

**DESIGN, MANUFACTURE, SUPPLY, TESTING, COMMISSIONING AND
TRAINING OF 378 NOS. OF STANDARD GAUGE METRO RAIL CARS
FOR MUMBAI METRO RAIL INVESTMENT PROJECT**

**CONTRACT AGREEMENT
CONTRACT 'MRS1'**

PART-I

SUPPLY REQUIREMENTS

**APPENDICES TO EMPLOYER'S REQUIREMENTS:
GENERAL SPECIFICATIONS**



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APPENDIX 1**PROGRAMME****1 Time-Scaled Network/Bar Chart**

- 1.1 All programmes shall be developed by computerised Critical Path Method (CPM) using the Precedence Diagramming Method (PDM) and shall be presented in either bar chart or time-scaled network diagram format, suitably coloured to enable easy reading. All duration for the purpose of programming shall be in calendar days. All reference to network shall mean time-scaled network unless otherwise specified.
- 1.2 Not Used.
- 1.3 The coding structure shall be such that the activities can be summarised to the various levels. Each level shall be summarised and collapsed to the next level using the programming software. The Contractor shall propose essential codes and activity codes to be used for review of the Engineer. The Engineer may require additional activity codes subject only to restrictions imposed by the programming software. Additional codes where necessary may be created by the Contractor with the approval of the Engineer. Each activity in the network shall be coded, as a minimum, with the following:
 - (i) Contract number, activity type, and unique identification numbers.
 - (ii) Activity codes to indicate Unit, Segment, Stage or Phase, for e.g. design, manufacturing, delivery, installation, etc.
 - (iii) The Contractor shall note that breakdown of system into sub-systems is essential and shall be carried out not through further coding but through activity descriptions in a consistent manner such as to allow storing. However, the Engineer shall have the right to require the Contractor to code sub-systems, using codes approved by him, if necessary.
 - (iv) Area, location and location details under Activity Code – Unit.
 - (v) Cost and resources.
 - (vi) Cost and resources codes shall be submitted for the approval of the Engineer. For tender purposes, the Tenderer shall use his own codes.
- 1.4 All logical and necessary relationships between activities shall be shown.
- 1.5 All key dates indicated in the Contract shall be shown. In addition to the key dates, the Contractor may require certain events that are critical to his work to be reflected in his programmes. These shall be reflected as "milestones". Appropriate activity codes shall be used to distinguish "milestones" from the key dates.
- 1.6 The level of programme development, information and detail shall be sufficient to permit the Engineer to have a good appreciation of the Contractor's project management plan especially with regard to the co-ordination and timing of his work in relation to the work of the other Designated contractors and the obtaining of necessary approvals from the relevant local authorities. It shall demonstrate ability to meet specified key dates through a logical work sequence that has taken account of the Project constraints.
- 1.7 Activities pertaining to review/acceptance by the Engineer and local authorities shall be identified. Where duration for review of the Contractor's submissions are specified elsewhere in the Contract, they shall be used. Where they are not specified, a duration of 30 days for review of each submission shall be used.
- 1.8 Activities outside the scope of the Contract that may affect the Contractor's progress shall be shown.
- 1.9 The activity network shall be organised so that major work sections are carefully co-ordinated with the Civil Contractor and the System-wide Contractors to allow opportunity for all to work with as minimal disruption as possible.
- 1.10 Critical paths shall be identified.



1.11 Activity descriptions shall be brief (< 48 characters) and shall convey the nature and scope of the work. Uncommon abbreviations shall be explained in the legend. Float time shall be distinguished from schedule performance.

1.12 The CPM Network Diagram shall be developed to permit modification to the schedule and allow for impacts on the schedule to be analysed by introduction of "what if" statements into the input data.

2 Time Scaled Network/Bar Chart Details

2.1 Design

The Design network/bar chart shall detail the various design, submission and acceptance stages including approval by local authorities and the Engineer, preparation, submission and approval of drawings, manuals and all other activities related to the design.

2.2 Manufacturing

The manufacturing network chart shall indicate the relationship and duration of the activities necessary to procure, fabricate manufacture, assemble equipment/complete car tests, ship and deliver Rolling Stock in time to support the activities at site. It shall establish milestones for monitoring the progress of the manufacturing process. Major areas of work shall be shown as separate and distinct activities. The network shall also cover activities of Sub-Contractor as appropriate, including testing.

2.3 Testing and Commissioning

The Factory and On Site Testing and Commissioning network/bar chart shall present the relationship and duration of those items relating to Commissioning tests including those related to other Designated Contractors. The network/bar chart shall present testing approach to be used, the deployment of resources in accordance with train delivery dates.

2.4 Instrumentation Tests for Prototype Rake

Instrumentation Tests network/bar chart shall indicate that activities related to Instrumentation Tests, including Oscillation Trials, followed by Statutory approval, on the Prototype Rake including those related to Designated Contractors.

2.5 Integrated Testing

The Integrated Testing network/bar chart shall indicate the activities required to verify the functioning of the Rolling Stock in conjunction with activities of the System-wide and Civil Contractors.

2.6 Service Trials

After completion of Commissioning, the Contractor shall be required to carry out service trials.

The network/chart shall indicate tests, measurements and interface tests required to be carried out to verify system performance and readiness for revenue service.



APPENDIX 2**MONTHLY PROGRESS REPORT****1 Contract Stages****1.1 General**

The Contractor shall submit to the Engineer, a Monthly Progress Report. This Report shall be submitted by the end of each calendar month and shall account for all work actually performed from 26th day of the last month and up to and including the twenty-fifth (25th) day of the month of the submission. It shall be submitted in a format to which the Engineer shall have given his consent and shall contain sections/sub-sections for, but not be limited to, the topics listed in clauses 2 to 10 below.

2 Financial Status

- 2.1 A narrative review of all significant financial matters, and actions proposed or taken in respect to any outstanding matters.
- 2.2 A spreadsheet summarising each Cost Centre, the budget, costs incurred during the period, costs to date, costs to go, cost forecast (total of costs to date and costs to go) and cost variance (difference between cost forecast and budget).
- 2.3 A spreadsheet indicating the status of all payments due and made.
- 2.4 A report on the status of any outstanding claims. The report shall in particular provide interim updated accounts of continuing claims.

3 Physical Progress

- 3.1 It shall describe the status of work performed, significant accomplishments, including critical items and problem areas, corrective actions taken or planned and other pertinent activities, and shall, in particular, address interface issues, problems and resolutions.
- 3.2 It shall include a simplified representation of progress measured in percentage terms compared with percentage planned as derived from the Works Programme.

4 Programme Update (For Entire Project)**4.1 Programme updating shall include:**

- (i) The monthly Programme Update which shall be prepared by recording actual activity completion dates and percentage of activities completed up to the twenty-fifth (25th) of the month together with estimates of remaining duration and expected activity completion based on current progress. The Programme Update shall be accompanied by an Activity Report and a Narrative Statement. The Narrative Statement shall explain the basis of the Contractor's submittal:
 - (a) Early Work and Baseline Submittals – explains determination of activity duration and describes the Contractor's approach for meeting required Key Dates as specified in the Contract.
 - (b) Updated Detail Programme Submittals – state in narrative the Works actually completed and reflected along Critical Path in terms of days ahead or behind allowable dates. Specific requirements of narrative are:
 - If the Updated Detailed Work Programme indicates an actual or potential delay to Contract Completion date or Key Dates, identify causes of delays and provide explanation of Work affected and proposed corrective action to meet Key Dates or mitigate potential delays. Identify deviation from previous month's critical path.
 - Identify by activity number and description, activities in progress and activities scheduled to be completed.
 - Discuss Variation Order Work Items, if any.
- (ii) The Programme Status which shall:



- (a) Show Works Programme status up to and including the current report period, display Cumulative progress to date and a forecast of remaining work.
- (b) Be presented as a bar-chart size A3 or A4 and as a time-related logic network diagram on an A1 media, including activity listings;
- (iii) The Activity Variance Analysis which shall analyse activities planned to start prior to or during the report period but not started at the end of the report period as well as activities started and/or completed in advance of the Works Programme.

5 Milestones Status

- 5.1 A report on the status of all Milestones due to have been achieved during the month and forecasts of achievement of any missed Milestones, and those due in the next month.

6 Three Month Rolling Programme

- 6.1 The monthly issue of the Three Month Rolling Programme.

7 Planning and Co-Ordination

- 7.1 A summary of all planning/co-ordination activities during the month and details of outstanding actions.
- 7.2 A schedule of all submissions and consents/approvals obtained/outstanding.

8 Procurement Report

- 8.1 A summary of all significant procurement activities along with the purchase technical specifications during the month, including action taken to overcome problems.
- 8.2 A report listing major items of plant and materials, which will be incorporated into the Works. The items shall be segregated by type as listed in the Specifications and the report should show as a minimum the following activities:
- (i) Purchase Order Date - Scheduled/Actual,
 - (ii) Manufacturer/Supplier and Origin,
 - (iii) Letter of Credit Issued date,
 - (iv) Manufacturer/Supplier Ship Date - Scheduled/Actual,
 - (v) Method of shipment,
 - (vi) Arrival date in India- Scheduled/Actual.

9 Production and Testing

- 9.1 A review of all production and manufacturing activities during the month.
- 9.2 Summaries of all production and manufacturing outputs during the month together with forecasts for the next month.
- 9.3 Review of all testing activities (both at site or at the manufacture's premises) during the month.

10 Safety

- 10.1 A review of all safety aspects during the month including reports on all accidents and actions proposed to prevent further occurrence.

11 Environment

- 11.1 A review of all the environmental issues during the past month to include all monitoring reports, mitigation measures undertaken, and activities to control environmental impacts.



APPENDIX 3

PROPOSED KEY DATE SCHEDULE FOR -TENDER 'MRS1'

Please Refer 'Attachment to Appendix FB-1' of 'Form of Bid' (Part-I, Section-4 of Bidding Forms).



APPENDIX 4**DRAUGHTING AND CAD STANDARDS****1 Introduction**

- 1.1 The purpose of this document is to define the minimum Draughting and CAD standard to be achieved by the Contractor for all drawings and documents produced by the Contractor for the purpose of the Works.
- 1.2 By defining a common format for the presentations of drawings and CAD files, the exchange of drawn information is improved and will maximise the use of CAD in the co-ordination process.
- 1.3 All submissions shall be made to the Employer's Requirement in a format reviewed without objection by the Employer's Requirement and in accordance with the requirements in:
- (i) The Contract
 - (ii) The Document Submittal Instructions to the Contractors.
- 1.4 Paper and drawing sizes shall be "A" series sheets as specified in BS 3429.
- 1.5 The documents shall be submitted in the following softwares 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:

<u>Document Type</u>	<u>Electronic Document Format</u>
Text Documents	MS office (latest) Professional version
Spread Sheets	MS office (latest) Professional version
Data Base Files	MS office (latest) Professional version
Presentation Files	MS office (latest) Professional version
Programmes Ver 2.0a	Primavera for Windows, Ver.2.0b, Suretrack
AutoCAD Graphics	AutoCAD 2013 (latest)
Photographic	Adobe Photoshop, Ver.4.0
Desktop Publishing	Page Maker 6.5,5
CADD Drawings	AutoCAD 2013 (latest)

- 1.6 Media for Electronic File Submission
- One copy shall be submitted unless otherwise stated in CD-ROM.
- 1.7 Internet File Formats/Standards
- (i) The following guidelines shall be followed when the Contractor uses the Internet browser as the communication media to share information with the Employer.
 - (ii) All the data formats or standards must be supported by Microsoft Internet Explorer version 3 or above running on Windows NT and Windows 7 and/or upgraded version.
 - (iii) The following lists the file types and the corresponding data formats to be used on the Internet. The Contractor shall comply with them unless prior consent is obtained from the Employer's Requirement for a different Data format:

File Type	Data Format
Photo Image	Joint Photographic Experts Group (JPEG)



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Image other than Photo	GIF or JPEG
Computer Aid Design files (CAD)	Computer Graphics Metafile (CGM)
Video	Window video (.avi)
Sound	Wave file (.wav)

- 1.8 The following states the standards to be used on Internet when connecting to database(s). The Contractor shall comply with them unless prior consent is obtained from the Employer's Requirement for a different standard:

Function to be Implemented	Standard to be Complied With
Database connectivity	Open Database Connectivity (ODBC)
Publishing hypertext language on the World Wide Web	Hypertext Markup Language (HTML)

The hard copy of all documents shall be the contractual copy.

2 General Requirements

2.1 General

- 2.1.1 The Contractor shall adopt a title block similar to that used in the Drawings for all drawings prepared under the Contract.
- 2.1.2 Each drawing shall be uniquely referenced by a drawing number and shall define both the current status and revision of the drawing.
- 2.1.3 The current status of each drawing shall be clearly defined by the use of a single letter code as follows:

P	-	Preliminary Design Drawing
D	-	Definitive Design Drawing
C	-	Construction Reference Drawing
W	-	Working Drawing
B	-	As-Built Drawing
M	-	As Manufactured Drawing
E	-	Employer's Drawing

2.2 Drawing Numbering System

- 2.2.1 A suitable drawing numbering systems shall be evolved by the contractor and submitted to Engineer for his review. It shall present unique numbers and take care of revisions.

2.3 Types of Drawing

- 2.3.1 'Design drawings' mean all drawings except shop drawings and as-built drawings.
- 2.3.2 'Working drawings' are design drawings of sufficient detail to fully describe the Works and adequate to use for construction or installation.
- 2.3.3 Site drawings and sketches are drawings, often in sketch form, prepared on site to describe modifications of the Working drawings where site conditions warrant changes that do not invalidate the design.
- 2.3.4 'Shop drawings' are special drawings prepared by the manufacturer or fabricator of various items within the Works to facilitate manufacture or fabrication.
- 2.3.5 'As-built drawings' show the Works exactly as constructed or installed. They are usually prepared by amending the working drawings to take into account changes necessitated by site conditions and described in Site drawings. These drawings shall be completed on a regular basis as the works progress and shall not be left until completion of the entire works.



3 Computer Aided Design & Draughting (CADD) Standards

3.1 Introduction

3.1.1 Scope of Use

Data input procedures between the Engineer and contractors must be co-ordinated, and the key parameters used to form CAD data files must be standardised. The production of all CAD data files shall comply with the following requirements.

3.2 Objectives

3.2.1 The main objectives of the CAD standards are as follows:

- (i) To ensure that the CAD data files produced for Project are co-ordinated and referenced in a consistent manner.
- (ii) To provide the information and procedures necessary for a CAD user from one discipline or external organisation to access (and use as background reference), information from a CAD data file prepared by another discipline or external organisation.
- (iii) To standardise the information contained within CAD data files, which may be common to more than one discipline such as drawing borders, title boxes, grid lines etc.
- (iv) To establish procedures for the management of CAD data files.
- (v) To ensure all contractors use 'Model space' and 'Paper space' in the production of their CAD files'.

3.3 General

- 3.3.1 To facilitate co-ordination between contractors, it is a requirement that all drawings issued by contractors for co-ordination or record purposes shall be produced using CAD methods. Drawings shall be issued in digital format in addition to the paper copies.
- 3.3.2 The intent of the issue of digital information is to aid the related design by others. The definitive version of all drawings shall always be the paper or polyester film copies, which have been issued by the contractor or organisation originating the drawing.
- 3.3.3 Drawings and drawing packages issued for co-ordination, record purposes or for acceptance shall be accompanied by a complete set of the corresponding CAD data files.
- 3.3.4 Any contractor or organisation making use of the CAD data from others shall be responsible for satisfying himself that such data is producing an accurate representation of the information on the corresponding paper drawing, which is satisfactory for the purpose for which he is using it. Provided the general principles of this section have been achieved by the originator of the CAD data, contractors making use of the CAD data from others shall not be entitled to require alterations in the manner in which such CAD data is being presented to them.
- 3.3.5 In particular, automatic determination of physical dimensions from the data file shall always be verified against the figured dimensions on the paper or polyester drawings. Figured dimensions shall always be taken as correct where discrepancies occur.

3.4 Terminology & Associated Standards / Guidelines

- 3.4.1 Any terminology used within this section that is ambiguous to the user shall be clarified with the Employer's Requirement. British Standard BS1192 is used in principle as a guide for drawing practice, convention, CAD data structure and translation.

3.5 Paper Drawings

- 3.5.1 For the Project "Paper" drawings are considered to be the main vehicle for the receipt and transmittal of design and production information, typically plans, elevations and sections.
- 3.5.2 The Project wide accepted media for the receipt and transmittal of "Paper" drawings will be paper and polyester film of various standard ISO 'A' sizes. The composition of this information shall be derived from a CAD "Model".



- 3.5.3 The CAD derived "Paper" drawing composition will reflect a window of information contained within a CAD "Model Space" file together with a selection of information contained within the associated CAD "Paper Space" file.

3.6 CAD Data Creation, Content & Presentation

- 3.6.1 A consistent method of CAD data creation, together with content and presentation is essential. The method of CAD "Model Space and Paper Space" creation is as follows:

(i) Model Space Files

Typically, CAD "Model Space" files are required for general arrangement and location plans and will consist of a series of other "Model Space" referenced CAD files covering the total design extents at a defined building level (the number of referenced files should be kept to an absolute minimum). Data contained within a CAD "Model Space" files is drawn at full size (1:1) and located at the correct global position and orientation on the Project Grid / or defined reference points.

Each CAD "Model Space" file will relate to an individual discipline. Drawing border / text, match / section lines or detailed notation shall NOT be included within a CAD "Model Space" file. Dimensions shall be included within a CAD "Model Space" but located on a dedicated layer. Elevations, Long Sections and Cross Sections shall also be presented in CAD "Model Space" as defined above, but do not need to be positioned and orientated on the Project Grid.

(ii) Paper Space CAD Files

Paper Space" CAD files are utilised to aid the process of plotting "Paper" drawings and are primarily a window of the CAD "Model Space" file. A "Paper Space" CAD file will typically contain drawing borders, text, match or section lines & detailed notation. Once these files are initially set up and positioned, the majority of "Paper Drawing" plots at various approved scales are efficiently and consistently generated by displaying different combinations of element layers and symbology contained within the "Paper Space" file and the referenced "Model Space" files.

The purpose is to ensure that total co-ordination is achieved between the CAD "Model Space" file and the "Paper Drawing" output during the revision cycle of the design and production process. Duplicated data in "Model and Paper Space" files will not be acceptable unless an automatic update link exists between the two data sets. "Paper Space" files are not typically required as part of the CAD Media Receipt from contractors, unless specifically requested.

3.7 CAD Quality Control Checks

- 3.7.1 Random CAD Quality Control Audits will be carried out by Engineer on all CAD media received and transmitted.
- 3.7.2 These checks DO NOT verify the technical content of the CAD data received or transmitted (as this is the responsibility of the originating organisation), however compliance with Project CAD and Draughting Standards shall be checked.
- 3.7.3 In addition, all contractors who transmit and receive CAD data from the Project shall have CAD quality control procedures in place. A typical quality control procedure shall contain CAD data quality checking routines coupled with standards for CAD data transmittal and archiving.

3.8 CAD Data Transfer Media and Format

- 3.8.1 When CAD data is received & transmittal between Engineer and the Contractor, the media shall be as follows:

- (i) Data Exchange Format - Autocad as stated above in clause 1.5.
- (ii) Operating System - / Window NT 3.51 / Windows 7 and/or upgraded version.
- (iii) Data Transfer Media: DVDs/ Hard disc/better.
- (iv) All media must be labelled on the data shield with:
- (a) Name of Company,
- (b) Project Title,



- (c) Drawing Filenames (for diskettes only),
- (d) Diskette No. / Total No. of diskettes or Tape No. / Total No. of Tapes.
- (v) All media shall be submitted with a completed Form (CAD Disk/Tape Sheet).
- (vi) The Contractor must ensure the supplied media is free from virus.
- (vii) Sub-directories on tapes or disks are not permitted. If CAD Data is created using UNIX, archive commands must be unrooted.

3.9 CAD Media Receipt & Transmittal

3.9.1 CAD Media Transmittal (from the Contractor to Engineer) - this will consist of the following:

- (i) CAD Digital Media [disk(s), CD's or tape (s)] shall typically contain CAD "Model Space" and "Paper Space" files.
- (ii) CAD data sheet.
- (iii) CAD issue / revision sheet.
- (iv) CAD Quality Checklist confirming compliance.
- (v) Plot of each "Model Space" file issued on an A1 drawing sheet (to best fit).

3.9.2 The above CAD media will be collectively known as "CAD Media Transmittal Set". The CAD data file transmittal format required by Engineer from all contractors shall be in AutoCAD.

3.9.3 All CAD media received from contractors will be retained by Engineer except for SCSI disk (if used) as an audit trail / archive of a specific contractor's design evolution.

3.9.4 CAD Media Receipt (from Engineer to the Contractor)

- (i) CAD media should normally be obtained from the respective designated contractor(s), but should Engineer issue CAD media it will consist of the following:
 - (a) CAD Digital Media (disk (s) or tape (s)) typically contain only CAD "Model Space" files.
 - (b) CAD data sheet.
 - (c) CAD issue / revision sheet.
- (ii) The above CAD media will be collectively known as the "CAD Media Receipt Set". The CAD data file transmittal format used by Engineer to all contractors will be in AutoCAD version as stated in clause 1.5.
- (iii) Each CAD transmittal disk / tape will be labelled with proper disk label as approved by the Engineer. Any CAD data transmitted without this label is assumed to be provisional information not to have been quality checked and therefore not formally issued.

3.10 Revisions

3.10.1 All 'Revisions', 'In Abeyance' and 'Deletions' shall be located on a common layer. This layer can be turned on or off for plotting purposes.

3.10.2 The following example text indicates the current CAD file revision, i.e. 'Revision [A]'. This shall be allocated to a defined layer on all CAD "Model Space" files, in text of a size that will be readable when the CAD "Model Space" file is fitted to the screen, with all levels on.

3.11 Block Libraries, Blocks, & Block Names

3.11.1 All Construction Industry symbols produced as CAD Cells shall typically conform to British Standard BS1192 - part 3.

3.11.2 All Blocks created shall be Primitive (i.e. NOT Complex) and shall be placed Absolute (i.e. NOT Relative).

3.11.3 The Contractor's specific block libraries shall be transmitted to Engineer together with an associated block library list containing the filename (max. 6 characters) and block description. The Contractor shall ensure that the library is regularly updated and circulated to all other users, together with the associated library listing.



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3.11.4 All Blocks of a common type, symbols or details should initially be created within a CAD "Model Space File" specifically utilised for that purpose. These files will be made available on request by Engineer.

3.11.5 All Blocks created will typically be 2D unless 3D is specifically requested. In both instances they shall have an origin at a logical point located within the extents of each Block's masked area or volume.

3.12 CAD Dimensioning

3.12.1 Automatic CAD Dimensioning will be used at all times. Any dimensional change must involve the necessary revision to the model space file. If the CAD Quality Control Checks find that the revisions have not been correctly carried out, the rejection of the entire CAD submission will result.

3.13 CAD Layering

3.13.1 All CAD elements shall be placed on the layers allocated for each different discipline. The layer naming convention to be adopted by the Contractor shall be submitted for acceptance and inclusion within these standards.

3.14 Global origin, Location & Orientation on the Alignment Drawing

3.14.1 Location or Plan information in "Model Space" files shall coincide with the correct location and orientation on the Project grid for each specific contract.

3.14.2 Location plans shall have at least three setting out points shown on each CAD "Model Space" file. Each setting out point shall be indicated by a simple cross hair together with related Easting and Northings co-ordinates. The Civil Contractor(s) will establish the three setting out co-ordinates for their respective works, which will then be used by all other contractors including the Contractor.

3.15 Line Thickness and Colour

3.15.1 To assist plotting by other users, the following colour codes will be assigned to the following line thickness / pen sizes.

Colour	Code No.	Line Thickness
Red	10	0.18
White	7	0.25
Yellow	2	0.35
Brown	34	0.5
Blue	130	0.7
Orange	30	1.0
Green	3	1.4
Grey	253	2.0

3.16 CAD Utilisation of 2D & 3D Files

3.16.1 Although the project standard is 2D CAD files, certain disciplines and contractors may use 3D CAD files for specific applications or where the isolated use of 3D aids the design and visualisation process (i.e. Architecture, Survey and Utilities). In these specific instances 3D CAD data will only be transmitted if all other users can use this data. If this is not the case, a 3D to 2D translation shall be processed by the creator prior to issue.

3.17 CAD File Numbering

3.17.1 Contractors CAD File Numbering shall be described in 2.2 above.

3.17.2 Employer CAD File Numbering Unlike most of the contractors, Employer will not be required to produce numerous CAD files. This will follow the numbering system Except that the status of the drawing in 2.1(3) shall be "E".

3.18 CAD File Naming Convention - General

3.18.1 CAD "Model Space" files shall be named in accordance with general drawing conventions.



APPENDIX 5**DESIGN CERTIFICATE**

This Design Certificate refers to Submission No..... which comprises:

[Description of the Works to which the submission refers]

The contents of this submission are scheduled in Section A below.

Section A: Submission No comprises the following:

Drawings: (Title, drawing number and revision)

Other: (Title, reference number and revision)

(i)

(ii)

(iii)

(iv)

etc.

The documents scheduled in Section B below, for which a Notice of No Objection has been issued, are of relevance to this submission.

Section B: Documents for which a Notice of No Objection has been issued and which are of relevance to this Submission No.....

Item Reference: (Title, reference number and revision)

(i)

(ii)

(iii)

(iv)

etc.



Contractor's Statement

We certify that:

- (a) The design of the Works, as illustrated and described in the documents scheduled in Section A above, complies with the Employer's Requirements General /Technical Specification

Clause.....

Covering.....
.....
.....

- (b) An in-house check has been undertaken and completed to confirm the completeness, adequacy and validity of the design of the Permanent Works as illustrated and described in the documents scheduled in Section A below;
- (c) All necessary and required approvals relating to the design of the Works, as illustrated and described in the documents scheduled in Section A, above have been obtained and copies of such approvals are annexed in Section C below;
- (d) All effects of the design comprising the submission on the design of adjacent or other parts of the Works have been fully taken into account in the design of those parts.

Name.....

Position/ Designation.....

Date.....

Signed by Contractor's Authorised Representative



Contractor's Certification

This Certifies that all design has been performed utilizing the skill and care to be expected of a professionally qualified and competent designer, experienced in work of similar nature and scope. This further certifies that all works relating to the preparation, review, checking and certification of design has been verified by us.

Name

(For Contractor)

Position/Designation

Signed by 'Authorized Representative'

Date

Note 1

The Contractor shall insert one of the following, as applicable:

- (i) The Contractor's Technical Proposals
- (ii) The Contractor's Technical Proposals and Design Packages Nos. for which a Notice of No Objection has been issued.
- (iii) Design Packages Nos. for which a Notice of No Objection has been issued if such Design Packages develop and amplify the Contractor's Technical Proposals.
- (iv) The Definitive Design

Section C

[Contractor to attach copies of necessary and required approvals]

- (i)
 - (ii)
 - (iii)
 - (iv)
- etc.



**APPENDIX 6
SPARES****6.1 Unit Exchange Spares**

- 6.1.1 For details, refer to 'Annexure-G1' in 'Price Bid Submission Sheet, Annexure PBS, Pricing document'. Prices of spares shall be actual prices and not apportioned prices. The spares shall be delivered at the nominated depots by the Employer.

6.2 Mandatory Spares:

- 6.2.1 For details, refer to 'Annexure-G2' in 'Price Bid Submission Sheet, Annexure PBS, Pricing document'. Prices of spares shall be actual prices and not apportioned prices. The spares shall be delivered at the nominated depots by the Employer.

6.3 Recommended Spares

- 6.3.1 Tenderers shall submit list of recommended spares and quote for the same as per 'Annexure-G3' in 'Price Bid Submission Sheet, Annexure PBS, Pricing document'. Prices of spares shall be actual prices and not apportioned prices. The spares shall be delivered at the nominated depots by the Employer.

6.4 Overhauling Spares

- 6.4.1 Tenderers shall submit list of overhauling spares for five train sets of six cars and quote for the same as per 'Annexure-G6' in 'Price Bid Submission Sheet, Annexure PBS, Pricing document'. Prices of spares shall be actual prices and not apportioned prices. The spares shall be delivered at the nominated depots by the Employer.



APPENDIX 7 DESIGN AND MANUFACTURE INTERFACES

1 INTERFACES

1.1 General

- 1.1.1 The Contractor shall interface the design, manufacture, supply covering with that of the Designated and Other Contractors, principally the Contractors for the Designated Contracts as defined in the Employer's Requirements - General and Technical Specification. The Contractor shall keep the Engineer fully informed in respect of such interfaces, such information being given to the Engineer in a manner and form and at such intervals as stated in the Contract or as required by the Engineer.

Major Designated Contractors for the MRS1 Contract are mentioned below.

1.2 Signalling and Communications Contract:

- 1.2.1 For MRS1 Project, the work of providing signalling and train control systems and telecommunications systems relevant to Contract MRS1 will be done under the following contracts:

- (i) Communication Based Train Control (CBTC) system for the corridor.
- (ii) Telecom subsystems including Train Radio works, PIDS, PAS, CCTV, telephone, Data Transmission Network etc. for the complete network of MRS1 Project.

1.3 Railway Electrification, Power Supply Contract

- 1.3.1 For the two corridors on SG, for flexible overhead 25 kV AC 50 Hz traction power, receiving, traction & auxiliary substation equipment, AC switchgear, transformers, auxiliary power equipment, power cables and SCADA are planned to be under one contract.
- 1.3.2 For rigid overhead 25 kV AC 50 Hz traction power, AC switchgear, transformers, auxiliary power equipment and power cables for underground another contract is planned.
- 1.3.3 A detailed design consultant may also be engaged by DMRC for the design of works.
- 1.3.4 The details of these contracts and contractors shall be made available during the execution of the contract MRS1.

1.4 Track Contract

- 1.4.1 For these corridors on SG, detailed design consultants, if any and construction contractors for the tracks works for the elevated corridor and underground corridor shall be advised during the execution of the contract MRS1.
- 1.4.2 The Project Owner may also procure the Head Hardened Rails and Fastenings and a contractor may be engaged for design and supply turnouts and Rail Expansion Joints (REJ).

1.5 Other Contracts:

- 1.5.1 Besides above there are several designated contractors who would need the information regarding the design features and other parameters of the Rolling Stock. Their contracts shall have the provisions to interface directly with MRS1 Contractor for the exchange of information. The above list of Designated Contractors is not exhaustive and many more contractors shall be added. MRS1 Contractor shall do the required interface with them as and when required.

2 Interface Responsibilities

- 2.1 The responsibility for specification and provision of the requirements for the works that interface with Designated Contractors' equipment are tabulated in this appendix.
- 2.2 This Appendix describes the interface requirements between Designated Contractors with Contract MRS1.



- 2.3 This Appendix shall be read in conjunction with the relevant clauses of the Employer's Requirements including the General Specifications and Technical Specifications. The MRS1 Contractor shall be responsible for ensuring that all requirements of the specifications pertaining to interfaces are satisfied.
- 2.4 The requirements specified herein are by no means exhaustive and it remains the Contractors' responsibilities to develop and execute jointly an Interface Plan after the commencement of the works and throughout the execution of works, to ensure that:
- (i) All interfacing issues between the two Contracts are satisfactorily resolved;
 - (ii) Supply, installation and testing of equipment and software are fully co-ordinated; and
 - (iii) That all equipment supplied under the Contracts are fully compatible with each other, whilst meeting the requirements of the respective Specifications.
- 2.5 Notwithstanding the requirements described elsewhere in the Contract regarding document precedence the provisions contained in the drawings and elsewhere in the Employer's Requirements shall prevail over the provisions contained in this Appendix.
- 2.6 This Appendix outlines the interfacing requirements during the execution of the Works. However, the requirements herein specified are by no means exhaustive and it remains the MRS1 Contractor's responsibility to develop, update and execute jointly an Interface Management Plan after the commencement of the Works and throughout the execution of the Works to ensure that:
- (i) All interface issues between MRS1 and the Designated Contractors are satisfactorily identified and resolved; and
 - (ii) All the construction tolerances at the interface shall meet the requirements of the respective specifications relating to the interface points.
- 2.7 Where details of the MRS1 design are required to enable the Designated Contractor to implement interface works, the MRS1 Contractor shall provide the Designated Contractors with the necessary information including, but not necessarily limited to, those described in the summary table appended to this requirement. The level of information provided shall be in sufficient detail to enable the Designated Contractors to design and / or construct the required interface work.
- 2.8 The MRS1 Contractor shall take a lead in developing the Interface Management Plan. (IMP), which will be prepared in conjunction with the Designated Contractors to cover all aspects of the implementation of the interface works required. The Plan will define the interface works necessary to complete all the works in this contract and may not be limited to those listed in the summary table attached.
- 2.9 The IMP shall be fully conforming with the Works Programme and shall, in respect of the Contractor and each of the Designated Contractors, show and be in logical agreement with Key Dates and Handover Dates for Rolling Stock. The IMP shall indicate dates for the commencement and completion of each principal activity by each contractor, and delivery and installation of principal items of equipment.
- 2.10 The IMP shall be submitted by the Contractor to the Engineer, in a preliminary form, as per schedule furnished in table 2-A. Thereafter, the IMP shall be updated by the Contractor at regular intervals, not exceeding twenty eight days, agreed with Designated Contractors and submitted to the Engineer. Should it appear to the Engineer that the progress of the Works, Works Programme or the Three Month Rolling Programme does not conform with the IMP, the Contractor shall be required to revise all such programmes and plans such that they do reflect that are progress of the Works is mutually consistent and conforms to other provisions of the Contract.
- 2.11 The MRS1 Contractor shall review the details of interface works and notify the Engineer of any amendments to the summary table required in the process of his works. Unless such requests are reviewed without objection by the Engineer, the MRS1 Contractor shall design and construct the MRS1 works in accordance with the provisions outlined in this Appendix and the attached summary table.



3 Scope of Work of Integrated Management Plan

- 3.1 The information and scope of works to be provided by the MRS1 Contractor include but may not necessarily be limited to those outlined in the attached summary table. This table only defines those tasks at the interface point and is not a complete itemisation of the Scope of Work.
- 3.2 The Designated Contractors shall liaison with the MRS1 Contractor in the design, installation, testing and acceptance of the MRS1 Works.
- 3.3 The MRS1 Contractor shall provide all access and attendance necessary in accordance with the Contract requirements to enable the Designated Contractors to complete those activities defined under the summary table attached to this interface specification in a timely manner.
- 3.4 Where MRS1 Contractor works are identified as failing to meet the requirements of the Contract and which will impact the Designated Contractor's works, the MRS1 Contractor shall submit the proposed remedial measures to the Engineer's Representative for review and shall copy the same to the Designated Contractors.

4 Interfaces between MRS1 and Signalling, Telecommunication Contracts.

This has been defined in the Appendix-TD of Employer's Requirements - Technical Specification.

5 Interfaces between MRS1 and Rigid OCS Contract

This has been defined in the annexure-(i).

6 Interfaces between MRS1 and Flexible OCS Contract

This has been defined in the annexure-(ii).

7 Interface specification of MRS1 and Track Contract

This has been defined in the annexure-(iii).

8 Interface specification between MRS1 and Other Contracts.

This has been defined in the annexure-(iv).



Annexure (I)
INTERFACE FOR RIGID OCS:

Interface between Rolling Stock Contractor MRS1 & Rigid OCS, Power Supply Designer and Construction Contractor for underground Corridor

1. These shall include the following but not limited to:

Item	Subject	MRS1 Contractor's Responsibilities	OCS and Power Supply Contractor's Responsibilities
1	Size and types of conductor wires	to incorporate into the design of the Pantograph	shall provide information to MRS1 Contractor.
2	Contact wire tension	to incorporate into the design of the Pantograph	shall provide information to MRS1 Contractor.
3	Arrangement of the Overhead Line System and sectioning	to incorporate into the design of the Pantograph	shall provide information to MRS1 Contractor.
4	Detailed drawings of pantograph and pantograph head	shall provide information to designated Contractor.	to incorporate into the design of the OHE System
5	Material of pantograph contact strip	shall provide information to designated Contractor	to incorporate into the design of the OHE System
6	Detailed masses, springing and damping of pantograph	shall provide information to designated Contractor	to incorporate into the design of the OHE System
7	Pantograph sway calculations	shall provide information to designated Contractor	to incorporate into the design of the OHE System
8	Details of harmonic contents of rolling stock power supply	shall provide information to designated Contractor	to incorporate into the design of the OHE System
9	Maximum traction return	shall provide information to designated Contractor	to incorporate into the design of the OHE System
10	Harmonic Limitations of power supply.	to incorporate into the design of the Pantograph	shall provide information to MRS1 Contractor.



ANNEXURE (II)**INTERFACE BETWEEN MRS1 AND FLEXIBLE OCS CONTRACTOR**

Interface between Rolling Stock Contractor MRS1 and Flexible OCS, Power Supply Construction Contractor for At-grade and Elevated Corridors

1. These shall include the following but not limited to:

Item No.	Subject	MRS1 Contractor's responsibilities	Flexible OCS Contractor's Responsibilities
1	Size and types of conductor wires	to incorporate into the design of the Pantograph	shall provide information to MRS1 Contractor.
2	Contact wire tension	to incorporate into the design of the Pantograph	shall provide information to MRS1 Contractor.
3	Arrangement of the Overhead Line System and sectioning	to incorporate into the design of the Pantograph	shall provide information to MRS1 Contractor.
4	Detailed drawings of pantograph and pantograph head	shall provide information to designated Contractor.	to incorporate into the design of the OCS System
5	Material of pantograph contact strip	shall provide information to designated Contractor	to incorporate into the design of the OHE System
6	Detailed masses, springing and damping of pantograph	shall provide information to designated Contractor	to incorporate into the design of the OCS System
7	Pantograph sway calculations	shall provide information to designated Contractor	to incorporate into the design of the OCS System
8	Details of harmonic contents of rolling stock power supply	shall provide information to designated Contractor	to incorporate into the design of the OCS System
9	Maximum traction return	shall provide information to designated Contractor	to incorporate into the design of the OCS System
10	Harmonic Limitations of power supply.	to incorporate into the design of the Pantograph	shall provide information to MRS1 Contractor.



ANNEXURE (III)**INTERFACE BETWEEN MRS1 AND TRACK CONTRACTOR**

Interface between Rolling Stock Contractor MRS1 and Track Turnout Designer and Construction Contractor:

1. These shall include the following but not limited to:

Item No.	Subject	MRS1 Contractor's Responsibilities	Designated Contractor's Responsibilities
1	Kinematic Envelope	MRS1 Contractor shall incorporate in his design.	MRS1 Contractor shall provide the Designated Contractor with the RS Kinematic Envelope.
2	Track Alignment drawings	MRS1 Contractor shall use the information for his design and train running simulation.	Designated Contractor shall provide the MRS1 Contractor, with the detailed Track alignment drawings.

2. If a DDC is engaged for the design of the track, MRS1 contractor shall interface with the DDC.



ANNEXURE (IV)**INTERFACE BETWEEN MRS1 AND DESIGNATED CONTRACTORS:**

1. These shall include the following but not limited to;

Item No.	Subject	MRS1 Contractor's Responsibilities	Other Contractors
1	Rolling Stock Details	MRS1 Contractor shall provide the relevant details of Rolling Stock as per his design.	Other contractors shall design their systems compatible to the Rolling Stock parameters provided to them.

2. Interface with Detailed Design Contractor(s) for Depot(s):

Engineer with experience and help of DDC will design the facilities in depots and workshops. This interface is to improve it further to meet the requirements.

Item No.	Subject	MRS1 Contractor's Responsibilities	Engineer / Depot Design Contractor's Responsibilities
1	Requirement for commissioning and testing of cars	Review the planning by Engineer and DDC and define the minimum facilities required for commissioning and testing the cars in the depot.	Based on Engineer's broad design and review of MRS1, DDC shall design the infrastructure facilities for commissioning and testing of cars in nominated Depot(s).
2	EMU Maintenance requirement	Shall furnish the maintenance schedules and equipment requirement for complete cars, assemblies and subassemblies systems and sub systems.	DDC shall design the Depot maintenance facilities including all depot buildings, to suit MRS1 requirement
3	Plant and Machinery, test panels, tools and instruments etc.	Supply all special tools/test panels suitable for the rolling stock to be supplied.	Engineer shall design and develop specification for supply and commissioning of General-purpose plant and machinery, tools and instruments at Depot.
4	Store facilities for important items of Rolling Stock.	Shall furnish the special requirements for storage and the quantities for storage.	DDC shall design the store facilities for assemblies, sub-assemblies, capital spares etc. at Depot.

3. Interface with Designated Depot Construction Contractor (s):

Item No.	Subject	MRS1 Contractor's Responsibilities	Depot Construction Contractor's Responsibilities
1	Requirement for commissioning and testing of cars	Define the minimum facilities required for commissioning and testing the cars in the depot.	Shall construct the facilities for commissioning and testing of cars in nominated Depot to meet the commissioning schedule of MRS1.



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2	EMU Maintenance requirement	Shall furnish the maintenance schedules and equipment requirement for complete cars, assemblies and subassemblies systems and sub systems.	Shall construct the facilities (except certain maintenance equipment) needed to meet the maintenance needs as advised by MRS1.
3	Plant and Machinery, test panels, tools and instruments etc.	Supply all special tools/test panels suitable for the rolling stock to be supplied.	Incorporate structural provision and Electrical and mechanical provisions for all Machinery and Plant. Supply and installation of machinery and plant.
4	Store facilities for important items of Rolling Stock.	Shall furnish the special requirements for storage and the quantities for storage.	Shall construct the store facilities

In order to perform the work, the contractor will be required to communicate directly with Engineer. The contractor will record the details of all these meetings and provide a copy to Engineer. The contractor will also give the notice for meetings with sufficient time to enable Engineer to attend these meetings.

Engineer will provide the contractor with authorization; assistance and the support of its own personnel should the contractor request Engineer to intervene on its behalf with such meetings.

4. Interface with PSD Contractors:

Platform Screen/Edge Door (PSD/PED) shall be provided for this project. Passenger doors of train shall be as per ERTS Chapter 7. The two door panels at each passenger doorway shall be synchronously controlled and shall provide a door clear opening width of 1400 mm. The passenger door pitch shall be approximately equally spaced to provide the smooth passenger flow. The Rolling Stock contractor shall provide KE and door drawings of train to PSD contractor for placement of Platform Screen Doors. The passenger door pitch shall be compatible with that of passenger pitch of the PSD being installed in the stations.

The design of the passenger door control system shall ensure that the passenger doors open before the PSDs open. The operation of the "Door Close" pushbutton shall broadcast an audible warning in each saloon, signifying that both the passenger doors and PSD shall subsequently close.

After the pre-set time, adjustable between 0 and 5 seconds, following the finish of the audible warning, the control system shall synchronously "Close and Latch" all the passenger doors and PSD on the corresponding side. The design of the passenger door control system shall ensure that the passenger doors close before the PSD close.



APPENDIX 8**ABBREVIATIONS**

Sl. No.	Abbreviation	Description
1	A0, A6	International Document Paper Sizes
2	AC	Alternating Current
3	AGC	Associated General Contractors
4	ATO	Automatic Train Operation
5	ATP	Automatic Train Protection
6	BS	British Standard (s) (Institution)
7	CAD	Computer Aided Design
7A	CADD	Computer Aided Design and Draughting
8	CPM	Critical Path Method
9	CR	Contractor Representative
10	DC	Direct Current
11	DCA	Design Certificate Application
12	DCC	Design Certificate (of) Consent (Sheet)
13	DLP	Defect Liability Period
14	DRCA	Design Review Certificate Application
15	EMC	Electro-Magnetic Compatibility
16	EMU	Electric Multiple Unit
17	EN	European Standards (Organization)
18	GCC	General Condition of Contract
19	Hz	Hertz (Frequency)
20	ISBT	Inter –State with Bus Terminus
21	ISO	International Standards Organization (Standard)
22	MRTS	Metro Rail Transport System
23	NTP	Notice to Proceed
24	OCS	Over-head Catenary system
25	OEM	Original Equipment Manufacturer
26	OSR (S)	Operational Safety Report (Software)
27	PDM	Precedence Diagramming Method
28	RAM	Reliability availability and maintainability
29	RDSO	Research, Design and Standard Organization
30	RS	Rolling Stock (Passenger Cars)
31	SECP	Software Engineering Change Proposal
32	SCC	Special Condition of Contract
33	SI	International System (of Metrication)
34	SI	Static Inverter
35	V	Volts
36	VCB	Vacuum Circuit Breaker
37	VCR	Video Cassette Recorder
38	VVVF	Variable voltage variable frequency
39	PSD	Platform Screen Doors
40	PSG	Platform Screen Gates
41	GoA	Grade of Automation



APPENDIX 9**1.0 SIMULATOR****1.1 DRIVING SIMULATOR****1.1.1 Scope of Supply:** Driving Simulator package shall include the following:

- | | | | |
|-----|---|---|--------|
| a1. | Motion Based Driving Simulator | - | 1 No. |
| a2. | Driving Simulator Workstation (DSW) | - | 1 No. |
| b. | Driving Instructors /Controller Workstations (IWS) for Motion Based Driving Simulator and for DSW | - | 2 Nos. |
| c. | Observer Workstations for Motion Based Driving Simulator and for DSW | - | 2 Nos. |

1.1.2(A) Motion Based Driving Simulator: Main components in Motion Based Driving Simulator shall include but not limited to the following:

- a. **Driving console** – Exact replica of driving console with full cab structure as provided in the train shall be provided and shall be capable of representing vibration, jerks, acceleration, braking, curves etc.

Driving Simulator shall have 6 Degrees of Freedom (DOF) motion system not surpassing the following DOF.

- (i) surge to represent variations in accelerations (start-up, oscillation at end of braking, start of braking, coupling).
- (ii) pitch to represent sustained longitudinal accelerations.
- (iii) sway to represent lateral impacts on entering bends and points.
- (iv) roll to represent the centrifugal force/cant result and in the bends.
- (v) heave to represent the heaving motion of the train as well as track defects such as subsidence.
- (vi) Yaw to represent swivels left & right.

The motion system will need to represent the following particular movements:

- (i) speeds of up to 100 km/h.
- (ii) longitudinal and lateral steady state accelerations.
- (iii) bounce in cross over, low joints
- (iv) Longitudinal shocks from on-set of acceleration.
- (v) lateral in the gage and entering a curve.
- (vi) bump from collision or coupling.
- (vii) y and z axis Driving Console vibrations including random phases.

The motion system shall have at least an overall frequency range and an acceleration as that of real train.



The motion system shall include an emergency stop button bringing the system to a stable state.

If mounted on a motion platform, the LED monitor (size at least 72") for the track view must be mounted so that the position of the image relative to the driver's eyes remains fixed. To achieve this in the simplest way, the LED monitor should be mounted on the body of the Driving Console itself, or on a frame directly attached to this.

The mounting should include anti-vibration and anti-shock features to protect the LED monitor from potential damage caused by the motion platform itself. With the LED monitor mounted on the Driving Console, any pitch and roll effects will have to be reproduced by software control of the image.

- b. At least 72" LED monitor, suitable for displaying Computer Generated Graphic Images (CGI) duly depicting the track, signals, PSDs, Overhead traction and stations etc. of the actual route of Line 2 and 7. On CGI, there shall also be realistic depiction of passengers movement on platform, announcements and door closing/opening etc. The forward view shall include a minimum horizontal field of view of 40 degrees. The forward view screen shall be placed as far away as possible to enhance and assist the driver's view, approximately 3 meters.
- c. Programmable sound system to simulate the train movements.
- d. HD video camera with recorder for recording video of the trainee on Driving Simulator. Provision for indexing and storage of the video footage of the trainee in suitable compact state-of-the-art (both fixed and portable) storage devices.
- e. Provision for voice as well as text communication with Instructor Workstation (IWS).
- f. Workstation Controller shall record not only the video images/files but shall also create "Response" file with log of the actions initiated by the trainee in response to each fault/condition loaded on the workstation either from the IWS or directly from Motion Based Driving Simulator.
- g. **Motion Based Driving Simulator Cab:**

The Driving Simulator Cab shall have an interior, which is highly realistic.

The Driving Simulator Cab shall be strong and robust enough to provide a reasonable service life of 35 years while attached to the motion system.

The exterior shall be painted in MMRDA livery and shall be discussed detailed during design stage. Design of the exterior can include a loss in realism in favour of light-weight and optical design issues.

The Driving Simulator Console shall have a ventilation and air-conditioning system required to maintain the Driving Console at a reasonable temperature and humidity (for at least 4 people in the Driving Console at any point of time).

- h. A "Virtual Train Navigator" (VTN) to simulate actions of the trainee in other cars, or out of the cab. This "virtual" access shall be capable to operate train equipment located outside the cab.

1.1.2(B) Driving Simulator Workstation (DSW): Main components in DSW shall include but not limited to the following:

- a. **Driving console** – Exact replica of driving console with enclosure as provided in the train shall be provided on the Workstation desk.
- b. 46" LED monitor, suitable for displaying Computer Generated Graphic Images (CGI).
- c. Programmable sound system to simulate the train movements. High quality headset shall be provided separately for Workstation with volume control.



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- d. HD video camera with recorder for recording video of the trainee on workstation. Provision for indexing and storage of the video footage of the trainee in suitable compact state-of-the-art (both fixed and portable) storage devices.
- e. Provision for voice as well as text communication with Instructor Workstation (IWS).
- f. Workstation Controller shall record not only the video images/files but shall also create "Response" file with log of the actions initiated by the trainee in response to each fault/condition loaded on the workstation either from the IWS or directly from DSW.
- g. A "Virtual Train Navigator" (VTN) to simulate actions of the trainee in other cars, or out of the cab. This "virtual" access shall be capable to operate train equipment located outside the cab.

1.1.3 Instructor Workstations (IWS) for Motion Based Driving Simulator and Driving Simulator Workstation (DSW): Two dedicated IWS one each for Motion Based Driving simulator and Driving Simulator Workstation (DSW) shall include but not limited to the following:

- a. All equipment as provided in driving console of the Motion Based Driving Simulator/ DSW.
- b. An additional LED touch screen monitor.
- c. Soft select option for viewing the footage of trainee on one screen.
- d. Menu driven option for loading different troubleshooting scenarios from IWS to the Motion Based Driving Simulator/ DSW.
- e. Facility for communication with the Motion Based Driving Simulator/ DSW.
- f. Workstation Controller shall be equipped with suitable software incorporating detailed modeling of the cab, under-frame, roof etc. In addition, exhaustive fault troubleshooting directory (programmable with facility for augmentation/editing of different scenarios) shall be available.

Evaluation of response file of the trainee with respect to the loaded troubleshooting scenario(s) shall be reasonably automated (by comparing with standard response file) to aid the instructor and to highlight the non-conforming response(s).
- g. Suitable facility in IWS to enable video calling between IWS and Trainee on the Motion Based Driving Simulator/ DSW.
- h. Suitable training facility in IWS for the Rolling Stock Controller of OCC for assigned duties in GoA2 and GoA4 mode of operation.

1.1.4 Observer Stations for Motion Based Driving Simulator and DSW: Two dedicated observer stations one each for Motion Based Driving Simulator and Driving Simulator Workstation (DSW) shall include but not limited to the following:

- a. 46" LED screen, suitable for display of Motion Based Driving Simulator/ DSW and IWS of Motion Based Driving Simulator/DSW.
- b. Suitable furniture for the observer stations.

1.1.5 Deleted.

1.1.6 General Provisions: The following shall be included:

- a. The Contractor shall be responsible to provide electrical power connections from the power mains to the Motion Based Driving Simulator, DWS, IWS and Observer Stations.
- b. Suitable capacity UPS for at least back up of 1 hour.
- c. Exhaustive library of images for generating CGI. The library shall be expandable.



- d. Exhaustive troubleshooting directory covering all major equipment, complete with standard expected response for faults up to two hundred (200) Nos. to be included. Provision shall be available with increasing the number of faults with facility for editing/augmenting the fault scenario.
- e. Suitable package with Interactive graphics shall be provided for indicating the exact location of any component on the train. Detailed instructions (with graphics interface) shall be provided to enable access to the specified component.
- f. Computer Based Tutorials (CBT) covering up to 15 different scenarios such as rescue operation, isolation of doors, isolation of bogie brakes, evacuation of passengers in the section etc. shall be provided with graphics and simple to explain instructions. Each CBT package shall be of approximate 30 minutes duration. Such CBT packages shall be designed to operate on any workstation/window based desk computer. Commentary of the CBT packages shall be submitted to Engineer for approval.
- g. Data Base Management System for organizing the detailed record trainee's response and evaluation thereof.
- h. Power Shut Down button at all Instructor Workstations (IWS) for shut down the complete Simulator Module in case of emergency.

1.1.7 Deleted.

1.1.8 **Training:** Training of Project Owner personnel for suitable duration shall be included either at Project Owner premises and at the premises of the firm engaged for developing the CGI, Troubleshooting directories, Data Base Management System and CBTs etc.

1.1.9 The contractor shall provide the optimized layout of the Motion Based Driving Simulator and other auxiliary rooms required to house the simulator. Adequate rooms and space shall be incorporated in the same layout for classroom for the trainees, rest rooms, pantry, chamber of instructor and office for the Project Owner's engineers. The building shall be built by the Project Owner at its expense as per the broad details and layout provided by the Contractor.

1.2 MAINTENANCE SIMULATOR MODULES (MSM)

1.2.1 Scope of Supply

1.2.1.1 Sub-system Maintenance Simulator Module (SSMSM): The Contractor shall supply working Sub-System Maintenance Simulator Module (SSMSM) for each of the following sub-systems:

- a. HVAC
- b. Doors including detrainment door
- c. TCMS
- d. Converter inverter and auxiliary converter-inverter
- e. Traction Motors and gear case
- f. Brake and pneumatics
- g. Bogies, suspension and wheel sets
- h. PA/PIS and CCTV
- i. Vehicle Control Circuit
- j. Couplers
- k. Gangways
- l. System integration and interface (including signaling and communication) of above items for UTO.

1.2.1.2 All equipment such as UPS etc. for installation and commissioning of above items.



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1.2.2 Salient features of SSMSM:

- a. Each module shall be fully equipped with replica/original equipment of the sub-systems. The modules shall be fabricated to provide hands-on experience for the maintenance personnel for both preventive and corrective maintenance.
- b. Wherever feasible, 3D cut sections of the equipment shall also be provided.
- c. Detailed instructions with video graphics on 46" LED touch screen monitor for assembling / dismantling for each subsystems as mentioned in clause 1.2.1.1 above and any other sub-system(s) as suggested by the Engineer during design stage.
- d. Detailed instructions of e-learning with audio and video graphics for carrying out preventive and corrective maintenance actions with linked tools and spares.
- e. Detailed data base (including part nos., drawing nos., vendor details etc.) of the various parts/components
- f. Detailed description and function of each part including electronic cards in text, graphics, logic diagrams etc.
- g. Detailed description of the software with graphics, detailed flow diagrams, logic diagrams etc. with detailed narrative explanation.
- h. Extensive library of faults and standardized response for rectification of faults. The number of faults in the library of each module would be average 250 or as agreed by the Engineer during design stage. Provision shall also be available for recording of the actions initiated by the trainee for rectification of the faults.
- i. Detailed Testing procedure of different equipment (including provisions in the relevant standards) with graphics.
- j. Any other feature that would assist in training of the maintenance personnel.
- k. Data Base Management System for organizing the detailed record trainee's response and evaluation thereof.

1.2.3 General Maintenance Simulator Modules (GMSM): The Contractor shall supply 6 nos. of GMSM Modules. Each module shall include the following:

- a. 46" LED touch screen monitor with controller and associated power connection equipment and associated furniture.
- b. Computer based tutorials (CBTs) for various major subsystems, including systems for which SSMSM are specified above in clause 1.2.1.1.
- c. Complete software package of all the functions covering list of faults and fault activation & response thereon, assembling/dismantling instructions, testing procedure, maintenance schedule etc. of each SSMSM.

1.3 TRAINING OF PROJECT OWNER'S ENGINEERS:

The Rolling Stock Contractor shall also impart training to 04 Project Owner's Engineers in the mathematical modeling and computer simulation programming and photographic techniques required for use in the Simulator hardware and software maintenance of the simulator for a minimum period of 10 working days. After completion of this training these Project Owner's Engineers will be authorized and provided with all necessary hardware/software tools for minor modifications and additions in modeling in close coordination with Simulator contractor, up to the completion of DLP.

The Contractor shall provide full descriptive manuals for Operation, Maintenance and Training in the use of the Motion Based Driving Simulator, Driving Simulator Workstation (DSW), Maintenance Simulator and associated equipment. The Contractor shall also supply a catalogue of spare parts for the equipment. All supplied documentation shall be in English language.



1.4 WARRANTY

- 1.4.1 The defect liability period of simulator and other equipment supplied shall be 24 months from date of acceptance or expiry of the defect liability period of trains, whichever is later.
- 1.4.2 All modifications done on actual train must be reflected on simulators within 6 months i.e. modification up gradation should be done twice in a year.
- 1.4.3 All observations raised by Project Owner and within the scope should be corrected within 90 days i.e. observation correction up gradation should be done on quarterly basis in each year.
- 1.4.4 Contractor shall ensure that the local technical support for the complete Simulator Module till the end of DLP shall be made available for meeting DLP obligations.

1.5 SUMMARY OF REQUIREMENTS:

Items included in one set of "Trouble Shooting & Driving Simulator", for which prices are to be quoted against item 'G7' of Cost Centre 'G' are detailed above at 1.1.1 and 1.2.1. The modules included in the above said one set is summarized below:

S.No.	Description	Quantity
A	Driving Simulator package will include the following:	
1	Motion Based Driving Simulator with cab & driving console complete	1 No.
2	Driving Simulator Workstation (DSW)	1 No.
3	Driving Instructors /Controller Workstations (IWS) for Motion Based Driving Simulator and for DSW	2 Nos.
4	Observer Workstations for Motion Based Driving Simulator and for DSW	2 Nos.
B.1	Sub-system maintenance Simulator Module (SSMSM) include the following sub-systems	
1	HVAC	1
2	Doors including detrainment door	1
3	TCMS	1
4	Converter Inverter and Auxiliary Converter-Inverter	1
5	Traction Motor and gear case	1
6	Brake and pneumatics	1
7	Bogies, Suspension and wheel sets	1
8	PA/PIS and CCTV	1
9	Vehicle Control Circuit	1
10	Couplers	1
11	Gangways	1



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12	System integration and interface (including signaling and communication) of above items for UTO	1
B. II	General Maintenance Module (GMSM)	6 Nos.

1.6 SPARES, SPECIAL TOOLS & TEST EQUIPMENT

- (i) Spares for maintenance up to DLP is also required to be delivered as part of the Contract.
- (ii) The Contractor will recommend a suitable spares inventory to be held for first-line repairs.
- (iii) The Contractor will provide a recommended set of spare parts for emergency replacement, to be held on-site with the simulator. The Contractor will ensure that the local holding of spare parts is promptly replenished and maintained at the level agreed in the contract.
- (iv) Any special tools and test equipment required for normal operation of the simulator will be provided by the Contractor and handed over along with the simulator.

