be in subcontractor's scope.

The requirement of Passenger alarm and emergency system shall be met as per ERTS 6.7.

Door chime & Door close announcement requirement shall be met as per ERTS 5.4.1(d), 6.4, Appendix-C Clause 2.3.4(i).

The sub contractor shall meet the requirements but not be limited to ERTS 14.1.7, 14.2 with regard to TCMS interface.

The sub contractor shall meet the requirements of CCTV Display Redundancy between CCTV HMI & TCMS VDU as per ERTS 13.13.10.

PAPIS & CCTV system shall have its own data terminal port for fault downloading / software uploading (Including application software/firmware) both at PAPIS & CCTV system and TCMS for single point downloading/uploading as per ERTS 13.13.10 & 13.13.11.

The PA/PIS & CCTV system shall have provision of single point downloading the data log stored in the internal memory using TCMS interface as per ERTS 13.13.10.

The PA/PIS & CCTV system shall have provision of single point uploading of parameters, route / station database, software through TCMS as per ERTS 14.9.5(a).

PAPIS system shall have remote downloading feature for PAPIS database (message, voice, advertisement or LCD contents) as a provision and wiring shall be furnished as per ERTS 13.8.16.3.

Time stamping of date of software(s) as well as version of software(s) used in different subsystems of the train and their compatibility shall be ensured by TCMS as per ERTS 13.13.8.

All the software(s) used in train, diagnostics, monitoring or analysis purpose shall be compatible with latest Windows version and upgradable for higher versions of Windows as per ERTS 14.9.6.

The sub contractor shall be fully responsible for integrated testing and commissioning including Commissioning Type tests and Commissioning Routine tests of the PA/PIS & CCTV system at BEML works (Factory test) and at CMRL site (Depot & Main line tests) for 3-car and 6-car train formation.

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

The sub contractor shall provide all the documents for CMRL project and shall also provide any other documents required by CMRL as per ERTS 13, 16 and Appendix H.

- *Design documents – Preliminary, Pre-final & Final.*
- *Description of PA/PIS & CCTV system with drawings.*
- *Quality assurance plan (QAP)*
- *Software quality assurance plan (SQAP)*
- *Type test procedure for PAPIS & CCTV system and aggregates*
- *Routine test procedure for PAPIS & CCTV system and aggregates*
- *Inspection and test plan (ITP)*
- *Factory tests , Depot tests and main line test procedures*
- *Testing and commissioning plan*

- *Interface plan*
- *Type test and Routine test reports*
- *Operation and maintenance manual*
- *Spare parts catalogue*
- *Special tools & Testing equipment*
- Any other documents requested by BEML/CMRL.

The sub contractor shall provide valid type test certificates/documents and routine test certificates/documents for the PAPIS & CCTV system aggregates.

The supplier shall maintain the PAPIS & CCTV system aggregates and supply of spares for at least 15 years from the date of completion of the contract as per

The supplier shall provide the spares of PA/PIS & CCTV system aggregates as per ERTS CMC 1.5.

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

The subcontractor shall provide the complete software documentation including source code details and developmental details as per ERTS Chapter 20, 20.4 (vii). The software & the source code shall be deposited in a locker and maintained by BEML/CMRL.

Only 110V D.C. (+25%, -30%) would be made available on train for control power supply of PA/PIS & CCTV system. The PA/PIS & CCTV system shall continue to operate correctly with the 110 V DC car battery voltage supply as per ERTS 9.3.4.

The picture quality shall be level E as minimum at 100% Rotakin measured according to EN50132-7 as per ERTS 13.13.1.

The visual images from each camera shall be recorded in non volatile memory without any limitation of repetitive writing of the data. The capacity of the recorder shall be of at least 7 days and shall have the provision of First in First out (FIFO).The memory shall be expandable by simple plug in of commercially available memory media. The recording shall be easily downloadable. The subcontractor shall provide equipment & means for the same. One set of equipment shall be provided to each depot in Chennai (ERTS 13.13.3 & 13.13.6).

The recorder shall be provided (1 No. per driver's cab) with SSD disc of sufficient capacity to record the footage of complete 6-car train for a minimum of 7 days. Provision for expanding the memory capacity by simple plug in of commercially available memory media shall also be available. Each recorder shall be able to record and store 6-car (1 train set)

data for 7 days and also shall ensure redundancy of operation. The recorder shall have provision of safe shutdown during power supply interruption / shutdown.

CCTV system shall have provision (Digital Input) for wirelessly relaying CCTV image in case of emergency condition.

The cameras shall have a mechanism to adjust lens axis to provide proper view of the image.

Subcontractor shall supply protective polycarbonate cover for front facing and detrainment camera which matches with the color / aesthetics of the cab mask design.

The system shall be based on open environment/protocol like Ethernet for ensuring interchangeability of cameras. The system shall have self diagnostics and communicate the same suitably to the maintainer.

All type of cameras and above systems must be of proven design as per ERTS clause 13.13.6 and shall be approved by the Engineer.

Location of the camera and number shall be discussed and finalized during the detailed design discussion.

Compatibility of the system must be ensured if camera from other type/supplier is added without any S/W& H/W change.

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 sub-contractor shall make every effort to minimize the energy consumption of each equipment.

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

One Audio amplifier in each car shall be provided with 4 Nos. of audio output lines to drive 4 (same car) + 4 (adjoining car) saloon speakers and 2 (right) + 2 (left) outside speakers.

All PIS equipment (LED and LCD) shall have a light sensor for automatic brightness control of displays based on the level of ambient light.

TFT displays provided shall be of scratch resistant type against vandalism and shall be provided with tempered glass.

The Ethernet backbone for PA/PIS & CCTV system shall be of ring structure to increase functional availability and to ensure redundancy.

The subcontractor shall ensure that the exterior cameras provide full coverage in a 3-car / 6-car formation. Suitable interface with PSD should be there to ensure the coverage in line with ERTS 13.13.7.

The equipments mounted on the exterior of vehicle shall be provided with cable of min. sslength 500mm along with connector assy.

The exterior cameras mounted on the exterior of vehicle shall have provision of metal wire support with the provision of adjustable hook/clamp to hold the equipment to carbody during removal / replacement of equipment.

Automated Voice Announcement system shall be provided in each cab which shall on hot standby. In case of failure of the identified master, the device at the other end shall automatically become master. The device shall be operable from the train operator's cab.

PEI Communication between Train Operator/OCC/BCC & passengers with PEI shall have a fallback system in case of failure of normal communication channel as per ERTS 13.10.

PAPIS system shall include the activation of Passenger alarm device for those who stands at platform (ERTS 13.10.12, 13.10.13). Apart from the above indication Exterior Side Destination Indicator may be used additionally to indicate the relevant Passenger Alarm Device activation and operation status, If decided by the Engineer.

All PAPIS & CCTV interface signal shall be recorded with time stamp as per ERTS 13.13.8 & 14.3.1.

PEA Communication system shall be SIL2 compliant.

The control logic shall ensure that the vital train control functions (such as couplers, door system, brakes, propulsion power removal, PEA etc.) are executed using conventional relay control and dedicated hardwired train line signals. All vital circuits including above shall be double wire, double break. The identified safety critical signals shall be carried using redundant train line pairs.

Front plate of Passenger Emergency Alarm Units (PEAU) shall be painted to match the color of interior panels with anti-graffiti paint.

All the stainless steel items / enclosures shall be at least of grade SUS 316

Min "Cross-section of 1.5 sq. mm for all cables including serial interface, Fire resistant. Shall be ensured as per ERTS 19.44.

8. Design Submission & Approval Responsibilities

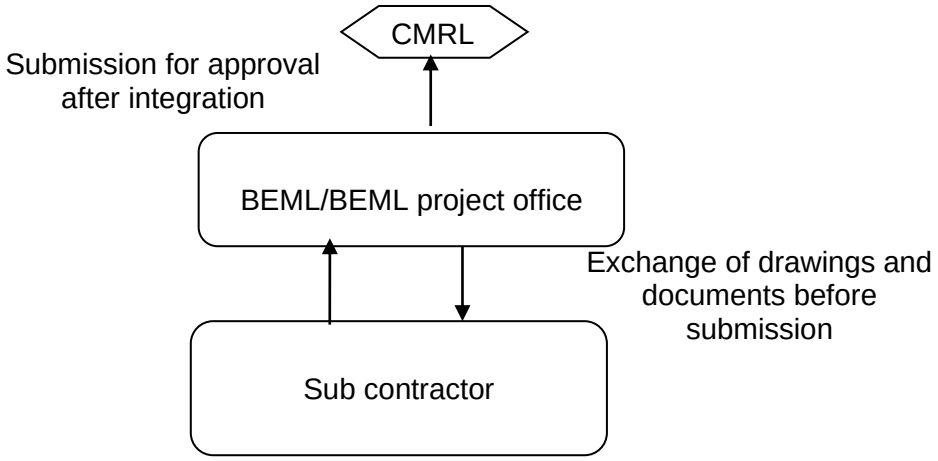
BEML & Subcontractor shall have an approval of their respective drawings and design documents from CMRL in accordance with ERTS-RS appendix G - “Documentation and cad drawing requirements” and ERTS-RS chapter – System support.

BEML & Subcontractor shall be responsible for the approval of design documents and drawings for respective scope of areas. BEML and Subcontractor will exchange their documents and drawings & review the same before submission to CMRL for a preliminary interface checking of mechanical and electrical parameters.

The drawings and documents related to interface shall be combined and integrated with the main principal part of system to form one combined material for submission to the client for approval.

The sub contractor shall comply ERTS-RS clause 16.6 to 16.13.

The work procedure for design submission to be followed is as below:



The sub contractor shall submit three (03) hard copies and electronically (in PMIS) all documents and drawings in agreed format to CMRL/BEML & GC. The sub contractor shall also submit knowledge sharing presentations / drawings / documents to BEML/CMRL & GC.

The documents shall be submitted in the following software unless otherwise stated, for the various electronic submissions required. Any formulae / micros / programmes used therein shall not be hidden / masked and must be visible and transparent without any compromise and shall be validated for the submissions. The following software compatible for use with Intel-Windows based computers shall be used, unless otherwise stated, for the various electronic submissions required:

Document Type	Electronic Document Format
Text Documents	MS office (latest) Professional version
Spread Sheets	
Data Base Files	
Presentation Files	

Programmes Version 2.0a	Primavera for Windows or any latest better tools
AutoCAD Graphics	AutoCAD 2019 (latest)
Photographic	Adobe Photoshop, Ver.4.0 or latest version
Desktop Publishing	Page Maker 6.5,5
CADD Drawings	AutoCAD 2019 (latest)

8.1 Design Information

The Subcontractor shall provide BEML with all necessary documents, drawings, software, reports, calculations, technical data and similar documents of design, system assurance, quality assurance, manufacturing and testing with respect to PTS according to the time schedule.

Detailed design submission list will be finalized during design stage. Further, if any additional documents demanded by end customer /statutory authority same shall be submitted by the subcontractor.

The subcontractor shall maintain the index of submissions with the revision dates & previous submission dates. The index of submission shall be included in every submission, even in case of a single document/ drawing submission.

The drawings and documents shall be written in English with data format of respectively, latest AUTOCAD 2019 (latest), CATIA release.(Document – MS word, Spread sheet – MS excel, Data base files – MS Access, Presentation file – MS Power point).

Three sets of all drawings, test procedures, manuals 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 hard copies and soft copy. The subcontractor shall comply with the requirements specified in ERTS-RS.

General:

The Supplier shall provide, but not be limited to, the following general information in accordance with the schedule approved by BEML before contract award. The subcontractor in accordance with the requirement of PTS shall provide to BEML for review and approval the following information,

a) Project Management Plan
   1) Data Submission Plan
   2) Design Submission Plan
   3) 1st Production Plan
   4) Type Test & FAI
   5) Mass Production after Testing and Delivery Plan
   6) Training Plan
   7) O&M Manual Plan
   8) As Built-In Drawing Plan.

b) Preliminary Inspection and Test Plan (ITP)
c) Preliminary Quality Assurance Plan (QAP)

d) Preliminary Technical system/product/function description (including Lay-Out Drawing)
e) Supplier's Option Suggestion about PTS requirements
f) Clause by Clause commentary for PTS.

Design:

The Subcontractor shall be held responsible to provide sufficient support and information for obtaining No Objection Advice for complete design documents of PDR/PFDR/FDR/FDD including O&M manuals pertaining to PAPIS & CCTV system for the complete 3-car/6-car design in accordance with ERTS-RS. Failure to submit such deliverables in time by subcontractor may attract Liquidated damage as defined in GTC.

The Subcontractor shall comply with ERTS-RS chapter 2 & for PDR design documents submission, PFDR design documents submission, FDR design documents, FDD design documents submission, As-built drawings submission as per ERTS-RS chapter 15, 16 and 17.

The Subcontractor shall comply with PTS, ERTS-RS and shall provide, but not be limited to, the following design information of the PAPIS & CCTV system aggregates in accordance with the time schedule approved by BEML

(a) Detail Documents with Description

Sl. No.	TITLE
1	General Description of PAPIS & CCTV System
2	Technical Description & Drawing of PAPIS System
3	Technical Description & Drawing of CCTV System
4	PAPIS Message List
5	Test Specifications of PAPIS System
6	Test Specifications of CCTV System
7	Factory Level Test Specifications of PAPIS & CCTV System
8	Site Level Test Specifications of PAPIS & CCTV Systssem
9	Test Report of PAPIS System
10	Test Report of CCTV System
11	Factory Level Test Report of PAPIS & CCTV System
12	Site Level Test Report of PAPIS & CCTV System

(b) Test specifications/procedures

Sl. No.	TITLE
1	Type/Routine Test Procedure of PAPIS & CCTV System

(c) Test Specification/Procedures at Car Builder Factory

Sl. No.	TITLE
1	Commissioning test and type test procedure of PAPIS & CCTV System

(d) Test Specification/Procedures at Depot/Mainline

Sl.No.	TITLE
1	Test procedure of PAPIS & CCTV systems on main line (Type tests and Routine tests)
2	Test procedure for PAPIS & CCTV in Depot and Mainline (Type tests and Routine tests)
3	Routine standstill test procedure in depot for PAPIS & CCTV System
4	Any other tests as advised by CMRL/BEML Engineer

(e) List of Type Test Reports

Sl.No.	TITLE
1	Type test report of PAPIS & CCTV System

(f) List of Manuals related to Subcontractor portion only

Sl. No.	TITLE
1	Maintenance Training manual (For Training to Maintenance personnel)
2	Operators Training Manual (For Training to Train Operator)
3	O & M Manuals
4	Fault Diagnostic Manual
5	Software Manual
6	Spares, Special Tools part Manual
7	Training plan
8	As-built drawings
9	**Requirement for management plan** • Project Management plan • Interface Management Plan • Work Management Plan • Quality Assurance Management Plan • EMC Management Plan • System Safety Assurance Plan • Reliability, Availability & Maintainability Assurance Management Plan • Site Safety Management Plan • Software Quality Assurance Management Plan • Environmental Management Plan • Inspection, Test and commissioning Management Plan • DNP Management Plan • Maintenance Plan

(g) Stage wise Submission Documents

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

Sl.No	Description of Stage	Submission from subcontractor to BEML (from LOI / contract award)
1	Preliminary design completion (PDR)	2 weeks
2	Pre final design completion (PFDR)	12 weeks
3	Final design completion (FDR)	40 weeks
4	Final design document delivery (FDD)	80 weeks
5	PAPIS & CCTV equipment delivery to BEML factory	52 weeks
6	Software delivery of Converter-Inverter, TCMS	64 weeks
7	Testing & commissioning of PAPIS & CCTV equipment (Type, Routine, Mainline & Integrated tests)	64 weeks

Note: All above listed stages of Design documents related to scope will be closed up on receipt of CMRL approval certificates.

The subcontractor shall submit, but not be limited to, the following design information.

Design Stage	Document/Deliverables	Submission date required (from LOI / contract award)
Evaluation Stage	Refer to submittals	Along with Technical Offer
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

Design Stage	Document/Deliverables	Submission date required (from LOI / contract award)
		happens.
	Compliance certification to all required Standards of PAPIS & CCTV system	Within 2 weeks
	Concept design Drawings (Dimensional Installation Drawings: Autocad 2019 (latest)	Within 3 weeks
PDR/ PFDR/ FDR	Technical Description (incl. at least following information) : The detailed submission schedule of each item shall be submitted for approval according to required design stage.	Required to keep updating to the latest design.
	- General description	PDR
	- Compliance certificate to Standard applied for design, test & manufacture	PDR/PFDR
	- Detailed Tech. Spec. & data of PAPIS & CCTV system	PDR
	- Construction Details of PAPIS & CCTV system	PDR
	- Spec. & Life of aggregates for PAPIS & CCTVsystem	PFDR
	- The details of aggregates for PAPIS & CCTV system	PFDR(if applicable)
	- Estimated/Measured Heat Transmission value of the PAPIS & CCTV system aggregates	Estimated PDR Measured /PFDR/FDR
	- Estimated/Measured Noise attenuation data	PDR/PFDR/FDR
	- Estimated/Measured weight of all PAPIS & CCTV system aggregates	To update monthly
	- Material List/Spec. & Certification for Fire safety	PFDR
	- Surface Finish Specification	PFDR
	- Equipment Strength Calculation	PFDR
	- Manufacturing tolerance of Equipment	FDR
	- Function Description (Complete documentation along with Signal flow diagram, flow charts, logic flow diagrams, functional blocks, details - of signals interpretations)	PFDR
	- System block diagram	PFDR
	- Preliminary/Final Power Consumption	PDR
	- Constraint of Electric connection	PDR
	- Electrical Function description	PDR
	- Validation report for Specific Energy Consumption value	PDR
	- Operating Instruction	PFDR
	- Preliminary/Final 3D modeling data	PDR/PFDR
	- Cleaning details & maintenance instruction of - Equipment	FDR
	- Safety Analysis	FDR
	- Part list of electronic elements(device) of electronic	PDR

Design Stage	Document/Deliverables	Submission date required (from LOI / contract award)
	unit	
	- Aging test process of electronic unit	PDR
	- Repairing process of electronic unit	PDR
	Preliminary/Final Samples	PDR/PFDR
PFDR	Preliminary Design Drawings (Dimensional Assembly Drawing: AutoCAD (2019 latest)	Within 2 month
	Water-Tightness and Acoustic Improvement Method	Within 3 month
	Caution Instruction for PAPIS & CCTV system aggregates Installation	Within 3 month
	Replacement Instruction & Demonstration	Within 3 month
	Life expectancy of major parts and LRUs	Within 3 month
	Consumables List	Within 3 month
	Preliminary Plan/schedule for Testing & Inspection	Within 3 month
	O&M Manual, IPC submission List	Within 3 month
	Preliminary list of spares, special tools and test equipment	Within 3 month
	List of equipment identification labels	Within 1month
FDR	Final Design Drawings (Dimensional Sub-assembly drawings: AutoCAD 2019 (latest)	Within 6 month
	The manufacturing details of all PAPIS & CCTV system aggregates	Within 6 month
	Installation Instruction of all PAPIS & CCTV system aggregates	Within 6 month
	Cleaning, storage and handling instruction of PAPIS & CCTV system aggregates	Within 6 month
	Maintenance & Inspection Instructions	Within 6 month
	Detailed Test & Inspection Plan/Schedule	Within 6 month
	Type Test Procedure (incl. record sheet) & Report	Within 6 month
	Routine Test Procedure (incl. record sheet) & Report	Within 6 month
	FAI Procedure & Report	Within 6 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 6 month
	Final List of Special Tools, Spare Parts, Test Equipment	Within 6 month
	Draft & Final O/M manuals	Within 6 month
	Draft & Final IPC (Illustrated Parts Catalogue)	Within 6 month
	Training Manuals & Materials	Within 6 month
	Details of equipment identification labels	Within 6 month
	All relevant Operation & Maintenance Information and Training Manual for Special Tools and Test Equipment	Within 6 month
	As-built drawings & List	Within 8 month

Design Stage	Document/Deliverables	Submission date required (from LOI / contract award)
All Stages	Monthly Progress Report including followings at minimum -. 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	Monthly
	Any other design data requested	During design stage

Sl. No.	Document/Deliverables
A	**Preliminary Design submission**
1	General Description of PAPIS & CCTV System
B	**Pre-final Design submission**
1	Technical Description & Drawing of PAPIS System
2	Technical Description & Drawing of CCTV System
3	PAPIS Message List
C	**Product Level Test Report**
1	Test Specifications of PAPIS System
2	Test Specifications of CCTV System
3	Factory Level Test Specifications of PAPIS & CCTV System
4	Site Level Test Specifications of PAPIS & CCTV Systssem

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

All detailed drawings, documents, test procedures; etc. as listed above tables shall be submitted along with the offer. In addition to above, any other documents required by CMRL for approval shall be provided.

8.2 Testing

Refer section 20 of this PTS.

8.3 Operation & Maintenance Manuals and Spare Parts Catalogues

The Subcontractor shall provide the operation/maintenance/ spare parts manuals and spare parts catalogues for the PA/PIS & CCTV system aggregates both in the hard copies and electronic format (editable copy of word document in BEML provided template) as

required in ERTS-RS chapter 15 and appendix G. 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
h) Volume 8 – OEM manuals

The subcontractor shall provide the operation/maintenance manuals and spare parts catalogues to BEML for approval of CMRL according to the time schedule defined by BEML.

Failure to submit the deliverables in time by subcontractor may attract Liquidated damage as defined in GTC.

Submissions
The Supplier shall submit the draft of all manuals to BEML for approval of CMRL/BEML. The final manuals shall be provided after duly incorporating the changes indicated.

8.4 Electronic Manuals

The subcontractor shall provide manuals in electronic format (editable copy of word document in BEML provided template). This is in addition to the submission of manuals in hard-copies.

8.5 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 PAPIS & CCTV system aggregates and supply of spares for at least 20 years from the last date of taking over of whole of Works.
The sub contractor shall comply the requirements specified in ERTS Section lV C – Comprehensive maintenance conctract (CMC) requirements.

Throughout the CMC period, the sub contractor shall always maintain sufficient stock of all Spares and Consumables to the full extent necessary to fulfil all the obligations of the CMC scope and in compliance with the inventory requirements defined in ERTS section lV C Clause 1.5.12.

Spares and Consumables (herein referred to only as Spares) shall include but shall not be limited to the following subcategories, as applicable to both Rolling Stock and Depot Machinery & Plant (including CMV) assets,

a) Unit exchange spares
b) Mandatory spares
c) Recommended spares

d) Consumable spares
e) Special Tools, Jig, Fixtures, Gauges, Testing and Diagnostic Equipment
f) Overhauling Spares
g) Any other items required for maintenance (identified by the sub contractor / BEML / CMRL / OEM).

The list of the above spares, consumables, special tools, special equipment and ordinary tools/equipment shall be as per the agreed design in train configuration and recommendation indicated in the OEM O&M Manuals.

8.6 Storage, Packing Crating and Marking

The subcontractor shall provide all packing, crating and markings in accordance with the requirements specified in ERTS section Vl A chapter 18.5. When handing over, hand over the complete PA/PIS & CCTV system aggregates and the spare parts, special tools and testing equipment.

The subcontractor shall provide the instruction for proper storage, handling and logistic functions of components supplied by the subcontractor before handing over the first complete PA/PIS & CCTV system aggregates. All items shall be labeled with the maker's name and the type and form of the piece or item, discrete serial number and rating, and the date of manufacture of the particular piece of equipment. For detail information refer to ERTS section Vl A chapter 18.5.

8.7 Training

The subcontractor shall provide comprehensive training to the CMRL/ BEML Employer's staff (maintenance, operating, training and engineering) in accordance with the training activities and works for the PAPIS & CCTV system specified in ERTS Section VIA Chapter 15 shall be approved by BEML.
The subcontractor shall provide according to requirement of BEML and CMRL training schedule, time, method and site etc.

The subcontractor shall provide a training proposal, one original and five copies and electronics copies of the training manual for use by CMRL / BEML for conducting in-house training.

The detailed requirements are specified in ERTS Section VIA Chapter 15.
The Subcontractor shall provide the training materials (presentation, student guide, Instructor's guide) and training activity for the required days to assure that the Employer's staff is thoroughly trained in the operation, maintenance, and overhaul of the equipment supplied under this PTS.

The Subcontractor shall propose the required days for the supplied equipment for Operation and Maintenance staffs. Additionally the Subcontractor shall be quoted on daily basis for the further training course for Employer's staffs.

The subcontractor shall submit CV of instructor and training material of proposed training at least 6 weeks in advance of actual training schedule.

Subcontractor shall dispatch the trainer(s) to the end user works/depot and/or BEML's plant for based on the relevant duration of each training course.

The Subcontractor shall provide the training according to BEML's Training Plan for End user.

The Subcontractor shall provide, but not limited to, training materials (Hard copies & Electronic files), tools and equipment.

In addition to the training material, subcontractor shall provide computer based inter-active tutorial module. These interactive tutorials modules may include animation, videos, flash programs, etc.

Repair service training should provide the explanation and practical experience about the technical competence and operation of the system for the trainees who are responsible for troubleshooting and repairs.
Subcontractor should provide training program about operating and maintaining all the system devices provided. Training should be provided enough so that the corporate personnel may practice and learn how to use the operation, interface with other devices and testers.

The program should also contain the theoretical background and practical experiences for troubleshooting, repairing procedure and preventive maintenance to the trainees, who should be provided with the training about personally operating the systems and using testers/maintenance devices in case failing to troubleshoot.
Sub-contractor shall also submit training evaluation module.

The training material and the entire training program shall be approved by BEML.

Subcontractor shall propose necessary hours for each subject.

If End user or BEML request more training courses, subcontractor should provide them.

All expenses for trainings are to be borne by Subcontractor.

The Technical Documents and Training section, specification requires some very specific guidelines for the development of the technical documentation .These guidelines are but not limited to the following:
This section lists extensive requirements for the development and implementation of the training.

(a) Specifies include;
- General Program Outline
- Instructor Manuals with Lesson Plans
- Participant Manuals
- Supplemental training materials
- Training aids
- Classroom attendance requirements

(b) Specific Objectives for operating and maintenance personnel;
- Proficiency in operation, inspections, maintenance, servicing, troubleshooting and repair of cars to instruct and train other personnel
- Qualify individuals as Qualified Maintenance Person (QMP) or Qualified Person (QP)
  i. Daily and periodic inspections
- Understand and effectively use the technical documents developed
- Select, order and stock replacement parts

(c) Course Categories
- Introduction and Familiarization
- Major systems and sub-systems
- Operation and fault isolation
  i. Fault isolation via TCMS/Hardware switches
- Servicing and maintenance
  i. Detail maintenance and fault isolation via TCMS/Hardware switches
- Special tools and test equipment

(d) Personnel by function
- Maintenance
  i. Field – daily inspections and running repairs
  ii. Electrical
  iii. Non-electrical
  iv. Shop – periodic inspection and heavy repair

(e) Classroom and hands-on
- Sufficient time in both to do all diagnostics correct malfunction and use special tools

(f) Instructor qualifications
- Fluent in English
- Experienced trainers
- Adult education techniques

(g) Lesson Plans to include:
- Student prerequisites
- Safety, fault isolation and inspections up to 5 year level
- Time frames for each unit
- List of training aids and other training technology
- Set-up time and equipment lists for hands-on
- Safety, protective equipment, hazards
- Instructor preparation
- Student preparation
- Evaluations of students
- Lesson summary
- Student application of material
- Student assignments

(h) Training Aids and Standards (all training aids and lesson plans become the property of End-User)
- Manuals, catalogs, OEM's
  ii. PAPIS & CCTV system compatible format (no overhead projections)
  iii. Specifics – visual aids
    a) Component locations, cutaways, schematics, wiring diagrams
    b) Flow direction on hydraulic, pneumatic, air conditioning

c) Maintenance schedules, diagnostic process diagrams, special tolls usage, test equipment application
d) Engineer approval electronic medium for review

iv. Simulators demonstration units for hands-on
a) Nomenclature, operation, inspection, maintenance, troubleshooting repairs

v. Training aids list
a) Test equipment considered training aids used to troubleshoot, diagnose, inspect, vehicle operation except meters, meggers, oscilloscopes, laptops)
b) Actual mechanically-operable devices without dismantling – non-examples as diagrams, cut-away views

vi. Schematic wiring diagrams sectionalized – single line functional diagrams for each system and component

(i) Classroom Instruction:
- Outlined in classroom and hands-on information
- Qualified instructors

(j) Field Instruction
- Instructor must be qualified
- All materials available and ready
- Access to cars per authority
- Participants must demonstrate competency

It is subcontractor's responsibility to provide sufficient support and information for obtaining No Objection Advice for Training pertaining to sub-supplier in accordance with GS.

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

The Subcontractor shall depute the technical experts for design review meetings and for technical discussions to sort out design / technical issues whenever required. Following are tentative meetings duration which might be required during design approval.

- CDR meeting: 2~3 days
- PDR meeting: 2~3 days
- PFDR meeting: 5~6 days, two times
- FDR meeting: 8~10 days, two times

Other interface meeting, if necessary with TCMS, Signaling and Telecom

Installation guide for first train: Depending on manufacturing schedule

Testing

- Equipment Type / Routine test (at subcontractor's place)
- Combination test with signaling/ TCMS/ Train Radio at any time whenever required
- Factory Acceptance (Complete car) test: Full support depending on the test schedule
- On-Site (Depot at Chennai & Mainline) Test: Full support depending on the test schedule
- Subcontractor shall provide additional days to resolve faults and defects of PAPIS &

CCTV system.

The Subcontractor shall depute the design engineer(s) / technical experts for design review meetings and for technical discussions to sort out design / technical issues as per above requirements. All costs related to the meetings shall be borne by the Subcontractor.

9. Comprehensive Maintenance during Comprehensive Maintenance Period

The sub-contractor shall at all times throughout the Comprehensive Maintenance Contract (CMC) period, maintain PAPIS & CCTV system of Rolling Stock in accordance with the provisions of the Contract, Applicable Laws, Applicable Permits and Good Industry Practices.
"Spares" and “Tools” shall include all types of Spares and Consumables, Special Tools, Jigs, Fixtures, Gauges, Testing and Diagnostic Equipment, Mechanical & Electrical Measuring and Testing Equipment, Mechanical, Pneumatic and Electric Tools, test benches and any other items required for all types of maintenance activities carried out on Rolling Stock for PAPIS & CCTV system as per ERTS Part- 2: Section VI C, CMC -RS & DMP.

Refer Annexure-A for CMC Spares & Tools Requirement.

Refer ERTS-RS and ERTS-CMC & DNP related clauses of the tender.

9.1 Warranty

Refer ERTS-RS and ERTS-CMC & DNP related clauses of the tender.

10. Subcontractor Responsibilities

The responsibility of the subcontractor scope of equipment and works as described below

Design and engineering works on the major Electrical equipment on the train

- All equipment of subcontractor scope for PA/PIS & CCTV system
- System description and function description of subcontractor equipment
- Earthing information for all equipment
- Cable specification for PA/PIS & CCTV system between subcontractor equipment
- Male & female connectors which are mounted on subcontractor equipment including pins/sockets to be used for the connection of subcontractor equipment
- Cable glands (water-proof type) of each equipment

Functional Design of Electrical System related to PAPIS & CCTV

- Specification and drawing of control system & sequence for overall train control through PAPIS & CCTV.
- Interface specification between PAPIS & CCTV and all Train borne equipment, ATP/ATC/UTO equipment, Train Radio.

- System description, function description and product description for subcontractor scope of equipment.
- Complete list of input/output signals both Analog & Digital
- Cable specification & information for communication between PAPIS & CCTV & other subsystems.
- Earthing information for PAPIS & CCTV equipment.
- Cabling instruction for PAPIS & CCTV (includes shielding and twisting)

Drawings and circuit diagram for subcontractor equipment

- Detail outline drawings of SUBCONTRACTOR equipment
- Circuit Diagrams
  - Power circuit diagram
  - Schematic Diagram of PAPIS & CCTV control circuit
  - Interface circuit of PAPIS & CCTV
  - Line breaker control circuit
  - Fault indicating lamp circuit
  - Anti-skid system
  - Electric loads table
  - Wiring diagram of all scope of equipment
  - Pin arrangement of electric equipment on wiring diagram of subcontractor equipment

10.1 Product and component responsibility

The product and component responsibility of the subcontractor scope of equipment and works as described below:
Product responsibility includes the following;

Design

- Manufacturing and delivery
- Testing (routine and type tests) including submission of test reports
- Delivery according to agreed schedule
- Warranty

Design responsibility includes;

- Meeting the customers specification (According to ERTS-RS of CMRL)
- Meeting the specified standards, Appendix B of ERTS-RS
- Meeting the requirement of RAMS and Hazard Analysis,
- EMI/EMC, noise, fire load, weight management
- Design drawings to be completed for production
- Design drawings (customers documentation) delivery according to schedule
- Strength calculations
- Meeting the technical performance requirements
- Labels and signs
- Documentation (according to tender specification)
- Customers training
- Spare parts lists

- Inspection and test plan
- Test program (routine and type tests)
- Integrated Testing & Commissioning according to ERTS-RS
- Painting specification
- Corrosion protection specification

10.2 Equipment Interface Responsibility

Subcontractor will provide BEML with all required information in order to verify the mechanical and electrical interface between vehicle and subcontractor equipment.

BEML will integrate the complete vehicle circuit diagrams, which will be reviewed and agreed by subcontractor for interface and EMC Consideration.

BEML will provide external wiring installations between the box and other equipment modules. Subcontractor shall supply the miscellaneous parts, such as the anti-vibration mounting resilient pads, nameplates, the test connections with male and female connection including pins/sockets to be used for the external connection of subcontractor equipment.

Interface document made by subcontractor will include, but not limited to, the following interface factors;

- Mechanical Interface
  - Outline dimension.
  - Size and distance dimension of mounting hole
  - Electrical connection position.
  - Fastening Hardware & torque values.
  - Requirement of space for installation and maintenance of equipment.
  - Weight and center of gravity.
  - Earthing position.
  - Thickness of fitting frame/ bracket.Cooling requirement, if any.

- Electrical interface
  - Power requirements
  - Technical specification
  - Rated current &voltage characteristic, power consumption
  - Cable specification (power, control, grounding)
  - Connector (male and female) with pin and socket part no.
  - Signal input/output list.
  - Connector/terminal arrangement
  - Cable inlet/outlet dia. (Size for cable gland of holes)

If the delayed submission of interface documents cause the delay of delivery schedule or cost effect for the Project, Subcontractor shall take full responsibility for it.

10.3 Combined System Test (Integration Test) Responsibility

Subcontractor shall perform the combined system test on combined test bed covering the PAPIS & CCTV equipment and interfaces with the other system in accordance with the specifications of CMRL ERTS-RS.

11. Equipment handling

Subcontractor shall provide the instructions for handling and mounting & dismounting of equipment in Subcontractor scope of supply.

Subcontractor shall designate and mark lifting points taking into consideration centers of gravity and strengths of the equipment cases.

In case of requirements of any special tools for moving and installation of equipment, same shall be informed to BEML and provided before first equipment delivery.

12. Commissioning and testing

Subcontractor shall be responsible for Testing & commissioning and integrated testing for Subcontractor scope of supply.

Subcontractor shall perform type test, routine test and commissioning tests covering Factory test, Depot test, Main line test & service trials of the 3-car/6 car trainsets including the component and completed car tests according to CMRL ERTS-RS.

Subcontractor to submit all type test reports for all the components /aggregates and all the necessary test reports after testing & commissioning in both hard copy and soft copy.

13. Liabilities

Subcontractor will be responsible for the trouble-shooting & rectification/replacement of components/aggregates for their scope of supply during the DNP Period.

14. Technical Requirements

14.1 General requirements

The subcontractor shall be responsible for meeting all the general and technical requirements of the PAPIS & CCTV system as specified in CMRL ERTS-RS. The General Requirements comprising:

i. Interface Activities (ERTS-RS Appendix-C)
ii. Quality Assurance (ERTS secton Vl A 18.8)
iii. System Safety Assurance (ERTS secton Vl A 18.5)
iv. Hazard Analysis
v. Fail safe design
vi. Reliability, Availability & Maintainability (ERTS secton Vl A chapter 15)
vii. Electromagnetic Compatibility (ERTS secton Vl A 17.5.4.9)
viii. Noise and Vibration (ERTS secton Vl A 2.18)
ix. Fire performance and Toxicity Standards (ERTS secton Vl A 2.26)
x. LCC (ERTS secton Vl A 2.27)

14.2 Technical requirements of PAPIS & CCTV SYSTEM

The system requirements for PAPIS & CCTV system aggregates shall be met, but not be limited to, the following in the respective sections in ERTS-RS:

1) General and description of work (ERTS section VI A chapter 1)
2) Design and system Requirements (ERTS section VI A chapter 2)
3) Vehicle body (ERTS section VI A chapter 3)
4) Bogie (ERTS section VI A chapter 11) and coupler & draft gear (ERTS section VI A chapter 4)
5) Pneumatic brake equipment (ERTS section VI A chapter 12)
6) High voltage Electrical System (ERTS section VI A chapter 10)
7) Auxiliary Electrical equipment (ERTS section VI A chapter 9)
8) Train Control Management System (ERTS section VI A chapter 14)
9) Communications (ERTS section VI A chapter 13), VAC (ERTS section VI A chapter 7), passenger doors (ERTS section VI A chapter 6) and lighting system (ERTS section VI A chapter 8)
10) System support (ERTS section VI A chapter 15) and management program (ERTS section VI A chapter 16)
11) Materil and workmanship (ERTS section VI A chapter 19)
12) Welding ,Corrosion , Wires and Cables ,Protection and earthing ,Circuit diagram, Electronic equipment , Printed circuit board and connectors, Microprocessors and software-based equipment , Software , Integrated circuits, Painting
13) Inspection, Tests and Commissioning
14) Interface of TCMS with all the subsystem & train control
15) Interface with all subsystems and designated contractors (Appendix-C ERTS-RS)

15 Project Management

The subcontractor shall assist BEML to smoothly carry out Project management, Co-ordination with designated and other contractors, Design submission, Software management and control, etc according to the requirements specified in ERTS section VI A chapter 16.

The subcontractor shall comply with the detailed requirements to be specified later by BEML/ CMRL if any.

16 Interface Activities

The subcontractor shall comply with the detailed requirements as per ERTS-RS.

17 Quality

17.1 General

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

17.2 Quality Assurance Plan

The sub contractor shall develop and submit Quality Assurance (QA) Program Plan. The QA plans shall include a company policy statement, which defines the authority and role of

QA within the subcontractor's or other suppliers organization, particularly with regard to schedules and cost. The plan shall be formatted in accordance with ISO 9001, which shall be used as the guiding document for all QA activities. Other suppliers QA plans shall be approved by the sub contractor and submitted to BEML during Pre Final Design stage.

Submission of QAP shall not be later than 30(thirty) days after purchase order by BEML. The plan shall illustrate how the Supplier intends to meet the quality assurance requirements of this Technical Specification and shall include as a minimum:

a) An organizational chart, including a definition of the responsibilities of personnel thereon, for receiving inspection, defect material handling (especially related to material found malfunctioning during production conformance testing), production conformance testing verification, process specification implementation, equipment calibrations, etc.
b) The methods and procedures used to control the daily manufacturing processes and material quality.
c) Flow charts of paperwork for the acceptance or rejection of material, for identification and disposition of Unacceptable items resulting from inspections, for the specific accountability of material found malfunctioning during production conformance testing, and configuration verification of the items to be Included in the submittal and etc.
d) Forms to be used to convey, track and account for design changes implemented in the product regardless of their state of completion and any other forms necessary for the program. Each form shall be serial numbered.

The Quality Assurance plan shall have a live document status. Any changes must be submitted to Quality Control team of BEML. Changes affecting the project will be subject to approval by Quality Control team of BEML.

17.3 Organization

The organization of the Supplier's Quality Assurance (QA) Program shall have sufficient, well-defined responsibility and organization. It shall report directly to the General Manager of the Supplier's facility or the Supplier's Project Manager. The QA/QC personnel shall have complete freedom to identify and evaluate problems; to recommend solutions; to verify implementation of solutions; and to control further processing, delivery, or installation of a Non-conforming or deficient item until proper and documented disposition has been obtained.
The QA/QC organization shall be arranged to promote a control function that operates in an independent, objective manner unbiased by schedule, cost, and authority limitations imposed by personnel other than the Suppliers high level management starting with the General Manager or equivalent.

17.4 Certification of Personnel

The Suppliers QA/QC personnel performing inspections and tests shall be certified for such work. Certification of personnel shall be by the virtue of those skills which are obtained by experience or training and verified by testing. Manufacturing personnel performing special processes, such as welding, brazing, painting, crimping, NDT (Nondestructive tests), etc. shall be certified for such work. Records of personnel

certifications shall be maintained and monitored by the Suppliers Quality Assurance personnel. These records shall be made available to the Engineer of BEML for review.

17.5 Evidence of Compliance

The Supplier's QA/QC personnel shall maintain objective, verifiable evidence of compliance with the Technical Specification as it pertains to hardware configuration, purchasing, inspecting, handling, assembling, fabricating, production conformance testing, storing, shipping and warranty/repair work in the interest of quality.

17.6 Certificates Of compliance

The Supplier shall submit to BEML the certificate of compliance for each delivery lot of products. The certificate shall contain inspection/test result data in accordance with the specification of the product. The inspection/test result shall be summarized to an inspection / test report (or record) in which the specification and inspection/test result are described clearly.

And, the inspection / test report (or record) shall contain information, as a minimum, of Product name (description), Part number, Serial number(if specified or necessary), Drawing number, Specification number, Revision number of drawing & specification, Software name(description) & Software version of the product (if software's installed to the product), Barcode number of the product(if barcode system is specified in the specification of product), Project name, Supplier's & Manufacturer's name, Inspection / test date, Acceptance decision, Name & Signature of inspector and approver and etc.

Each shall clearly identify the lot certified by the certificate and be signed by an authorized representative of the Supplier, stating the product complies in all respects with the specification of the product.

Each certificate shall contain the information specified for samples, the name and address of the organization performing the tests, the date of the tests and the quantity of materials shipped and also, if a test is performed by a licensed test laboratory, the test certificate issued by the laboratory shall be attached to the certificate of compliance of the Supplier.

17.7 Calibration

The Supplier shall demonstrate an effective time or usage cycled calibration program for testing of measurement equipment and tools. Validity of measurements and tests shall be ensured through the use of suitable inspection, measurement and test equipment of the range and type necessary to determine conformance of items with the specification. At intervals established to ensure continued validity, measuring devices shall be verified or calibrated against certified standards. Tooling used as a media of inspection shall be included in this program. Furthermore, every device so verified shall bear an indication attesting to the current status and showing the date (or other basis) on which inspection or recalibration is next required. Devices suspected of being out of calibration before the stated recalibration date shall be promptly recalibrated. Inspections performed with devices proven to be out of calibration must be re-inspected. All calibration certifications shall be recorded and become part of the Quality Assurance records.

17.8 Procedure Documents

The Supplier shall establish and maintain written procedures defining his Quality Assurance Program. The procedures shall encompass all phases of the program to include, but not be limited to, control of suppliers, inspection, production and process control, functional testing, discrepancy control, measuring and test equipment calibration, configuration control, quality assurance records, shipping inspection and other quality specifications to meet the requirements of the Contract. All such documents shall be made available to the Engineer of BEML upon request.

17.9 Quality Assurance Activities

The Supplier 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 ERTS section Vl A clause 18.8.

17.10 Procurement

The Supplier shall document in writing the methods to be used for the selection and control of suppliers. These methods shall identify a means of:

a) Selecting qualified procurement sources.
b) Communicating and approving all product quality requirements and changes thereof.
c) Monitoring the supplier's quality performance through the evaluation of procured items against purchase order requirements and/or through audits.
d) Providing for early and effective information feedback and correction of non conformances, especially of items found malfunctioning during production conformance testing.
e) Approving special processes.

The Supplier shall require each supplier to be responsible for maintaining and retaining records. Furthermore, the Supplier shall require each supplier, as a minimum, to submit with each shipment appropriate certifications, final inspection results and test results. Requirements shall be included for chemical or physical testing records in connection with the purchase of raw materials by the suppliers.

17.11 Manufacturing Inspection

Inspection shall occur at appropriate points in the manufacturing sequence to ensure quality consideration for compliance with drawings, test specifications, process specifications and quality standards. BEML may designate inspection hold (or witness) points into the Supplier's Inspection and Test Plan (ITP) upon review of the Supplier's efforts. Inspection/test shall be 100% (one hundred percent) unless there is a specified sampling plan in the specification of BEML. Non-conforming materials shall be identified as discrepant, and shall be segregated and reviewed for disposition.

17.12 Production Conformance Testing

The Supplier's QA/QC personnel shall perform all Production Conformance inspections/tests and verify proper configuration of the equipment inspected/tested. If any item does not satisfy all performance or design criteria, the item shall be re-inspected

retested until the inspections/tests are passed with the necessary adjustments or repairs documented and certified by a witness.

17.13 Receiving Inspection

The Supplier's receiving inspection activities shall provide for the inspection of all incoming materials. These inspection measures shall used to preclude the use
of incorrect or discrepant materials and to ensure that only correct and accepted items are used and installed. All material certifications and test reports used as
the basis for acceptance by the Supplier shall be preserved. Inspection measures shall identify any item at any stage of production to an applicable drawing, specification or other pertinent technical document. Permanent physical identification shall be used to the maximum extent possible.

17.14 Shipping Inspection

The Supplier's Quality Assurance Program shall provide and enforce procedures for the proper inspection of all products to assure completion and conformance as required by the Contract prior to shipment. All shipments shall be prepared as require precluding damage during shipment. The inspections and preparation for shipment shall be verified by the Supplier's QA/QC personnel.

17.15 Ensure Inspection with Latest Revisions/ Changes

The Supplier shall ensure that inspection and tests are based on the latest approved revision or change to drawings and specifications. The Supplier shall ensure that obsolete drawings and change requirements are promptly removed from all points of issue and use. Means of recording the effective points of changes shall be employed.

17.16 Identification of Items using tags etc.

The Supplier shall maintain a system for identifying the progressive inspection status of materials, components, sub-assemblies and assemblies as to their acceptance, rejection or non-inspection. The system shall provide for ensuring that required inspections and tests are performed and that the status of items with regard to inspections and test performance is known throughout manufacturing, installation and testing. Nonconforming items shall be identified by physical segregation and status indicators such as tags, serialization, markings, stamps and inspection records. The identification system shall ensure that only items that have passed the required inspection and tests are used or installed.

17.17 Handling

The Supplier's Quality Assurance Program shall provide for adequate surveillance work and inspection instructions for the handling, storing, preserving, packaging, marking and shipping to protect the quality of products.

17.18 Non-conformance Control

The Supplier shall establish and maintain an effective and positive system for controlling nonconforming material and workmanship, including procedures for its identification, segregation and disposition.
The supplier shall assure that nonconforming materials are not used. To assure prompt Correction, Corrective action Compensation and any necessary actions for any nonconformity caused by the Supplier or Supplier's suppliers, the Supplier shall establish nonconformity control procedure and includes it in the QAP.

All nonconforming issues shall be positively identified to prevent unauthorized use, shipment or intermingling with conforming material.
Corrective action and related information shall be documented and made available to BEML upon request. Corrective action shall extend to the performance of all sub- suppliers and include as a minimum:

a) Immediate response, prompt action and prevention of recurrence for nonconformity.
b) Analysis of data and examination of discrepant products to determine extent and causes with corrective action implemented in an expeditious manner prior the next shipment, order or inspection.
c) Submission of detail documents (specifications, drawings, repair procedure, analyzed data, test/inspection data, measures, action plan and etc) required to resolve nonconformity detected.
d) Introduction of required improvements and corrections, initial review of the adequacy of such measures, and monitoring of the effectiveness of corrective action taken.
e) Analysis of trends in processes or performance of work to prevent nonconforming products.

18 Quality Audit

The Supplier 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 Supplier's QAP. If any Nonconformity is detected during the audit, Corrective Action request will be issued to the Supplier. For the Corrective Action Request, the Supplier shall prepare and submit appropriate action plan within 10 (ten) days, perform the action plan and reply the result to BEML QC team.

18.1 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.

1) The ITP shall include all the major inspection and test activities planned prior and during the design, procurement and installation phases. The (ITP) shall include, as a minimum, the following:
    a) Introduction of ITP (purpose, application scope and etc)
    b) Description of Symbols, Abbreviations arid Definitions
    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 describe & manufacturing flows and inspection/test points.
g) Description of Inspection, test activity and item.
h) Kinds of Inspection and Test such as Design Qualification Verification test (Type 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 and 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).

2) Witness/Hold point of Inspection/Test

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

- 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 Supplier. The supplier can proceed to 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 Supplier to BEML. In case of hold point, Supplier 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) and First Article Inspection (FAI) are designated as the Hold Point.

3) Inspection/Test Notification of Witness/Hold point

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

18.2 System Safety

18.2.1 PAPIS & CCTV System Aggregates

The subcontractor shall provide BEML with all information for the completion of Safety Assurance Plan and also comply with Safety Assurance Plan defined by BEML according to the requirements specified ERTS-RS.

The system requirements for PAPIS & CCTV system aggregates shall be met as per ERTS-RS and shall meet any other requirements indicated by other sub systems supplier to Interface with propulsion system.

18.2.2 System Safety Assurance Management

The subcontractor shall meet the System Safety Assurance Management Plan compliant with the requirements specified in ERTS section VI A chapter 18.
The responsibility of safety assurance for the train level is with BEML.

subcontractor will be responsible for the requirement of safety Assurance for the equipment in subcontractor Scope of Supply and shall follow the BEML/ CMRL guidelines and ERTS-RS for procedures, plans & test criteria.

subcontractor shall comply with the quantitative reliability levels for the equipment group of the train as specified in ERTS-RS.

Subcontractor shall provide Safety Assurance Management Plan to BEML during the preliminary design stage in accordance with ERTS-RS.

Subcontractor shall achieve their reliability targets for their equipment group by the end of the reliability demonstration period.

BEML/ CMRL will review the subcontractor's targets and inform the results to subcontractor.

The responsibility of RAMS for train level will be with BEML. Subcontractor shall be responsible for meeting the requirement of RAMS and hazard analysis for the equipment in the scope of supply.

18.2.3 Safety Requirement

The supplier shall demonstrate that the PAPIS & CCTV system aggregates / Equipment provide adequate protection against other hazards, by showing compliance with the CMRL Hazard Classification Matrix (Refer ERTS-RS). There shall be no hazards associated with the PAPIS & CCTV system aggregates / Equipment which are classified as Unacceptable (risk reduction must be achieved) or Undesirable (high priority to be given to reducing risk in accordance with Principle) Frequency of occurrence of hazards shall be assessed across the whole of the fleet in service.

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

- System Safety assurance plan as per ERTS section VI A chapter 18.
- Hazard Analysis including preliminary hazard analysis, sub-system Hazard Analysis, operating and support hazard Analysis and interface hazard analysis as per ERTS section VI A clause 2.26.
- FMECA (Failure Mode, Effects and Criticality Analysis)
- Fault Tree Analysis (FTA) for Safety Critical Events

The subcontractor shall fully compliance with the RAMS (Reliability, Availability, Maintainability and Safety) requirements given in the ERTS-RS and ERTS-CMC & DNP.

The subcontractor shall comply with the safety requirements set forth in this Contract and particular Applicable Laws including but not limited to 'Metro Railway General Rules (MRGR), 2020 and amendments thereof.

18.3 Hazard Analysis

The subcontractor shall provide the reports of hazard analysis, Fault tree analysis and Failure Modes Effects and Criticality Analysis (FMECA) of the PAPIS & CCTV system aggregates / Equipment and assist the contractor to perform the interface hazard analysis compliant with the requirements specified in ERTS section Vl A clause 18.5.

18.3.1 The Programme of system assurance

System assurance tasks shall include the following:

a) Theoretical system assurance analyses

- Preliminary Hazard Analyses
- Deterministic safety analysis (at system level)
- Interface Hazard Analysis (excluding EMI)
- Subsystem Hazard Analysis
- Operating & Support Hazard Analysis
- Hazard analysis shall provide input to the BEML Hazard log for the train

- FMECA

  The FMECA shall be used to identify the consequences of single failures, and shall identify any failures of the PAPIS & CCTV system aggregates / Equipment for inclusion in the Train Failure Register, which shall be maintained by BEML. The reliability Prediction for the PAPIS & CCTV system aggregates / Equipment shall identify the contribution to system reliability from each of the system failures entered in the Train Failure Register.

  RAM Modelling and Predictions shall be prepared based on data from similar equipment operating in a similar environment. Where such data's not available, predictions may be based on Mil Std and other equivalent generic data sources.

  Safety Verification; The PAPIS & CCTV system aggregates / Equipment supplier shall provide support to the System Engineering Manager as required to Log have been incorporated in the system design and have been confirmed during manufacture and test as required.

b) Safety Verification
c) RAM Testing/ Commissioning
d) RAM Performance Demonstrations
e) Failure Reporting and Corrective Action System

The Hazard Analyses shall provide data for inclusion in the BEML train Hazard Log in the format in accordance with TS.
The FMECA shall be used to identify failures of the PAPIS & CCTV system aggregates / Equipment for inclusion in the Register of Train Failures, which shall be maintained by BEML in accordance with TS.

RAM predictions shall be prepared as an estimate of MTBF, MDBF per PAPIS & CCTV system aggregates / Equipment given the following service conditions:

The detailed MTBF of PAPIS & CCTV system aggregates / Equipment shall be specified by the subcontractor.

18.4 Reliability & Availability

The subcontractor shall comply with the reliability and maintainability requirements prepared by BEML in accordance with the requirements specified in per ERTS section Vl A chapter 18, ERTS section Vl C 3.2 and 3.3.

18.4.1 Reliability Target

The PAPIS & CCTV system aggregates / Equipment shall achieve the reliability targets specified.
The MDBCF (Mean Distance Between Component Failure) per 6 car train-set shall be as follows:

Communication System		
PIS control unit	1,400,000	7.14E-07
Saloon control unit	1,400,000	7.14E-07
Main operational panel	1,400,000	7.14E-07
Cab loudspeaker	1,400,000	7.14E-07
Passenger emergency control unit	1,400,000	7.14E-07
Saloon loudspeaker(SLSP)	1,400,000	7.14E-07
Dynamic route map(DRM)	1,400,000	7.14E-07
37 inches Liquid Crystal Display(LCD)	1,400,000	7.14E-07
Cab switch(CSW）	1,400,000	7.14E-07
Saloon switch(SSW）	1,400,000	7.14E-07
Front display unit(FDU)	1,400,000	7.14E-07
Train number indicator(TNI)	1,400,000	7.14E-07
Side display unit(SDU)	1,400,000	7.14E-07
Saloon camera(SCAM)	1,400,000	7.14E-07

ODD camera(OCAM)	1,400,000	7.14E-07
Track view camera(TCAM)	1,400,000	7.14E-07
Front camera(FCAM)	1,400,000	7.14E-07
Detrainment camera(DCAM)	1,400,000	7.14E-07
Pantograph monitoring camera(PCAM)	1,400,000	7.14E-07
Exterior camera (ECAM）	1,400,000	7.14E-07
Network Video Recorder (NVR)	1,400,000	7.14E-07
External loudspeakers(ELSP)	1,400,000	7.14E-07

* Operation Conditions as per ERTS section Vl A chapter 2
Annual Operation Distance: 150,000 km
The reliability performance shall be assessed by the following measure:

Where, Mean $MDBCF = \frac{\sum \text{Travelled kilometer per train set}}{\sum \text{Number of Service Failures}}$ Distance Between Component Failure (MDBCF): The MDBCF of a system is the ratio of the total operating distance accumulated by the total population of identical items in the available fleet of the trains to the total number of Service failures occurring within the population identical items.

Service Failure: As per per ERTS section Vl A chapter 18, ERTS section Vl C 3.2, 3.3 and ERTS Appendix I, Failures that result in a service operational delay of a specific train for more than 2 minutes at any location of the mainline or during induction from depot to the mainline of CMRL Phase 2 Network. This category of failures also includes an unscheduled withdrawal of a trainset from revenue service.

A list of anticipated scenarios which may lead to an unscheduled withdrawal is provided in ERTS Appendix I of Part 2 Section VIA). It is clarified that when such failures occur, the incident will not be categorised as a Type-1 / Service Failure if the train had continued running until the end of service without affecting punctuality.

The discretion of declaring a train as Not available to start Commercial/Revenue service after successful completion of pre-departure checkout or withdrawing a train from Commercial/Revenue service on account of any relevant failure rests solely with the BEML/CMRL Project Manager & shall be final.

Relevant failure: As per per ERTS section Vl A chapter 18, ERTS section Vl C 3.2, 3.3 and ERTS Appendix I, A relevant failure of an item is an independent failure which results in a loss of function of that item as a result of a fault/defect in an equipment or sub-system of the train while operating within its design and environmental specification limits or a maintenance error by the sub contractor in undertaking its obligations during CMC period. Improper operation, maintenance, or testing of the item as a result of erroneous

documentation supplied by the sub contractor or Failures of transient nature (including those with post investigation status as 'No fault found'), shall be considered as a relevant failure if in the opinion of BEML/CMRL these are attributable to rolling stock. The decision of BEML/CMRL shall be final.

Withdrawal Scenario: The train withdrawal scenario described in per ERTS section Vl A chapter 18, ERTS section Vl C 3.2, 3.3 and ERTS Appendix I and includes possible anticipated failure scenarios which can affect safety, punctuality and passenger comfort. Reasonable changes to the list can be proposed by the subontractor for CMRL's consideration.

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

Deboarding: Any failure attributable to the sub contractor resulting in passenger de-boarding in mid-section or any station. Refer ERTS appendix I

Penalty: For each case of de-boarding of commuters on account of reasons attributable to the subcontractor, CMRL may at their sole discretion impose a penalty as per ERTS section Vl A chapter 18, ERTS section Vl C 3.2, 3.3 and ERTS Appendix I. Engineer's decision to impose the penalty for de-boarding/availability damage shall be final as specified in ERTS section Vl A chapter 18, ERTS section Vl C 3.2, 3.3 and ERTS Appendix I.Same will be imposed on the subcontractor.

18.4.2 Availability Requirements

Definitions

Commercial / Revenue Hours of Operation: This defines the period when trains are expected to run according to a timetable to convey passengers. It is expected that this shall ordinarily be between 04:00 hrs - 00:00 hrs However, CMRL may at its sole discretion apply minor changes to the start / end times to allow for flexibility in the timetable.

Non-Revenue Hours: Defines the period when trains are not required to convey passengers and is expected to be between 00:00 hrs - 04:00 hrs.

Morning Peak Hours: Defines the anticipated morning rush hours, during which shorter headways will be planned. It shall ordinarily be between 08:00 hrs - 11:00 hrs on Weekdays.

Evening Peak Hours: Defines the anticipated evening rush hours, during which shorter headways will be planned. It shall ordinarily be between 17:00 hrs - 20:00 hrs on Weekdays.

Peak Hours: Shall be taken to mean either Morning Peak Hours, Evening Peak Hours or the combination of both as the case may be. CMRL may at its sole discretion apply minor changes to the nominal Peak Hours to respond to changes in passenger demand.

Availability shall be assessed by the following measure:

$$\%\text{Availability} = \left(1 - \left(\frac{DT(SC) + DT(OPM) + DT(CM)}{\text{Total Time}}\right)\right) \times 100$$

Total Time Where:

(i) Total Time is the time in hours during the assessment period multiplied by the total number of trains of the fleet.

(ii) DT (SC), or Down Time due to service checks, is the total down time in hours due to service checks summed over all the trains during the assessment period.

(iii) DT(OPM), or Down Time due to Other Preventive Maintenance, is the total down time in hours due to Preventive Maintenance other than service checks, summed over all sessions carried out on all trains during the assessment period.

(iv) DT (CM), or Down Time due to Corrective Maintenance, is the total down time in hours due to corrective maintenance or retrofit modifications in trains, summed over all sessions carried out on the trains in revenue operation during the assessment period. Any unreasonable delay in handing over the train for repairs for reasons not attributable to the Contractor shall be excluded. Time spent on train integrity inspections after train reformations arising from corrective maintenance work shall be included.

(v) DT(CM) shall be counted starting from the moment when the defective train is handed over to the Contractor and shall end when the train is restored to service condition.

(vi) The down times DT (SC), DT (OPM) and DT (CM) shall also cover the full content of the maintenance work concerned, including safety precautions, inspections, servicing, replacement of equipment, defect detection and rectification, testing and restoration to service condition.

18.4.3 Availability targets

The sub contractor shall ensure that Trains are offered and made available for operation at the respective Depot as per the Train Operation Plan and in accordance with the procedures agreed upon during execution phase. The entire process pertaining to monitoring of Train Operation Plans shall be administered through DCC / PPIO. Detailed procedures for placement and withdrawal of the Trains, daily availability monitoring of trains and anything necessary to apply the above-mentioned requirements shall be finalized and agreed during the execution phase.

CMRL shall prepare the monthly Train Operation Plan (TOP) indicating the scheduled placement and withdrawal timings of Trains from the train handover point and inform the same at least 7 (seven) days before start of each month.

In some emergency / festive scenarios, TOP can be changed subject to condition that it will be informed at least 24 hours in advance and for not more than 15 days in a calendar year.

At the time of major maintenance such as major overhaul of trains, the availability targets as applicable will be revised by CMRL, decision of CMRL shall be final and binding.

The fleet of trains supplied shall achieve a minimum average availability target of 95.0% overall for the assessment durations mentioned in ERTS section Vl C clause 3.3.3.

18.4.4 Availability demonstration during CMC period

The availability of trains shall generally be more than 95% during CMC period.

The average availability of the trains shall be assessed during CMC period under the Contract. The total down times for all trains shall be collected by the CMRL on monthly basis, and the average availability during the preceding three (3) months (assessed quarterly of respective year) shall be worked out from the above-mentioned formula in ERTS section Vl C clause 3.3.1.
The assessment period for the availability calculation shall be scheduled from the actual date of start of CMC Works and assessed separately for each quarter of respective year for the entire duration of CMC period. The su contractor shall submit monthly reports and the calculation of availability demonstration as below,

$$ADQ = (AD1 + AD2 + AD3) / 3$$

Where ADQ is the average availability demonstration of the monthly score AD1, AD2, AD3.
If the availability target mentioned in ERTS section Vl C clause 3.3.2 (e) is not achieved for any assessment period duration, availability penalty/damages is applicable as per ERTS section Vl C clause 3.3.4 of this chapter.

18.4.5 Availability damage

Trainsets shall be considered as 'Available' provided they are offered for revenue service at least 30 minutes prior to the scheduled departure time as per the Train Operation Plan.

As far as reasonably practicable, no trainset shall be inducted on mainline with a defect, the Contractor may however, prepare and submit the list based on previous experience for CMRL review and acceptance.

Penalty / Damages on not meeting Availability targets: Penalties for not meeting Availability targets shall be imposed on the sub contractor through a reduction of the certified payment for Price Center RS-CMC. Availability performance shall be calculated on a Monthly basis. The assessment period against the targets defined in below Table shall be on a quarterly basis throughout the entire CMC period.

SL No.	Availability target	Penalty / Damages
1	> 95%	No penalty shall be imposed during the respective quarter when this target is met.
2	> 93% to ≤ 95%	0.5% Penalty on the respective quarter Price Center RS-CMC apportioned amount.
3	> 90% to ≤ 93%	1% Penalty on the respective quarter Price Center RS-CMC

		apportioned amount.
4	≤ 90%	2% Penalty on the respective quarter Price Center RS-CMC apportioned amount. If availability ADQ is ≤ 90% consecutively for 3 (three) times, the CMC Works is liable for termination as per the provisions of GCC.

18.4.6 Penalties on service failures

Penalties on account of service failures: If train is withdrawn from service as per withdrawal scenario present in ERTS Appendices I of Section VI A Part 2 then penalty shall be imposed on sub contractor as per below table.

Trainset available with delay: A Trainset shall be considered as available with delay if such Trainset is offered with a delay such that it affects its scheduled departure time as per the Train Operation Plan. Availability damages in such cases shall be as per the Number of trip(s) delayed / cancelled as defined and penalty shall be imposed on sub contractor as per below table. CMRL shall return the trains as per TOP ordinarily.

Non-Available Trainset: A trainset can be classified as non-available if the sub contractor is already accruing penalties outlined in SL No. 3 of below table or is attending to a fault/defect (service failure/relevant failure) in the train(s) that are attributable to the sub contractor.

The subcontractor shall comply to ERTS section Vl C 3.3 for availability of trainset for commercial services.

Detailed list of different conditions and corresponding penalty / damages which shall be levied on the sub contractor are outlined below.

SL No.	Conditions	Penalty / Damages per incident (Figures in INR)
1	Passenger De-boarding & Train withdraw in mid-section due to train immobilization	20,00,000
2	Passenger De-boarding & Train withdrawn at station due to train immobilization	15,00,000
3	Passenger De-boarding at any Station, but train not immobilized	1,00,000
4	Train withdrawn at terminal Station during Peak Hour	20,000
5	Train withdrawn at terminal Station during Non- Peak Hour	10,000
6	>2 minutes ≤5 minutes (Trip Delay)	10,000 per trip delay
7	>5 minutes	20,000 per trip delay
8	Trip Cancellation	75,000 per trip cancellation

Note:

1. Penalty / Damage figures shall prevail for the entire CMC Period.
2. Where a failure arising on a single trainset causes scenarios 1 – 5 to occur on multiple Trainsets; only one penalty shall be imposed on the sub contractor derived by the scenario attracting the highest penalty amount.

3. Delays shall be calculated according to the time deviation from Timetable recorded at the destination station (one-way trip). BEML judgement shall be final and binding on the sub contractor.
4. In case of partial trip cancellation, penalty corresponding to 8 of table above shall be applicable on pro-rata basis.
5. The damages mentioned above are calculated on a per train incident basis and shall be recovered by deduction from the certified payment amount for Price Center RS-CMC
6. Escalation of 5% compounded annually shall be applicable for the figures mentioned under Penalty / Damages from the Commencement date of the Contract.

Penalties as defined in Table above shall not be applicable to the sub contractor for delay / withdrawal / de-boarding due to faults in equipment which are maintained by CMRL or other designated Contractors viz. Signalling, Telecom etc.

Incorrect troubleshooting by Train Operators / Attender / Station Controller shall not relinquish the sub contractor from failure attribution.

18.5 Reliability and Maintainability

18.5.1 Maintainability targets

The plan for maintainability shall conform to EN 50126. Reliability of electronic components shall conform to IEC 61709 or equivalent international standards

The sub contractor shall ensure that the design of the equipment and system gives maximum consideration to maintenance, troubleshooting, component removal, repair, and inspection requirements. The objective shall be to minimize maintenance labor and materials costs, passenger car downtime, and the need for especially skilled or highly skilled service personnel.

The sub contractor shall complt the requirements specified in the ERTS section Vl A clause 18.7.

The maintainability of a given maintenance operation shall be measured by the arithmetic mean of the times required to complete a sample of the same operation.

After the maintenance operation the train involved shall be restored to service condition. The mean time to repair
(MTTR) of equipment should be less than the specified value in below table:

SNo.	Equipment	MTTR (Hours)
1	PAPIS & CCTV system:	1.5 (ERTS 18.7.6.2)

18.5.2 Reliability and Maintainability Demonstrations

During Defects Liability Maintenance 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.

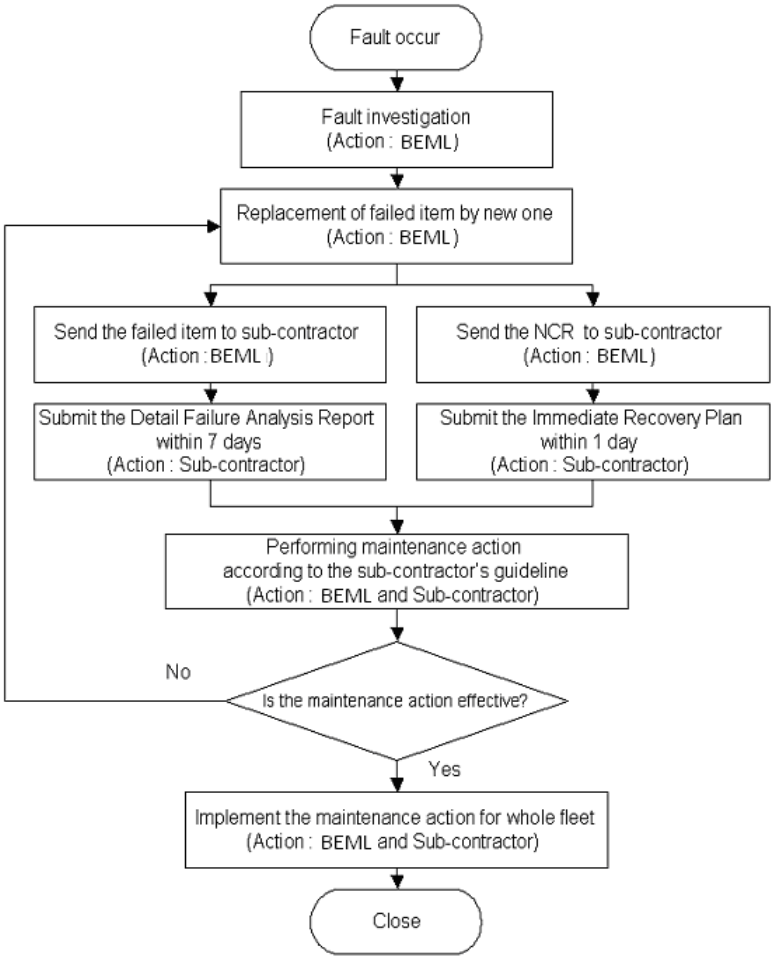


Figure: Maintenance Procedure

The sub contractor shall complt the requirements specified in the ERTS section Vl A clause 18.6.

The sub-contractor shall support an active A/S for high availability. The A/S procedure of BEML is shown in the above figure: Maintenance Procedure. Therefore, the sub-contractor should comply with BEML's procedure. If some failure needed the sub-contractor's support, the sub-contractor should dispatch engineer as soon as possible. Also, the sub-contractor shall impart training to BEML's maintenance engineer.

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.

The subcontractor shall assist BEML to complete a final report to enable the Employer's Representative to assess acceptability of the vehicle and its components for reliability, maintainability and system safety. The detailed requirements are specified in ERTS section Vl A clause 18.5, 18.6, 18.7 and section Vl C chapter 3.

18.5.3 Time required for maintenance

The subcontractor shall comply with the maintenance requirements until DNP.
Preventive Maintenance: Elapsed time to perform preventive maintenance (exclusive of servicing) on each Car shall not exceed 4 hours. Preventive maintenance shall not be required more frequently than every 12,000 km or 45 days, whichever occurs first.

Servicing: Servicing shall be restricted to the replenishment of consumables (such as oil, grease and other fluids); cleaning or replacement of filters; and inspection of brake pads. Servicing shall not be required more often than every 5,600 km or 30 days, whichever comes first, and shall not require more than one hour in elapsed time nor more than two person-hours per car. A 30 day interval will be acceptable for the HVAC filter cleaning under dusty conditions.
Interior and exterior cleaning and refilling of windshield washing fluid containers are excluded from this requirement.

Component Change-Out Requirements: In addition to the above, the sub contractor shall design the equipment or system such that the component change-out requirements listed in Table below can be met. The person-hours are based on fully trained maintenance personnel using standard tools and test equipment.

Item	Maximum Person-Hours
PAPIS & CCTV system:	1.5 Hr

Maintenance Type	Interval (Service time or Running Distance)
A Service Check	15 days or 6,000km
B1 Service Check	45 days or 18,000km
B4 Service Check	180 days or 72,000km
B8 Service Check	360 days or 150,000 km
C1 Intermediate Overhaul1	Minimum 4 years+ or 600,000km+
C2 Periodic Overhaul1	Minimum 8 years+ or 1200,000 km+
C3 Intermediate Overhaul2	Minimum 12 years+ or 1800,000km+
C4 Periodic Overhaul2	Minimum 16 years+ or 2400,000 km+
C5 Mid-life refurbishment	Minimum 18 years+ or 2700,000km+

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

18.5.4 RAMS Deliverables

The subcontractor shall submit the following RAMS Deliverables.

1) RAMS Plan during preliminary design

2) Product Breakdown Structure during Preliminary Design Stage
3) Reliability Analysis with train withdrawal scenarios as per ERTS Appendix-I
4) Reliability Block Diagram and Reliability Prediction during Pre-final Design Stage
5) Hazard Analysis including PHA, Subsystem Hazard Analysis, Operating and Support Hazard Analysis and Interface Hazard Analysis during Pre-final Design Stage
6) Preventive and Corrective Maintenance Analysis during Pre-final Design Stage.
7) Master Maintenance Schedule during Pre-final Design Stage
8) FMECA (Failure Mode, Effects and Criticality Analysis) during Pre-final Design Stage
9) LRUs list during pre-final design stage
10) Safety FTA during Final design Stage
11) Life Cycle Cost Analysis(CM, PM & OH) during Final design Stage
12) List of LRU
13) RAM Analysis (MDBCF, MDBCSF & MTTR)
14) Maintenance Schedule (CM, PM & OH)
15) Reliability Block Diagram (RBD)
16) Hazard Analysis
17) Subsystem Hazard Analysis (SSHA)
18) Interface Hazard Analysis (IHA)
19) Operating Hazard Analysis (OHA)
20) Fault Tree Analysis

18.6 Safety-related System Interference

Special attention must be given to the interference with safety-related operations and equipment such as the signaling systems. Special tests must be designed to ensure that the full range of emissions, whether conducted, induced, or radiated, individually or in combination with one another, conform to the specific requirements of these safety-related systems. Adequate safety margins must be ensured between the immunity levels of these safety-related systems and the emission levels of the rolling stock specified by prevailing international standards.

The subsystems and components which could possibly give rise to the level of emissions under both normal and fault conditions (conducted, induced or radiated) that may affect the safety-related systems must be identified. The quantified risk assessment must be carried out as part of the Hazard Analysis to determine the probabilities and effects of such interference, Measures must be taken to reduce such emissions. The reliability of subsystems and components as well as the additional measures, e.g., filter, must be investigated.
These shall include both long and short-term reliability and shall conform to guidelines given in, but not limited to:

(i) IEC60571 Electronic Equipment Used on Rail Vehicles,
(ii) IEC60300-1 Dependability Programme Management,
(iii) IEC60319 Presentation of Reliability Data on Electronic Components
(iv) IEC60300-3-2 Dependability Management — Pt. 3-2: Application Guide Collection of Dependability data from the Field.

The probabilities of various conditions which could lead to an unsafe operation must be determined. An appropriate technical construction file suitable for safety audit must be developed to demonstrate EMC compliance to the Employer's Representative.

18.7 Design information

18.7.1 General

The Subcontractor shall provide all necessary documents, drawings and etc. for BEML/ CMRL according to the time schedule defined by BEML. The time schedule is defined according to design submission program compliant with the requirements specified . Subcontractor shall provide the interface information and the time schedule required to provide documents shall be indicated.

The detailed requirements are specified in ERTS-RS.

18.7.2 Design and Performance Requirements

The subcontractor shall develop the design based on the specification of ERTS-RS and on sound proven and reliable engineering practices. The design details shall be submitted with technical data and calculations to BEML and CMRL for review and approval.
The design of subcontractor shall meet the requirements specified in ERTS-RS.

18.7.3 Design Submission Requirements

Drawings and CAD data shall comply with the requirements of ERTS-RS.

The documents, drawings and CAD data shall be provided in both paper copies and electronic format in accordance with the requirements of ERTS-RS.

The format and quantity of the documents and drawings shall meet the requirements specified below.

- Document & drawings; the format specified in General specification (Drawing and CAD standard).
- The quantities of the submission of documents, drawings and CAD to be submitted will be specified later by BEML.

If BEML should deem the submission to be unacceptable, the subcontractor shall revise and resubmit the entire submission within two weeks.

18.8 Software

The subcontractor shall provide BEML with all information for the completion of software assurance plan and also comply with the software assurance plan defined according to the requirements specified in ERTS-RS.

Software shall be written in a structured manner and fully documented during all stages of its design and development, with at least two levels of documentation above source code level.

All software to be developed or modified shall follow the standardization requirements of EN 50128 (Railway Applications: Software of Railway Control and Protection Systems).

Independent review, verification and testing, using real and synthetic data shall be performed at the software module and system level. The subcontractor shall specify the software interface testing with the sub-systems along with the Pre-requisites of the testing and the site proposed for testing.
Sufficient software documentation shall be provided to BEML and CMRL a full understanding of the software function and operation.

The subcontractor shall provide all tools, equipment, manuals and training necessary for CMRL to maintain and re-configure all software provided under the contract.

After loading, and the satisfactory functioning of the software, the subcontractor shall supply two back-up copies of the software, including any new versions and adopted.

All test software, with the exclusion of built-in test software, shall be produced in accordance with a quality system controlled under the requirements of ISO 90003.

The detailed submissions to be made to CMRL project and shall be approved by CMRL/BEML.

18.9 Weight

The weight of each component of PAPIS & CCTV system aggregates shall be verified and controlled by the subcontractor in accordance with the requirements specified in ERTS section VI A 2.12.

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

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

The actual measured weights shall not deviate by +/-4% of the estimated weights. Over weight tolerance is not permitted. Any unit exceeding the permissible weight shall be rejected. The weight of each component shall be verified and written in the weight control list as well as on each equipment drawing.
Weight of the PAPIS & CCTV system aggregates shall be furnished by supplier.

18.10 Materials and workmanship

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

The requirements for material and workmanship of PAPIS & CCTV system and TCMS aggregates shall meet the requirements as per ERTS section Vl A chapter 19.

18.11 Operation and Maintenance Manuals and Spare parts catalogues

18.11.1 General

The Supplier shall prepare the Operation Manual, the Maintenance Manual, and the Illustrated Parts Catalogue for the PAPIS & CCTV system. The requirements for Operation/Maintenance manual and Spare parts Catalogues shall be met, but not be limited to, the ERTS section Vl A clause 15.8, 15.9, 15.10, 15.11 and 15.19.

The documentation contains the required information as outlined in this section and its subsections. All manuals and catalogues shall be in the English language.

BEML/ CMRL reserves the right to make any future presentation refinements at the detail level. All materials shall be subject to CMRL final approval.

The Supplier shall submit to BEML/ CMRL for review and approval, five preliminary color hard copies and the electronic copy of the Operations and Maintenance Manuals for all the Systems, sub-systems, equipment, and components supplied under the Subcontract. For the final revisions of the Operations and Maintenance Manuals, the Supplier shall submit to BEML/ CMRL for review and approval. These manuals shall provide comprehensive operating instructions, maintenance instructions, maintenance drawings, and illustrated parts lists for the entire Supplier's System such that every item of the System's equipment can be properly operated and maintained. The information provided in the manuals shall be comprehensive and adequate to accomplish the required tasks and scope of works.

The instructions contained in the Operations and Maintenance Manuals shall be in sufficient detail to enable the CMRL and/or BEML to operate, maintain, and repair each part of the System.

Information contained in the Operations and Maintenance Manuals shall be in pictorial form whenever possible and shall include step-by-step instructions, detailed descriptions, block diagrams, exploded views, photographs, illustrated parts breakdowns, and schematic drawings to facilitate descriptions of assemblies and the relationships of components, sub-systems, systems, etc.
The content of the Operations and Maintenance Manuals shall be thorough, clear, and complete, and shall be presented in language free of vague and ambiguous terms, using the simplest of words and phrases that shall convey the intended meaning. Sentences shall be short and concise. Punctuation shall be used in a manner that aids in reading and prevents misreading.

Programmable equipment and Systems shall be supplied with sufficient flow charts and fully documented programmes to enable faults to be quickly identified and modifications to be undertaken at any time.

18.11.2 Operation Manuals and technical description

The Supplier shall prepare and submit to BEML/ CMRL for review and approval, the Operations Manual for the System. The Operations Manual shall be provided as a stand-alone manual. The Operations Manual shall include, but not be limited to, the following System related content:

(a) Introduction and general information including, but not be limited to, the following items:

- Explanation of the manual's purpose,
- The scope of the manual
- A description of the System and its sub-systems and components
- The features of the System
- The location of the System's controls
- The characteristics and physical makeup of the System with illustrations and exploded views

(b) The theory of operation

(c) The detailed operating procedures including, but not limited to, the following items:

- Adequate operation instructions of the System for a complete start to stop cycle including safety precautions to be observed, preliminary adjustments, alignments, and positioning required, and warm-up procedures.
- The means of connection between equipment components within the System and to other systems.
- The step-by-step procedures to operate the System under normal operating conditions.
- The step-by-step procedures to operate the System under emergency operating conditions, and the list of controls and indicators for the System and the explanation of the function of each (d) The detailed operation planning instructions (i.e., all of the steps required to prepare the basic System for function checks, all necessary steps to perform functional checks, etc.)

(d) The troubleshooting procedures and trouble recognition symptoms

(e) The safety precautions

(f) The functional relationship with other equipment, sub-systems, or systems

(g) The operational limits and restrictions

(h) Illustrations depicting control layout or other pertinent features required to Supplement the description of the operational procedures and instructions

(i) Any other information necessary for proper and efficient operation

These manuals shall be produced specifically for each group of user with due regard to the qualifications of personnel who shall be required to refer to them.

The information contained within the various Sub-system operating manuals and technical descriptions by OEM's shall include, but not be limited to the following:

a. General functional description of the equipment, other relevant or connected equipment and subsystems.
b. Theory of operation of all elements complete with block diagrams/exploded diagrams.
c. Detailed operating instructions.
d. Illustrations depicting equipment locations and layouts together with appropriate nomenclature to facilitate identification of all controls and indications.
e. Common fault handling procedures including recovery procedures where appropriate.
f. Electrical schematic connections within the equipment and with the other equipment.
g. Input – Output pin diagrams for the electronic equipment.
h. Digital interface of each component with TCMS.
i. Network interface of the equipment.
j. Details of software protocols and firmware protocols utilized for the individual equipment.

No later than three (3) months prior to the commencement of Revenue Service, minimum of three (03) hard copies and two (2) electronic copies of all equipments operating manuals and minimum of three (03) hard copies and two (2) electronic copies Technical descriptions by OEMs shall be provided to CMRL. The electronic copies shall be in the original source file format to facilitate future editing.

18.11.3 Maintenance Manuals

The manuals required for maintenance shall be complete and shall include but not be limited to the following:

- Preventative maintenance manuals including work instruction cards and Job Cards.
- Corrective maintenance manuals including fault finding instructions & fault rectification

Equipment Maintenance Manual

a) General standard practices applicable to maintenance and repair of the equipment.
b) Lubrication list.
c) Schematic diagrams.
d) Cleaning agent list.
e) Wiring and cabling diagrams, including interconnection lists with source and destination descriptions for each wire with its unique label.
f) Torque schedule for various types of fasteners.
g) Paint list.
h) Material specification list for various structures and parts.
i) Technical data list for all replaceable items.
j) Applicable special tools and test equipment list.
k) Master schedule for the periodical maintenance and cleaning of all modules / assemblies.
l) Checklist for each level of examinations / overhaul from the lowest level of examination to the mid-life overhaul. The list shall include items of equipment which determine the maximum interval of a particular examination/overhaul and are Safety Critical.
m) Bill of materials for each level of examination.
n) Detailed work instructions for the inspection, reconditioning, testing, adjustment of all assemblies / modules / subsystems for each level of examination / overhaul.

The work instructions shall include all precautions to ensure safety to personnel; and

o) Trouble shooting flowcharts for common failure symptoms.
p) Preventative maintenance manuals including work instruction cards and Job Cards.
q) Corrective maintenance manuals including fault finding instructions & fault rectification instructions up-to the lowest line replaceable unit (first line maintenance)

The Supplier shall prepare and submit to BEML/ CMRL for review and approval, the Maintenance Manual for the System. The Maintenance Manual shall include, but not be limited to the following sections:

(a) Introduction — an introduction to the System and its components.

(b) Functional Description — detailed description and operation, including theory of operation of the System and its components.

(c) Troubleshooting — troubleshooting procedures in a tabular form with headings of Trouble, Probable Cause, and Possible Remedy. All adjustment and alignment procedures shall include tolerances and limits, where applicable.

(d) Inspection and Maintenance — procedures for preventative maintenance, including but not limited to cleaning, lubrication, and adjustment. Inspection requirements shall include procedures and intervals. Schedules shall be in tabular form with headings for Component, Procedure, and Interval. The inspection interval can be expressed in distance or time or both. All test procedures shall be supported by line drawing illustrations, Photographs shall be acceptable for conditions, such as bearing wear, which cannot be clearly illustrated by line drawing illustrations.

(e) Removal and installation: Disassembly and Assembly— procedures for component replacement. Line drawing illustrations shall be used to illustrate the procedures. Procedures for disassembly and assembly of all repairable electrical, electronic, pneumatic, and mechanical components, including the overhaul periods, inspection criteria for the disassembled parts shall also be provided.

The Maintenance Manual shall include, but not be limited to, the following inspection and maintenance sections:

- Corrective Maintenance (fault finding and diagnostics)
- Preventative Maintenance
- Spare Parts List
- Standards
- Special Tools and Test Equipment

The Corrective Maintenance section shall detail all unscheduled servicing actions performed, as a result of a System failure, to restore the System to a specified condition. The corrective maintenance cycle shall include, but not be limited to, failure, localization and isolation, disassembly, item removal and replacement or repair, re-assembly, checkout, and condition verification. This section shall contain sufficient information,

drawings and schematics to allow a suitably qualified person to identify the cause of faults, and shall describe the steps necessary to rectify the fault.

The Corrective Maintenance section shall also specify test procedures required to be carried out after corrective maintenance action on any part of the System in order to verify that the Systems integrity has not been compromised.
The Preventative Maintenance section shall describe all preventative maintenance activities required to achieve the specified performance levels for the life of the System, Preventative maintenance shall include, but not be limited to, and all scheduled servicing actions performed to retain the System in a specified condition. Scheduled servicing shall include the accomplishment of periodic inspections, condition monitoring, critical item replacements, overhaul, adjustment, and calibration, in addition, servicing requirements (for example, lubrication, cleaning, housekeeping, etc.) may be included under the general category of scheduled servicing. The Preventative Maintenance section shall be ordered such that for each level of maintenance the complete instructions to perform that maintenance are included such that each section of the manual is effectively stand-alone; In addition the Preventative Maintenance section shall specify the following:

(a) All preventative maintenance inspections, including limits, settings and Tolerances

(b) All lubrication and cleaning required, including frequency, methods, materials and location

(c) All routine component replacements, including frequency, replacement criteria and methods

(d) All routine reconditioning or overhaul of components including frequency, replacement and methods.

The Spare Parts List section shall provide an Illustrated Parts Catalog for the System supplied and shall contain sufficient information to identify and requisition the appropriate part by maintenance personnel. The Spare Parts List section shall include, but not be limited to, the provision of the following part descriptions:

(1) An alpha-numeric parts list including for each part, as a minimum, the part number, the part description, the part number of the next higher assembly (usually an LRU), a cross-reference to a figure or drawing number, the part category (consumable, LRU, repairable, etc.), and the part life data (expected part life, guaranteed MTBF, MTTR, etc.)

(2) Illustrations to indicate the location of each replaceable item (clear and progressive with exploded views to enable parts to be easily identified from the drawing cross-reference in the alpha-numeric parts list)
(3) A parts price list, in alpha-numeric sequence, that includes, as a minimum, the part price, the lead time, and the part vendor. The Special Tools and Test Equipment section (including gauges) shall identify all special tools, test equipment, gauges, and any other resources required to perform the tasks detailed in the Maintenance Manual. Operating procedures for Special Tools and Test Equipment shall be provided by the Supplier.

Preservation and storage procedures for repaired / overhauled components shall be provided. Testing procedures including test parameters shall be provided. In general, all test procedures shall be supported by line drawing illustrations.

18.11.4 Equipment illustrated Parts Catalogue

The illustrated parts catalogue of all equipment & components supplied and shall contain sufficient information to identify and requisition the appropriate part by maintenance staff. The catalogue shall comprise 3 sub-sections.

The first sub-section shall be an alphanumeric parts list, which shall include the following information:

a) Part number
b) Description
c) Name of manufacturer
d) Quantity and Unit
e) Part number of next higher assembly (usually a line replaceable unit).
f) Cross-reference to figure number.
g) Category: e.g. consumable, line replaceable unit, repairable.
h) Life-expected life, Mean time between failure or mean distance between failure where available.
i) General or specific purpose
j) Purchase and technical specification
k) Equipment hierarchy for the equipment, modules and assemblies, down to component level;
l) A list of components and related parts, including description, component identification code (similar code as used in the equipment hierarchy), name of the original supplier, supplier contact information, supplier's part number and the sub contractor's part number (if different), drawing number; and
m) Cut away drawings and exploded view drawings for identification of all parts.

The second sub-section is a series of illustrations to indicate the location of each replaceable item, which shall be clear and progressive with exploded views to enable parts to be identified easily by cross-reference with the alpha-numeric list.

The third sub-section, an indicative price list which shall list in alpha-numeric sequence the part number with the price, lead time and vendor.
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 BEML/CMRL.

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 portrait).

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 Supplier's) 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.

18.11.5 Software manuals

Software system manuals shall comply to ERTS Section VI A 15.11.6 and consist the below details for all the software used in CMRL trains.

a) Algorithm and flow charts of the software being used in CMRL trains.
b) Revisions of actual software and firmware of all the equipment of train are to be provided.
c) For each software package and each piece of equipment that incorporates programmable devices including all software that has been prepared specifically for this application.
d) Operational environment requirements.
e) Operation procedures.
f) Debugging procedures.
g) Testing and/or simulation procedures; and
h) Verification and/or validation procedures prior to returning to normal operation.
i) procedures to install/uninstall software, downloading of fault logs and other train data from DMS & RTR DMS system (as defined in ERTS Chapter 14), usage of trace files and any other required software trouble shooting details.
j) Usage of Passenger information system with options to modify the audio-visual announcements based on future requirements.
k) Introduction and modification of advertisements, CMRL promotional videos etc. on the advertisement displays in trains.

18.11.6 Submissions

The Supplier shall submit the draft of all manuals to BEML for approval of CMRL/BEML. The final manuals shall be provided after duly incorporating the changes indicated.

18.11.7 Electronic Manuals

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

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

The Documents Management System and Language used shall be subject to Employer's Representative's Review.

18.12 Training

The subcontractor shall provide comprehensive training to the CMRL / BEML Employer's staff in operation, maintenance, and engineering, etc.., of the PAPIS & CCTV system and TCMS in accordance with the training activities and works as per ERTS section Vl A 15.4, 15.5, 15.12, 15.13, 15.14, 15.15, 15.16 and ERTS section Vl B 1.6.

The supplier shall provide according to requirement of BEML and CMRL training schedule, time, method and site etc.

The subcontractor shall provide a training proposal, one original and five colour copies and electronics copies of the training manual for use by CMRL / BEML for conducting in-house training.

Milestone activity	No of Days
Training of Employer's operating personnel in India	5 Man Day
Training of Employer's maintenance personnel at Employer's Metro Rail works (CMRL depot).	100 Man days

19. Testing

19.1 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 ERTS-RS.

The PAPIS & CCTV system aggregates of individual cars and complete train- set (3car/6 car), for three the corridors (corridor 3, corridor 4 and corridor 5) shall be type and routine-tested in accordance with IEC 61133 and other appropriate international standards and in accordance with the requirement specified in ERTS section Vl A chapter 17. Such tests may be performed either at BEML factory, or on site (CMRL Depot & Mainline).

The individual equipment, systems and sub systems, shall be type and routine tested in accordance with the test specifications & test procedures drawn by the sub contractor & agreed by the Project manager (CMRL/BEML). The test specifications shall be based on the requirements specified in respective IEC standard or any other equivalent International standards. After successful completion of tests, sub contractor has to submit the test reports for review and acceptance by the Project manager (BEML/CMRL).
In addition to 'mandatory tests' as prescribed in IECs, BEML & CMRL may also require any of the prescribed 'optional test' to be carried out & any additional tests as required by the statutory authority for obtaining the sanction of rolling stock for passenger service. 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 CMRL, who reserves the right to witness any or all of the tests.

Wherever any equipment, system or sub-system is not specifically covered by an internationally recognized specification or test procedure, or where the type and routine tests prescribed by IEC or other international standard do not adequately cover the

requirement, tests which are acceptable both to the Sub-Contractor and to the Project manager (BEML/CMRL), shall be devised.

Type tests for certain equipment may be waived if these were carried out earlier on equipment of identical design, witnessed by a reputed organization, and the service performance of such equipment was found to be reliable. The subcontractor shall submit a proposal in this regard to the Project manager (BEML/CMRL) for review. The waiver of type test is entirely at the discretion of the Project manager (BEML/CMRL).

However in the event, new vendors / new design are being identified for CMRL project, necessary approval is to be taken from CMRL and type test if any required shall be conducted at sub-contractor's cost.

The subcontractor shall carry out Commissioning Type test on completed train at factory, Depot and mainline for 3car/ 6 car trains as required in ERTS section Vl A chapter 17.

Project manager (BEML/CMRL) reserve the right to witness any or all of the tests, and to require submission of any or all test specifications and reports. Project manager (BEML/CMRL) reserves the right to reasonably call for additional tests as are considered necessary, including the quality of welds particularly in highly stressed areas, by non-destructive testing methods. Prototype tests may be required to verify the suitability of the process or the materials proposed. Project manager may if considered necessary may call for conducting optional tests as per relevant standards without any additional cost to the BEML & CMRL. In case, repeat tests are required to be performed either on account of failure of original tests or failure of the components/sub-systems/system, the cost of the repeat tests shall be borne by the subcontractor. However , cost pertaining to travel & lodging for witnessing the tests of BEML & CMRL representative(s) shall be borne by the Sub-contractor.

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

The Type test of subcontractor equipment and train level will be responsibility of subcontractor, subcontractor shall depute their engineers to conduct the vehicle level type test at BEML Factory and Depot/Mainline for testing as per schedule agreed between BEML & Subcontractor. Subcontractor shall continuously update themselves about the type test schedule of Factory and Site as it may happen that first schedule could not be followed due to rise of unexpected hindrance.

Subcontractor shall arrange all necessary tools & instruments for relevant field test. If there is a problem encountered during testing & commissioning and request dispatching engineer to solve the problem, the subcontractor should dispatch concern engineer within 24 hours.

Subcontractor shall provide full instrumentation to conduct all tests and carry out modifications as required, to ensure that the cars will meet safety requirements. All tests shall be conducted both at full load, and tare conditions, under both new and fully worn wheel profiles and with both fully inflated and fully deflated secondary suspension air springs. The performance of each type of car will be separately evaluated.

Subcontractor shall prepare a report/test results after completion of all tests, which shall be submitted to BEML and CMRL, who will record his conclusions as to whether or not the equipment being tested has passed satisfactorily.
All test procedures, reports including all maintenance activities and check lists shall be submitted and approved by BEML and CMRL.

The subcontractor shall produce a test report, in three coloured copies (hard copy & softcopy), and in an approved format, within a defined period following the test, for acceptance by BEML and CMRL.

19.2 Inspection

The subcontractor shall perform First Article Inspection (FAI) of all the components. The test reports of all the FAI shall be submitted to the Project manager (BEML/BCMRL) for review.

The sub contractor shall meet the requirements specified in ERTS section Vl A 18.9.1 to 18.9.19.

19.2.1 Hold point inspection

The subcontractor shall propose a set of inspection hold points in the Inspection, Testing and Commissioning Plan in accordance with the requirements specified in ERTS section Vl A 18.9.9.

19.2.2 Test Procedure

The test planning and procedure shall be as specified in ERTS section Vl A chapter 17.
Following items shall be complied & all be borne by the subcontractor.

(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.

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 & detailed requirements are specified in ERTS section Vl A chapter 17.

19.2.3 Sequence of Tests

(1) Routine and Type test of equipment and sub-systems in accordance with relevant standard and specifications in Sub-contractor's factories.
(2) Factory and Site Tests (Depot and Mainline) of complete cars in accordance with IEC 61133.

(3) Testing and commissioning of cars/trains in Depot and main line in accordance with IEC 61133.
(4) Integration Tests in conjunction with all Designated Contractors.
(5) Instrumentation and Oscillation Trials on Prototype Train
(6) Service Trials

19.3 Routine and type tests of equipment and sub-systems

19.3.1 Type Test, PAPIS & CCTV system aggregates

This test is required to verify that PAPIS & CCTV system aggregates operates in accordance with the approved design data.

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

Type tests for certain equipment may be waived if these were carried out earlier on equipment of identical design, witnessed by a reputed organization, and the service performance of such equipment was found to be reliable. The subcontractor shall submit a proposal in this regard to the BEML and CMRL for review. The waiver of type test is entirely at the discretion of the BEML and CMRL.

However, in the event, new vendors / new design are being identified for CMRL project, necessary approval is to be taken from CMRL and type test if any required shall be conducted at sub-contractor's cost.

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

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

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

19.3.2 Routine Test, PAPIS & CCTV system aggregates

This test is required to verify that the PAPIS & CCTV system aggregates has been built in such a way that it satisfies the requirements of the Approved Design Data as verified by the Type Test.

Subcontractor shall perform routine test of PAPIS & CCTV system components/ aggregates/ subsystems in accordance with ERTS-RS.

Subcontractor shall perform routine test of equipment/system under his responsibility.

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

Records from Routine test shall be held by the Subcontractor and made available timely for BEML and/or CMRL's inspection.

Copies of the approved routine test results shall be submitted together with the associated log-book. Additional copies of records of all tests/inspections result shall also be held at the Subcontractor work to be made available to BEML and/or CMRL on demand.

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 subcontractor shall perform, as a minimum, but not limited to the following test;

(1) Operation Tests
(2) Visual Inspection
(3) Dimensional Inspection
(4) Performance Test
(5) Shock/ Vibration Test
(6) Dielectric Test
(7) Insulation Resistance Test
(8) EMI/EMC Test
(9) IP classification test
(10) Noise & Vibration test
(11) Combined Test
(12) Other Equipment tests, as applicable for the respective aggregates as per the respective standards.

The subcontractor shall perform above tests on the following Equipment;

(1) Converter - Inverter
(2) Traction Motor
(3) Combined Test of PAPIS & CCTV System as per IEC 61287-1,IEC 61377-1
(4) Arrester
(5) PWM Generator, Display unit (If applicable)
(6) WIFI Unit
(7) TCMS, VDU
(8) Event Recorder
(9) Current transformer
(10) Key box
(11) SSU, PEB

19.3.3 Fire Performance Test

The sub-contractor shall perform the fire performance tests of PAPIS & CCTV system aggregates in accordance with the requirements specified in ERTS section Vl A 2.26 3.14 and EN 45545.

19.3.4 Noise and Vibration Performance Test

The sub-contractor shall perform the noise and vibration performance test of PAPIS & CCTV system aggregates in accordance with the requirements specified in ERTS section Vl A 17.5.4.8.12 and 2.17 and shall submit the type test in the form of 1/3 octave sound pressure level for the noise prediction Analysis.

Sub-contractor to note that the Noise level performance for the CMRL supplies shall comply to the following:

1) PAPIS & CCTV-

- Converter - Inverter sound pressure level (noise) shall be less than 57dB(A) at 7.5m from the centre of car/track, without pure tones in all direction including cooling air exhaust outlet.
- Traction Motor sound power level (noise) shall be less than 101dB(A) train running conditions at speed 80km/h.

The noise specification applies to all speeds upto design speed (90kmph) in both rotation (clockwise and counter clockwise) with no load and Tare load (AW0) conditions. Resonance test shall be performed prior to any other tests to find peak values in noise and vibration by sweeping rotation speed.

If Subcontractor could not meet the above noise levels indicated then the subcontractor shall provide noise mufflers/ silencer/ dual speed blower to reduce the noise emission to bare minimum, the same may be discussed & finalized during design stage.

19.3.5 EMI/ EMC Test

The sub-contractor shall perform the EMI/EMC test of PAPIS & CCTV system aggregates in accordance with the requirements specified in ERTS section Vl A 10.19 or if any other.

All equipment is required to pass the full EMI/EMC tests on one train at locations adjacent to television and radio transmission stations, airport and other transmitting control station. These tests shall include simulated fault conditions.

All system must be tested for emission and immunities in accordance with the appropriate international standards for equipment operating in railway or similar industrial environment.

The subcontractor shall specify the equipment that shall be connected with EMC connectors and the same shall be discussed during design stage.

The sub-contractor shall be complaint of PAPIS & CCTV system equipments for magnetic flux emission norms to human exposure as per EN50500 standard for measurement at train level and EN45502,ICNIRP guidelines for limiting values.

19.3.6 Test Items (Standard) for each System

The Subcontractor shall define show a test level for each test. The Subcontractor shall test his system by the level.

Overall Compliance:

- EN50121:Railway Application – Electro-Magnetic Compatibility – Rolling Stock
- EN50121-1:Railway Application – Electro-Magnetic Compatibility Part 1.General
- EN50121-2: Railway Application – Electro-Magnetic Compatibility Part 2. Emission of the Whole Railway System to the Outside World.
- EN50121-3:Railway Application – Electro-Magnetic Compatibility – Rolling Stock
- EN50121-3-1: Railway Application – Electro-Magnetic Compatibility – Rolling Stock Pt. 3–1 : Train and Complete Vehicle. traction stock, train sets and independent hauled stock. Covers the frequency range DC to 400GHz.
- EN50121-3-2: Railway Application – Electro-Magnetic Compatibility– Pt. 3–2: Rolling Stock Apparatus. Specifies emission and immunity requirements for electrical and electronic apparatus for use on rolling stock. Covers the frequency range DC to 400GHz.

Specific standard:

Test Item		**Standard**	**Remark**
Immunity	Electrostatic Discharge	IEC 61000-4-2	
	Radio frequency fields	IEC 61000-4-3	
	Electrical fast transient/burst	IEC 61000-4-4	
	Surge	IEC 61000–4-5	
	Conducted RE	IEC 61000-4-6	
	Power frequency magnetic field	IEC 61000-4-8	
	Pulse magnetic field	IEC 61000-4-9	
immunity	Damped oscillatory Magnetic field	IEC 61000-4-10	
	Voltage dips, short interruptions	IEC 61000-4-11	
	Oscillatory Waves	IEC 61000-4-12	
Emission	Radiated Emission	EN50121-2 or CISPR16	
	Conducted Emission	EN50121-3-1	

The conducted emission must also satisfy special requirements for ATO/UTO

19.3.7 Software Verification and Testing

The sub-contractor shall perform the independent review, verification and testing at the software module and system level according to ERTS section VI A chapter 20.

The sub-contractor shall perform the software testing on the completed car, unit and train. So, Subcontractor shall be responsible to achieve the performance criteria.

The pre-requisites required for the testing of shall be specified by subcontractor and the means to arrange for the same shall also be considered or informed to BEML prior to the testing.

The subcontractor shall indicate the list of tests that will be performed on the individual equipment, Integrated testing at the vehicle level and at Depot, with the tentative schedule/ the timeline required for completion of the tests.

19.4 Factory and Site Tests of complete cars

The Scope of work (SOW) related to Comprehensive Static, Dynamic & Interface Tests (Type & Routine Tests) and supply of Testing Tools & Equipment refer to Section 4 of this PTS.

19.4.1 Type Test, Completed car, unit and Train Tests

The individual cars, complete units and trains (3 car/6 car) shall be type tested by Subcontractor for PAPIS & CCTV system aggregates in accordance with IEC 61133 and ERTS-RS.

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

Before the Type commissioning Test, Complete Car at the vehicle level, The TCMS combination test for the Electric equipment connected to TCMS using communication shall be performed, with all necessary test equipment except subsystem part prepared by the subcontractor. And the test shall be conducted in accordance with a test procedure to be prepared by the subcontractor and approved by BEML under BEML and/or End User participation. The subcontractor shall submit the combination test details for the test. The subcontractor shall provide the list of subsystem parts prior to the testing, which are required for the TCMS combination test.

Before the Type commissioning Test, Complete Car at the vehicle level, The Subcontractor shall meet the TCMS combination test between TCMS and their equipment. One or several equipment including connector, power, cables and etc should be delivered to TCMS supplier's test placement before the testing period by Subcontractor. Subcontractor's engineer should attend the combination test for technical support, for example software changes or equipment installation, in accordance with TCMS supplier's requirement.

19.4.2 Routine Test, Completed car, unit and Train Tests

The individual cars, units, complete trains (3 car/6 car) shall be routine tested by Subcontractor for PAPIS & CCTV system aggregates in accordance with IEC 61133 and in accordance with ERTS-RS. The Subcontractor shall be responsible for correcting any interfacing defects.

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

19.5 Testing and Commissioning of cars/trains in Depot & Mainline

The Scope of work (SOW) related to Comprehensive Static, Dynamic & Interface Tests (Type & Routine Tests) and supply of Testing Tools & Equipment refer to Section 4 of this PTS.

19.5.1 Type Commissioning Tests in Depot & Mainline

The subcontractor shall carry out commissioning Type Test on the complete 3 car/6 car trains in accordance with IEC 61133 & ERTS-RS.
The subcontractor shall carry out the Commissioning Type Tests for PAPIS & CCTV system & TCMS to adequately demonstrate that the same meets requirements of ERTS-RS of CMRL. The commissioning Type tests shall include tests on the train in accordance with IEC 61133.

The Subcontractor's design engineer shall also participate in this testing to ensure that PAPIS & CCTV system meet the performance requirements specified at the contract and do not introduce any adverse effects into the railway and its environment. This testing shall demonstrate compatibility between PAPIS & CCTV system aggregates and the interfacing systems including signaling and telecommunication system. The Subcontractor shall be responsible for correcting any interfacing defects.

All test essential for Safety Certification and technical clearance of Metro systems by CMRS/RDSO/Statutory authority shall be carried out for PAPIS & CCTV system by the subcontractor and test reports as per the format insisted by CMRS/ RDSO/Statutory authority shall be submitted.

The other tests are described as followings and the acceptance criteria shall be defined by Subcontractor.

- Interface Combination Test with TCMS
- Specific Energy consumption (SEC)
- Schedule run Test with Declared schedule speed
- Temperature rise Test
- Starting Resistance & Running Resistance
- Any other tests, as advised by the CMRL Engineer

19.5.2 Routine Commissioning Tests in Depot & Mainline

Commissioning Routine Test on the complete 3 car/6 car trains shall be carried out in accordance with IEC 61133 & ERTS-RS chapter.

Train will be commissioned at an appropriate time. The Project Manager will witness certain of these tests to satisfy himself that the PAPIS & CCTV system are acceptable for operating in passenger service. The commissioning shall include tests on the train in accordance with IEC 61133.

These tests will be a subset of those tests performed at Type and Commissioning Test to demonstrate that the principal features of the PAPIS & CCTV system are compliant with the ERTS-RS. This test shall include but not be limited to a test of all safety system.

Subcontractor shall provide the source details along with Type/Make , specifications for test instruments required for Vehicle Type, Routine Test for PAPIS & CCTV System.
Subcontractor shall provide training for BEML Engineers for carrying out Type/routine test with detailed documentation for instrumentation setup, configuration settings of test equipment's , analysis/reading of data., support.

19.6 Integration Test

The Scope of work (SOW) related to Comprehensive Static, Dynamic & Interface Tests (Type & Routine Tests) and supply of Testing Tools & Equipment refer to Section 4 of this PTS.

Integration test shall be carried out according to ERTS-RS at designated depot and mainline. The subcontractor shall submit all necessary information, test procedures and check sheets for the integration test for approval of CMRL/BEML.

The subcontractor shall also perform all those tests that are considered to be in the scope and was performed in the past indian projects or as advised by BEML/ CMRL engineer.

19.7 Instrumentation and Dynamometer Tests and Oscillation Trials

The Scope of work (SOW) related to Comprehensive Static, Dynamic & Interface Tests (Type & Routine Tests) and supply of Testing Tools & Equipment refer to Section 4 of this PTS.

Prototype train shall be subjected to Instrumentation Tests, Dynamometer Tests and oscillation Trails after Commissioning and the same shall be carried out by the subcontractor in accordance with ERTS-RS if required by CMRL.
The subcontractor shall submit all information for the tests to BEML.

19.8 Service Trials

The Scope of work (SOW) related to Comprehensive Static, Dynamic & Interface Tests (Type & Routine Tests) and supply of Testing Tools & Equipment refer to Section 4 of this PTS.

BEML shall perform the service trial as per ERTS-RS with the support of subcontractor.

The PAPIS & CCTV system supplier shall supply the sufficient information and assistance according to ERTS-RS.

The subcontractor shall submit all information for the service trials to BEML.

20 Defect Notification Period (DNP) / Defect Liability Period (DLP) / Warranty

1. Refer General Conditions & ERTS and related clauses of the tender.

2. Sub-contractor shall ensure minimum spare parts that he intends to make available during the installation, erection, commissioning and DNP/DLP/Warranty period.
3. The sub-contractor shall keep on site, throughout the installation, erection, commissioning and warranty period, stocks of spare parts, to enable rapid replacement of any item found to be defective or in any way in non-conformance with the specification.
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21 Others

The delivery format of all deliverables (design submission, maintenance manuals, training manuals and etc) shall be approved by BEML/ CMRL.

Any discrepancy in specifications can be clarified after the discussion between BEML and the subcontractor.

22 Submittals – Technical Offer

The sub contractor shall provide the following as part of technical offer for technical evaluation,

1) Complete Technical offer for PAPIS & CCTV system along with drawings.

2) Clause wise compliance against the following,

a) PTS - Doc no. GR/TD/7061.

b) CMRL ERTS (Refer "Compliance Matrix_ARE02A _Section VI A_ERTS-RS")

c) CMRL Project Wide Interface Document (Rollingstock Interface)

- Compliance Matrix_ARE02A _Section VI A_ERTS-RS document shall be filled as per the provided format i.e. category, Method of compliance, Sub-system, Document Reference.
- Please refer to the sheet 'Set List' in the Compliance Matrix_ARE02A _Section VI A_ERTS-RS document for the source list to be used in filling ssall the chapters of ERTS.

Offers with Non-compliance and deviations to any of the ERTS,

PTS & Interface clauses with regard to PAPIS & CCTV are liable for rejection.

23 List of Documents and Drawings attached- Appendices/Annexures

1. **ERTS CMRL phase-2 ARE02A**

2. **Compliance Matrix_ARE02A _Section VI A_ERTS-RS**
3. **Vendor approval form.**
4. **RAMS formats**
5. **LCC format**
6. **Submittal check list**
7. **Specification of ECN, ICD & SDT protocol**
8. **Annexure-A (CMC SPARES & TOOLS REQUIREMENT)**

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