

**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**

**EMPLOYER'S REQUIREMENTS: GENERAL SPECIFICATIONS (ERGS)**



000256

**CONTENTS:**

CONTENTS: .....	1
CHAPTER 1 .....	4
1.1 General .....	4
1.2 Not used .....	7
1.3 Power Supply .....	7
1.4 Climatic Conditions .....	7
1.5 Environmental Conditions In Tunnel .....	7
1.6 Standards And Codes .....	8
1.7 Units .....	8
1.8 Warranty (Defect Liability) .....	8
CHAPTER 2 .....	11
2.1 General .....	11
2.2 Project Management Plan .....	12
2.3 Interface Management Plan .....	14
2.4 Work Plan (Works Programme And Design Submission Programme)..	15
2.5 Quality Assurance Plan .....	15
2.6 Quality Plan .....	16
2.7 System Safety Assurance Plan .....	17
2.8 Reliability, Availability And Maintainability Assurance Plan .....	17
2.9 Site Safety Plan .....	18
2.10 Software Quality Assurance Plan .....	18
2.11 Environmental Plan .....	18
2.12 Inspection, Testing And Commissioning Plan .....	18
CHAPTER 3 .....	20
3.1 General .....	20
3.2 Dedicated Co-Ordination Team .....	21
CHAPTER 4 .....	22
4.1 Works Programme Submission Requirements .....	22
4.2 Part One-Submission By Tenderers .....	22
4.3 Part Two-Submission By Contractor .....	23
4.4 Review Periods For Contractor's Submissions .....	24
4.5 Failure To Make Submissions .....	24
4.6 Programme Revision .....	25
4.7 Planning And Programming Staff .....	25
4.8 Project Calendar .....	25
CHAPTER 5 .....	27
5.1 General .....	27
5.2 Review Of Data .....	27
5.3 Format Of Deliverables .....	27
5.4 Number Of Copies .....	27
5.5 Design Submission Programme .....	28
5.6 Design Process .....	28
5.7 Preliminary Design .....	29
5.8 Pre-Final Design .....	29
5.9 Final Design .....	29
5.10 Design Submission And Review Procedure .....	29



5.11	Engineer's Review .....	30
5.12	Final Design Document Delivery .....	31
5.13	As-Built Drawings And Documents.....	31
5.14	Manufacturing Drawings.....	31
5.15	Post Acceptance Changes .....	31
CHAPTER 6 .....		34
6.1	Prescriptive Framework.....	34
6.2	Software Framework.....	34
6.3	Software Management Control.....	34
6.4	Auditing.....	34
6.5	Software Acceptance.....	34
6.6	Application Software and Development Tools.....	35
6.7	Re-Use of Existing Software.....	36
6.8	Re-Engineered Software .....	36
6.9	Test Software.....	37
6.10	Software Rights .....	37
CHAPTER 7 .....		38
7.1	General.....	38
7.2	Sequence of Tests.....	38
CHAPTER 8.....		40
8.1	General.....	40
8.2	Unit Exchange Spares.....	40
8.3	Consumable Spares .....	40
8.4	Mandatory spares.....	41
8.5	Recommended spares .....	41
8.6	Overhauling Spares.....	42
8.7	Special Tools, Testing and Diagnostic equipments:.....	42
8.8	Special Jigs, Fixtures and Gauges .....	43
8.9	Manufacture, Delivery and Warranty.....	43
8.10	Purchase of Spares from Vendors .....	44
8.11	Commissioning And DLP Spares .....	44
8.12	List of Spares.....	44
8.13	Simulator.....	45
CHAPTER 9.....		47
9.1	Training Requirements .....	47
9.2	Training Objectives: Train Operating Staff. ....	48
9.3	Training Objectives: Maintenance Staff.....	48
9.4	Training Methods.....	48
9.5	Training Manual.....	49
9.6	Transfer of Training Aids .....	49
9.7	Training Location and Facilities .....	49
9.8	Administration.....	50
CHAPTER 10.....		51
10.1	Access to Site.....	51
10.2	Site Facilities.....	51
10.3	Site Management .....	52
10.4	Site Safety .....	53
CHAPTER 11.....		55
11.1	General.....	55



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11.2 Transportation to Site .....	55
CHAPTER 12 .....	57
12.1 General .....	57
12.2 Operation Manuals .....	57
12.3 Maintenance Manuals .....	57
12.4 Electronic Manuals .....	58
CHAPTER 13 .....	60
13.1 General .....	60
CHAPTER 14 .....	62
14.1 General .....	62
14.2 Progress Photographs .....	62



000259

**CHAPTER 1****SCOPE OF THE GENERAL SPECIFICATION****1.1 General**

1.1.1 This Specification covers the general aspects of the tender viz., description of the Works, submittal requirements of Design & Drawings, Management Plans, Project Planning and Progress Monitoring, Site Management, Draughting and CAD Standards, and Contractor's obligations for safety and health etc. This General Specification shall be read in conjunction with the General Conditions of Contract (GCC), Special Conditions of Contract (SCC), Technical Specification, and Instructions to Tenderers. The abbreviations used in this General Specifications are given in Appendix 8 to this Specification.

## 1.1.2 General Description of the Works

Mumbai Metropolitan Regional Development Authority (MMRDA) is proceeding with the implementation of the Mass Rapid Transit System (MRTS) between (i) Dahisar (E) to Mandala and (ii) Andheri (E) to Dahisar (E). The Table-1A below shows route length of those corridors that are relevant to tender MRS1. These corridors are on Standard Gauge. Table-1A shows the type of the corridors i.e. elevated or at grade.

**TABLE – 1A: Mumbai MRTS for MRS1 Tender (SG)**

LINE	Corridors	Elevated/At Grade (km)	Total (km)
2	Dahisar East–Mandala	41.507	41.507
7	Dahisar East to Andheri (E)	16.475	16.475
TOTAL		57.982	57.982

The above corridors may be modified on account of new stations/ relocation of stations/rationalisation of curves & gradients during final layout design. The Contractor shall be advised of such modifications, as appropriate and shall keep sufficient margins to ensure compliance to the specifications.

Charkop Depot and Mandala Depot are the associated Maintenance Depots for line 2 and line 7. The delivery priority for the trains for different sections may also vary slightly. Contractor shall have to make suitable changes in the delivery plan at the nominated depot at no extra cost to Employer.

1.1.3 The construction for SG Corridors is to commence. Revenue operations in different sections relevant to MRS1 tender shall be implemented progressively and completed before 2022. Rolling Stock supply targets for these shall be governed as per the specified key dates schedule.

## 1.1.4 Scope

The Scope of Works under this Contract covers design, manufacture, supply, testing and commissioning of passenger rolling stock and the training of operation and maintenance personnel for Mumbai MRTS. The Scope also covers supply of spares, special tools, testing and diagnostics equipment, jigs and fixture etc for maintenance, repair and overhaul of cars. The cars required for the corridors shall be of modern design, lightweight made of stainless steel, with 3 phase AC drive having V.V.V.F control, regenerative braking, suitable for CBTC based ATP, ATO, etc. provided by other Designated Contractors and shall be suitable for Unattended Train Operation conforming



to Grade of Automation– 'GOA4' as specified in IEC62290-1:2006. The cars shall operate on 25 kV AC single phase 50 Hz flexible OCS system for elevated and at-grade sections. The detailed performance requirements, and design criteria of the cars and equipment are covered in Employer's Requirements -Technical Specification.

- 1.1.5 For the corridors mentioned, the Rolling Stock requirements are mentioned in Table 1B below:

**Table 1B: Requirements of Cars**

S.N.	Line	Corridors	Rolling Stock Required		
			No. of rakes	Cars in rake	Total Cars
1	2	Dahisar(E) - Mandala	48	6	288
2	7	Dahisar(E) – Andheri(E)	15	6	90
		Total	63		378

- 1.1.6 For the cars manufactured in India (onshore factory), an essential condition for complying with the bid is that the Contractor shall establish facilities either independently or with an Indian Partner for local manufacture of coaches in India. In case local manufacture is undertaken in the facilities of the local partner, Quality control (total) and testing at works shall be the responsibility of the member of consortium based on whose credentials the bidder has qualified for this bid. The bidder shall submit detailed proposal indicating details of the Indian Partner (if any), the place of manufacture in India, work schedule etc in the bid. For the manufacture of cars in India in addition to the details submitted in the bid, the Contractor shall submit detailed proposal for approval by Employer within 6 (six) months of award of contract.

Total number of coaches, trainsets (including configuration) required to be supplied along with Key Dates for delivery & commissioning are indicated in the 'Attachment of Appendix FB-1 to the Form of Bid' (Section-4: Bidding Forms, Part-I).

- 1.1.7 The Tenderer are advised to survey manufacturing facilities already existing in India and make use of the same, if considered useful by them. While selecting the manufacturing facilities for the carbody manufacturer, it shall be ensured that the carbody manufacturing line shall be exclusively dedicated to stainless steel/Aluminium carbody manufacture/welding and shall be physically totally partitioned from manufacturing related works with any other varieties of steel/Aluminium. This shall specifically be certified and committed while deciding local manufacture of carbody and its components.
- 1.1.8 To facilitate ease in maintenance and easy availability of spares, DMRC is keen in standardisation and expects Contractor to make efforts to source maximum number of equipment and materials from India.

DMRC expects that efforts will be made by the Contractor to indigenise items given in Table 1C of Employer's Requirements-General Specifications, which can be indigenised and sourced from India to meet the required performance requirements and quality standards.

Contractor shall choose their partner in India or open a wholly owned subsidiary in India for manufacturing of indigenised items. Contractor shall arrange granting of unqualified licenses to their chosen Indian partners to manufacture and sell such indigenised items for other than MRS1 contract requirements also.

During vendor approval stage, the Contractor shall also submit a commitment from the approved vendors that in case of any future procurement action by DMRC, they shall quote directly to DMRC.

Contractor shall submit comprehensive proposal indicating details of the Indian Partner(s), the place of manufacture in India, work schedule etc. within 12 (twelve) months of the Commencement date for approval by the Employer. Maintaining quality standards, ensuring performance requirements and timely delivery shall be the sole



000261



responsibility of the Contractor.

Contractor shall ensure that indigenisation content in the train sets is progressively increased. The contractor shall furnish sufficient information to prove the basic soundness and reliability of the offered sub-system(s)/spares for review of the engineer in accordance with ERTS clause 3.2.2 and 3.2.5. The engineer's decision on contractor's proposal shall be final and binding.

The Tenderers are also advised to look for indigenisation of those items that are regularly required for the routine maintenance of the sub-systems of Rolling Stock.

**Table 1C: Recommended items for Indigenisation**

Sl no.	Description of Items
1	Pantograph including strips
2	Vacuum Circuit Breaker (VCB)
3	Brake blocks
4	Traction Motors
5	Converter / Inverter unit
6	Static Inverter (Auxiliary Converter-inverter)
7	Electrical panels / Cab panels
8	Application & release valve, relay valve, isolating cocks, safety valves & check valves
9	Battery set with box
10	Saloon Air-conditioner
11	Luminaries and Lamps
12	All types of Glasses
13	DC-DC converter
14	Consumables: Lubricants, Sealants, oils, greases etc
15	Axle taper roller bearing complete with axle box, housing & cover.
16	Earth Brush Assembly
17	Gear Drive
18	Saloon door accessories
19	Brake System including Brake blocks, Application & release valve, relay valve, isolating cocks, safety valves and check valves, pneumatic pipes, reservoir
20	Floor cover
21	Floor Board
22	Dampers
23	Stainless steel sections
24	Steel sections
25	Insulation like glass wool etc.
26	Brake System
27	Couplers
28	Auxiliary Motors
29	Gangways
30	Bearings
31	Wipers
32	Deleted
33	Deleted
34	Primary & Secondary springs
35	PCBs used in different equipment.
36	Internal Paneling
37	Public Address (P/A) / Public Information System (PIS) / CCTV
38	Cab Mask

1.1.9 Deleted.



1.1.10 For the manufacture of cars in India in addition to the details submitted in the bid, the Contractor shall submit detailed proposal for approval by Employer within 6 (six) months of award of contract. The proposal must include complete details of Indian partner including details of technical capability and financial capability. Details of the Indian partner shall include, but not limited to, the following:

- MoU indicating scope of work
- Procedure for assuring Quality Standards
- Detailed plan for deployment of Contractor's personnel in Indian partner's works
- Qualification procedures for key personnel including welders, crimpers, fitters etc.
- Detailed method statements for each activity including supply, manufacture, testing and commissioning.
- Inspection procedures (stage as well as final) for sub-systems and complete car.
- Availability of M & P, jigs & fixtures etc.
- Details of transfer of technology to Indian partner.
- Details of transfer of Engineering and manufacturing drawings.
- Any other documents desired by Employer.

1.1.11 The Contractor shall also carry out effective interface coordination with other Designated Contractors and other appointed Contractors by the Employer from time to time, during the Contract duration.

1.1.12 The Contractor shall carry out Integrated Testing and Commissioning of cars on the section in co-ordination with other Designated Contractors, under supervision of Engineer. He shall also carry out all statutory tests and trials on cars necessary for obtaining sanction of Competent/Statutory Authorities for opening the system for public carriage of passengers and provide assistance and information as required by the appropriate statutory authorities in India.

## 1.2 Not used

## 1.3 Power Supply

1.3.1 25 kV AC 50 Hz single phase traction power supply shall consist of overhead rigid Catenary system fed throughout the underground, and conventional overhead Catenary system (OCS) in the elevated, at-grade section and Depot. The power system shall be suitable for regenerative braking of trains.

## 1.4 Climatic Conditions

1.4.1 The climatic conditions, which need to be taken into account by the Contractor for designing the Rolling Stock and the equipment provided therein, are furnished in Clause-3.10 of the Employer's Requirements - Technical Specification.

1.4.2 All underground stations (if planned) will be fully air-conditioned.

1.4.3 Above ground stations will have air-conditioning for certain designated rooms only.

1.4.4 While designing and selection of the equipment and components, special care shall be taken for protecting these items against dust. As per the Employer's experience, high level of IP protection is required in order to ensure equipment reliability under severe dust conditions prevalent in Mumbai and the same shall therefore be suitably considered during design.

## 1.5 Environmental Conditions in Tunnel (if planned)

1.5.1 Tunnel ventilation is achieved primarily by the movement of vehicles inside the tunnel



000263



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

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

- 1.5.2 Track-way exhaust systems will be provided to extract a portion of train-generated heat while the train is within the bounds of a station. During normal conditions, under-platform exhaust as well as over-track-way exhaust fans will operate. In addition, control of these fans shall be possible during congested and emergency conditions for the purpose of aiding tunnel ventilation and providing additional smoke removal capability for the station and tunnel. During emergency fire conditions within a station, the station air handling system will be operated to supplement smoke removal.
- 1.5.3 Tunnel walls may be wet and seepage water will normally be present in the invert. Rolling Stock supplied must therefore be capable of withstanding the effects of seepage and continue to operate in such wet and humid conditions.

## 1.6 Standards and Codes

- 1.6.1 Rolling Stock equipment and software shall be in accordance with the requirements of the standards and codes specified in the Employer's Requirements - Technical Specification. The Contractor may propose an alternative equivalent international standard during the design stage. The acceptance of the alternative standard will however be subject to review by Engineer. When a Standard or Code is referred to, it shall be assumed that the revision that is current on the date of tender submission or the revision made during the design finalisation shall be applicable, unless otherwise stated.
- 1.6.2 Where no standard is identifiable, the Contractor shall make a proposal, based on the best International practice, which shall be subject to review by the Engineer.
- 1.6.3 During the preliminary design phase, the Contractor shall submit a consolidated list of all the standards that he intends to use for the design, manufacturing and testing and other phases of the contract, for review of the Engineer.
- 1.6.4 During the design phase, the Contractor shall provide original copies of the standards used/referred, English version (if not available translation shall be made available) as part of the Contract.
- 1.6.5 The standards shall be provided in electronic format (soft copy). However, in case the same is not available, with the Engineer's consent, original printed copy can be provided.

## 1.7 Units

- 1.7.1 All drawings and design calculations submitted with the tender, or in accordance with the requirements of the Contract, shall use SI units.

## 1.8 Warranty (Defect Liability)

- 1.8.1 Warranty (Defect Liability) period shall start from commissioning of first train upto 24 months from the date of taking over of the last train after its introduction into revenue operation. Thus, the duration of the various trains under DLP shall vary.
- 1.8.2 The Contractor shall be responsible for any defect or failure attributable to defective design, material or workmanship during the Warranty period.



Contractor shall also ensure that the technical support from Sub-Contractors/Vendors of following major equipment/subsystems shall be made available through permanent positioning of Sub-Contractor's/Vendor's staff at Depots for meeting DLP obligations:

- (i) Propulsion system (including Converter-Inverter, Traction motors, Main transformer etc.)
- (ii) Auxiliary Power Supply system
- (iii) Brake and Pneumatic system
- (iv) Door
- (v) HVAC
- (vi) Bogies

1.8.3 The warranty period of unit exchange, mandatory and overhauling spares, special tools, testing and diagnostic equipment, special jigs, fixtures and gauges, simulator or any other item / equipment delivered shall be:

- (i) either 24 months from the date of acceptance or
- (ii) up to expiry of the defect liability period of trains (clause 1.8.1), whichever is later.

1.8.4 The repair and or replacement of failed components and equipment and installation of repaired/replaced components/equipment shall be undertaken by the Contractor free of charge at Site. The Contractor shall bear custom duty, freight charges and all other expenses involved in collection of defective components and equipment from the Site, and transportation to the manufacturer's works in India or abroad for repairs/ update/ modification etc. as the case maybe and its return to site after making it good for use. Further, should any design modification be required to any component or equipment as a consequence of failure analysis, the minimum period of warranty i.e. 24 months shall commence from the date when the modified part is commissioned into service and modification shall be carried out free of charge. In all such cases, warranty will be applicable on complete sub-assembly, even when only component has been modified/replaced/repared due to design change.

1.8.5 All replacement and repairs under the warranty shall be carried out by the Contractor promptly and to the complete satisfaction of the Engineer on notification of the defect by the Engineer or his/her authorised representatives so that no car is unfit for revenue service for more than 48 hours, which shall exclude time taken for withdrawal/induction of trains from/to revenue services. In case any train remains out of revenue operation beyond specified duration above due to reasons attributable to contractor, Engineer with the approval of the Employer may at his sole discretion impose a penalty on the contractor, commensurate with the revenue and opportunity loss to the Employer. Decision of Employer shall be final and binding.

1.8.6 Not Used.



000265



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**CHAPTER 2****MANAGEMENT PLANS****2.1 General**

2.1.1 In order to ensure satisfactory execution of the Contract, completion of works within specified targets, and quality in design, manufacturing and execution of work, a series of Management Plans shall be developed. The following Plans shall be developed and submitted by the Contractor for Engineer's review:

- (i) Project Management Plan
- (ii) Interface Management Plan
- (iii) Work Plan (Work Programme and Design Submission Programme)
- (iv) Quality Assurance Plan
- (v) Quality Plan
- (vi) System Safety Assurance Plan
- (vii) Reliability, Availability and Maintainability Assurance Plan
- (viii) Site Safety Plan
- (ix) Software Quality Assurance Plan
- (x) Environmental Plan
- (xi) Inspection, Test and Commissioning Plan

2.1.2 The plans and documents shall be co-ordinated with each other and shall collectively define, describe and encompass the Contractor's proposed methods, procedures, processes, organisation, sequencing of activities to meet the requirements of the Technical Specification in respect of the subjects listed.

2.1.3 The respective Plans shall be submitted as per the submission schedule furnished in table 2-A.

**Table 2-A: Submission of Plans**

S.N.	Plan	To be submitted within
1	Project Management Plan	21 days of Commencement Date
2	Interface Management Plan	60 days of notification from the Engineer of the identity of each Designated Contractor
3	Work Plan : (Work Programme and Design Submission Programme)	45 days of Commencement Date
4	Quality Assurance Plan	60 days of Commencement Date
5	Quality Plan	60 days of Commencement Date
6	System Safety Assurance Plan	60 days of Commencement Date
7	Reliability, Availability and Maintainability Assurance Plan	90 days of Commencement Date
8	Site Safety Plan	150 days of Commencement Date
9	Software Quality Assurance Plan	75 days of Commencement Date
10	Environmental Plan	60 days of Commencement Date
11	Inspection, Test and Commissioning Plan	150 days of Commencement Date



## 2.2 Project Management Plan

2.2.1 The Project Management Plan shall provide a clear over-view of the Contractor's organisation, the management system and methods to be used for completion of the works. The organisation resources for the design, procurement, manufacture, installation, testing and commissioning, and setting to work, shall be clearly defined.

2.2.2 The Tenderer shall submit a Project Management Plan as a part of the Tender, which shall provide the following information.

- (i) A diagram showing the organisational structure for the management of the Contract, with locations, names and position titles of staff and their line and staff relationship. The diagram shall include associate organisations and sub-contractors and show clearly the individuals and lines of responsibility linking the various groups. It shall also identify the persons designated as contacts with the Engineer.
- (ii) The names, qualifications, positions and current resumes of key executive, supervisory and engineering staff to be employed full-time for the works, separately for principals and sub-contractors.
- (iii) A narrative describing the sequence, nature and inter-relationship of the main Contract activities including timing for exchange of information.
- (iv) Procedure for documentation control.
- (v) The Contractor shall nominate a suitably qualified and experienced English-speaking engineer from his staff to be Project Manager. The proposed Project Manager shall have total experience of minimum 15 years and shall have been the Project Head in at least one Rolling Stock Project in last 10 years. The proposed Project Manager shall be the employee of such Applicant based on whose experience and strength, the Bidder has qualified majority of the requirements for qualification criteria mentioned in clause 2.2.1 and 2.2.2.1 of section-3: 'Evaluation and Qualification Criteria'.

The Bidder shall submit relevant CV of the Project Leader/Project manager at the time of Bid, for the Bidder/Joint Venture/Consortium shall be furnished in the format provided in "Form FB-17" of "Part-I, Section-4, Bidding Forms: form of Bid". This will be a part of technical evaluation.

The nominee shall be subject to acceptance of the Engineer, who shall have the right to demand his replacement at any time after the work commences, should the Engineer consider this to be in the best interest of the Project.

- (vi) The Contractor shall also nominate a Senior Engineer (Manufacturing Head) to co-ordinate activities of the design offices and manufacturing works. Manufacturing Head shall be responsible to the Project Manager for all works executed outside India and in India for ensuring that effective co-ordination is maintained with the various manufacturing units of the Contractor, Sub-Contractors and Suppliers and that contract delivery schedules are met.
- (vii) The Project Manager shall be continuously on site in Mumbai and devote himself full-time to the Project, commencing not later than Thirty (30) calendar days from the date of the Commencement Date and shall continue up to the end of Defects Liability Period. Contractor shall also nominate a Deputy Project Manager and be posted at Mumbai site. In case of cumulative absence of the Project Manager and/or Dy. Project Manager from the project site in Mumbai for 40 days in a calendar year, Employer may at his sole discretion recover a reasonable amount from the due payments to the Contractor.
- (viii) To fulfil the Contractor's obligations during the Testing and Commissioning and the Defect Liability Period, the Contractor shall nominate experienced maintenance engineers and organise deployment after obtaining Engineer's



approval before undertaking testing and commissioning in depots. Separate maintenance engineer shall be positioned in each depot and they shall be supported by a dedicated team of testing / commissioning and maintenance personnel. Separate Chief Maintenance Engineer as incharge of all Testing and Commissioning and warranty activities shall be nominated at least 90 days before, and shall be positioned at least thirty days before the contracted scheduled date of receipt or expected date of receipt of first train in Depot (whichever is earlier). The deployed Chief and other Maintenance Engineer of the Contractor and supporting maintenance team in each Depot shall continue up to the end of Defect Liability Period. They shall be responsible for all works arising in the supplied rolling stock based in the respective depot.

- (ix) The work of the maintenance engineers of all the depots shall be coordinated by Contractor's Chief Maintenance Engineer. The Maintenance Engineer shall be posted at each depot at Mumbai site at least 01 months before receipt of prototype train and up to the expiry of warranty period.
- (x) The Chief Maintenance Engineer and maintenance engineers shall coordinate with the Engineer's nominated representatives in each depot and provide guidance as may be required to carry out the scheduled and un-scheduled maintenance activities from time to time. The work shall include, but not limited to, finalisation of detailed maintenance plans covering maintenance work instructions, requirements and specifications of tools, plants and test benches, test check sheets, etc.
- (xi) Suitable replacement after obtaining approval of Engineer shall be provided by the Contractor in case of absence of the Chief Maintenance Engineer and maintenance engineers from the site for a continuous period exceeding 15 calendar days, for whatever reason. In case of cumulative absence of the Chief Maintenance Engineer and / or maintenance engineers for 40 days in a calendar year, the Engineer may at his sole discretion recover a reasonable amount from the due payments to the Contractor.
- (xii) Timely deployment of the Chief Maintenance Engineer and maintenance engineers shall be a prerequisite for accomplishing the relevant key dates of testing and commissioning of the first train sets in the respective depots.
- (xiii) The Contractor shall position the Design Manager at Mumbai site from receipt of prototype train till one year before expiry of warranty.

2.2.3 The Contractor will submit a Project Management Plan within the specified schedule. The Engineer will review the Contractor's Project Management Plan and shall have the right to require the Contractor to make amendments as deemed necessary by the Engineer. The Contractor shall submit a detailed revised plan within 10 days of the review of the Engineer.

2.2.4 The Bidder shall submit relevant CVs of the following members of the proposed Management Team at the time of Bid, in addition to the Project Leader/Project manager, for the Bidder/Joint Venture/Consortium shall be furnished in the format provided in "Form FB-17" of "Part-I, Section-4, Bidding Forms":

- (i) Deputy Project Manager (to be posted at Mumbai site);
- (ii) Design Manager (to be posted at Mumbai site from receipt of prototype train till one year before expiry of warranty);
- (iii) Interface Manager (to be posted at Mumbai site, starting from not later than 6 months from commencement date);
- (iv) Procurement Manager (to be posted at production site);
- (v) Chief Maintenance Engineer (to be posted at Mumbai site at least 01 months before receipt of prototype train and up to the expiry of warranty period);
- (vi) Testing and Commissioning Engineer In-charge (to be posted at Mumbai site at least 01 months before receipt of prototype train and up to six months after commissioning of last car);



000269



- (vii) Maintenance Engineer (to be posted at each depot at Mumbai site at least 01 months before receipt of prototype train and up to the expiry of warranty period);
- (viii) Safety Manager (to be posted at Mumbai site at least 01 months before receipt of prototype train and up to the expiry of warranty period);
- (ix) Quality Assurance Manager (to be posted at Production site as well as Mumbai site).

2.2.5 The Contractor shall provide details of their current management organisation as the applicant or, if a Joint Venture/Consortium, of each constituent member and also a proposed management organisation for the contract.

### 2.3 Interface Management Plan

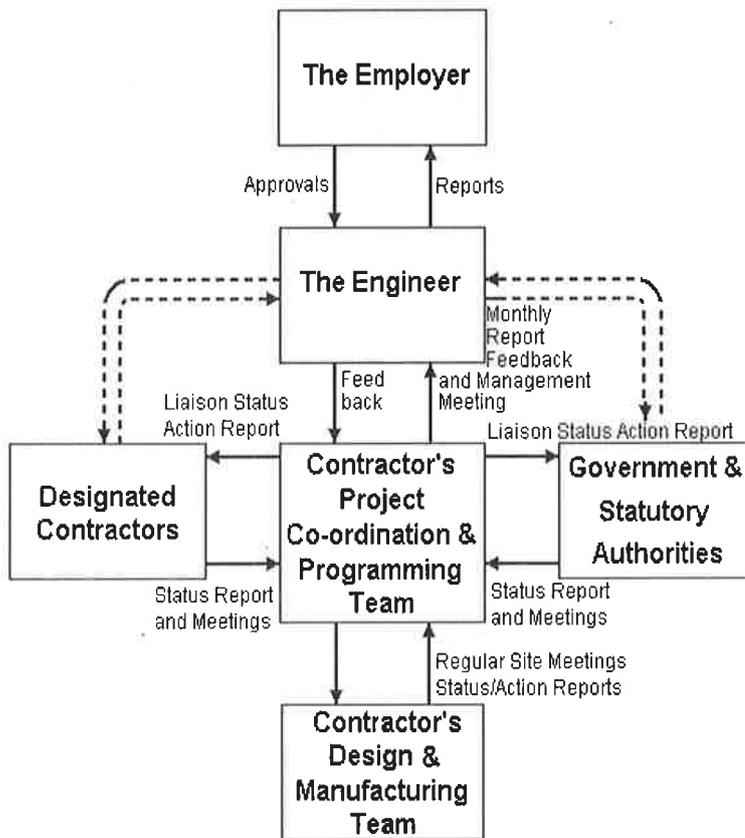
2.3.1 The Contractor shall interface and liaise with Designated and other Contractors in accordance with the requirements of Chapter 3 of the Employer's Requirement's General Specification.

2.3.2 The Contractor shall develop and submit to the Engineer within the specified schedule, an Interface Management Plan, which is mutually acceptable to both the Contractors and the Designated Contractors. The Contractor shall appoint an experienced Engineer as Interface Manager after approval of the Engineer. The Interface Manager shall be positioned at Mumbai site starting from not later than six months from commencement date and at least till commissioning of all trains and satisfactory resolution of all interface issues. The CV of the proposed IM shall be submitted to the Engineer for approval not later than the three (03) months from the commencement date. The proposed IM should have minimum five (05) years of metro rolling stock project experience and should have worked on metro rolling stock project as a member of interface design and testing team involving design, supply & commissioning of trains in GoA4. The IM will be the nominated person in-charge for all interface activities with other designated contractors. The Interface Management Plan shall:

- (i) identify the sub-systems as well as the civil works and facilities with interfacing requirements;
- (ii) define the authority and responsibility of the Contractor's and Designated Contractors' (and any relevant sub-contractors') staff involved in interface management and development;
- (iii) identify the information to be exchanged, precise division of responsibility between the Contractor and Designated Contractors and integrated tests to be performed at each phase of the Contractor's and Designated Contractors' works;
- (iv) address the works programme of the Contract to meet the key dates of each Contractor and highlight any programme risks requiring management's attention;
- (v) After the review of Interface Management Plan with no objections by Engineer, the Contractor shall execute the works in accordance with the Plan.



000270



**ORGANISATION CHART (Proposed Interfacing)**

## 2.4 Work Plan (Works Programme and Design Submission Programme).

- 2.4.1 The Tenderer shall submit a Work Plan as a part of the tender which shall contain the following:
- (i) proposed Works Programme.
  - (ii) proposed Design Submission Programme.
- 2.4.2 The Tenderer's proposed Works Programme shall indicate how the Tenderer intends to organise and carry out the Works and achieve stages and complete the whole of the Works by the appropriate Key Dates. The Works Programme shall be prepared in terms of weeks from the Date of Commencement of Works.
- 2.4.3 The Tenderer's Design Submission Programme shall cover the Design phase and include a schedule identifying, describing, cross-referencing and explaining the Design Packages and submissions, which he intends to submit.
- 2.4.4 The Design Submission Programme should take due account of the design co-ordination interface periods with other Designated Contractors and be consistent with the Works Programme.
- 2.4.5 The Works Programme and Design Submission Programme shall include details as stipulated in Chapter 4 and 5 of this Employer's Requirements – General Specification, for review by the Engineer.

## 2.5 Quality Assurance Plan

- 2.5.1 The Tenderer shall submit an Outline Quality plan, illustrating the intended means of



000271



compliance with Chapter 2 of the Employer's Requirements - Technical Specification, and setting out in summary form an adequate basis for the development of the more detailed document. The outline Quality Plan shall contain sufficient information to demonstrate clearly the proposed method of achieving the Tenderer's quality objectives with regard to the requirements of the Contract.

2.5.2 The Plan shall be based on acceptable international standards. The Quality Assurance Plan shall embrace all activities of Contractors, Sub-Contractors of any tiers including its Suppliers and Design Consultants, if any. The Quality Assurance Plan shall indicate the approach and structure that the detailed plan will take and shall include the following:

- (i) a summary of the Project requirements including all proposed quality activities;
- (ii) all quality assurance and quality control procedures proposed by the Contractor for his use in the execution of the Works;
- (iii) a list of all the Codes of Practice, Standards and Specifications that the Contractor proposes to apply to his work;
- (iv) the Contractor's proposals for internal and sub-contractor quality assurance audits;
- (v) a statement detailing the records that the Contractor proposes to keep, the time during which they will be prepared and the subsequent period and manner in which they will be stored;
- (vi) inspection and test plans for every activity requiring inspection. The plans shall identify the level of inspection required, Quality Control Points and Quality Hold Points;
- (vii) procedure for maintenance of records of inspection/tests.

2.5.3 The Quality Assurance System shall be applied without prejudice to, or without in any way limiting, any Quality Assurance System that the Contractor already maintains.

## 2.6 Quality Plan

2.6.1 The Contractor shall provide the Engineer with a detailed Quality Plan taking into account any directions or requirements from the Engineer on the Quality Assurance Plan. The detailed plan shall be updated as necessary from time to time to incorporate, to the Engineer's satisfaction, all changes to the Contractor's procedures. The Quality Plan shall comprise:

- (i) A Management Quality Plan for control of management related activities;
- (ii) A Design Quality Plan for control of design related activities; and
- (iii) A Manufacturing (including Inspection and Testing) Quality Plan for the control of related activities.
- (iv) Testing and Commissioning (including Integrated Testing and Commissioning) Quality Plan.

2.6.2 Quality Organisation

The Contractor shall submit a detailed organisation chart identifying the responsibilities, authority and inter-relation of all personnel who manage, perform and verify work involving quality in respect of all Quality Plans. The organisation chart shall be specific to this Contract. The chart shall identify the Quality Management Representative who shall act as the Quality Co-ordinator for the Contractor in all dealings with the Engineer. The Contractor shall post the Quality Assurance Manager at production site as well as Mumbai site.

2.6.3 Quality Audit

The Contractor shall audit all the activities in each Quality Plan at quarterly intervals or at other such intervals as the Engineer may require, to ensure continuing suitability and effectiveness of the quality management system. The Contractor shall make available upon request any document, which relates to his recent internal audits.



The Engineer may require compliance audits of the Contractor's quality system to be conducted. Not less than two weeks notice will be given by the Engineer. During audits, the Contractor shall provide suitably qualified staff to accompany the auditor.

- 2.6.4 Responsibility of quality control during manufacture, testing & commissioning, DLP shall solely rest with the member of the consortium based on which the consortium/JV got qualified.

## 2.7 System Safety Assurance Plan

- 2.7.1 The Tenderer shall submit, as part of its Tender, an Outline Safety Plan, which shall contain sufficient information to demonstrate clearly the Tenderer's proposals for achieving effective and efficient safety procedures in the design, manufacture, testing and commissioning of the Rolling Stock. The Outline Safety Plan should include an outline of the safety procedures and regulations to be developed and the mechanisms by which they will be implemented for ensuring safety including Hazard Analysis, Fire control, EMC/EMI control, RAM (Reliability, Availability and Maintainability) requirements, site safety, transportation of rolling stock etc.

The Safety Manager shall be posted at Mumbai site at least 01 months before receipt of prototype train and up to the expiry of warranty period.

- 2.7.2 The Outline Safety Plan shall be headed with a formal statement of policy in relation to safety and shall be sufficiently informative to define the Tenderer's Safety Plan and set out in summary an adequate basis for the development of the site safety and safety in transport.
- 2.7.3 The Contractor shall submit for review by the Engineer, a System Safety Assurance Plan in accordance with the requirements of Chapter 2 of the Employer's Requirements - Technical Specification. The Plan shall include Hazard Analysis Plan, Fire Control Plan and EMC/EMI Control Plan.
- 2.7.4 The Hazard Analysis Plan shall evaluate and ensure that all the hazards are identified and satisfactorily resolved.
- 2.7.5 The Fire Control Plan shall evaluate and ensure inter alia that the fire loadings of material proposed to be used, and the fire withstand ratings etc. are as per the requirements specified in the Employer's Requirements - Technical Specification and also are compatible with currently accepted international practices.
- 2.7.6 The EMC/EMI Control Plan shall evaluate and ensure that the requirements for electromagnetic compatibility and interference as specified in the Employer's Requirements - Technical Specification for all elements of the system are met.

## 2.8 Reliability, Availability and Maintainability Assurance Plan

- 2.8.1 The Contractor shall submit for review by the Engineer, a Reliability, Availability and Maintainability Assurance Plan in accordance with the requirements of Chapter 2 of the Employer's Requirements - Technical Specification.
- 2.8.2 The Contractor shall describe procedures required to perform the specific tasks necessary to achieve RAM requirements in the Reliability, Availability and Maintainability Plan.
- 2.8.3 Contractor shall also submit Rolling Stock Management system plan for smooth management of the maintenance and DLP issues for the engineer's approval. Changes suggested by the Engineer for improving management flow shall be implemented. The broad preferred guidelines are as under.

The system may be divided into different functional groups say Inspection data management group, Train set functions for commissioning, train set maintenance record (DLP), Failure control, drawing management, material management, Modifications & review/change, design document management. Links amongst the above functional groups may be developed by the Contractor and be got approved from the Engineer. Contractor can suggest alternative as well.



000273



**2.9 Site Safety Plan**

- 2.9.1 The Contractor shall also submit Site Safety Plan and a plan for safe transport of rolling stock to the depot as per requirements of Chapters 10 and 11 of this Employer's Requirement: General Specification.

**2.10 Software Quality Assurance Plan**

- 2.10.1 The Contractor shall submit a Software Quality Assurance Plan in accordance with the requirements of Chapter 5 of this Employer's Requirements - General Specification, and Chapter 14 of the Employer's Requirements - Technical Specification.

**2.11 Environmental Plan**

- 2.11.1 The Tenderer shall submit as part of this Tender an Outline Environmental Plan illustrating the intended means of compliance with the Employer's Environmental Quality Management Manual. Outline Environmental Plan shall also contain sufficient information to demonstrate clearly the proposed method of achieving the Environmental objectives with particular reference to Noise, Vibration, EMC/EMI etc. to meet the stipulations of Chapter 2 of Employer's Requirements -Technical Specification.
- 2.11.2 The Contractor shall submit the Environmental Plan, in accordance with the requirements of Chapter 2 of the Technical Specification with particular reference to Noise, Vibration, EMC/EMI etc. The Environmental Plan shall include Noise and Vibration Plan and Environmental EMC Control Plan as per details furnished in Chapter 2 of Employer's Requirements -Technical Specification.

**2.12 Inspection, Testing and Commissioning Plan**

- 2.12.1 The Contractor shall submit an Inspection, Testing and Commissioning Plan in accordance with Chapter 7 of this Employer's Requirements-General Specification and Chapter 15 of the Employer's Requirements – Technical Specification.
- 2.12.2 The Contractor shall position the Testing and Commissioning Engineer-in-charge at Mumbai site at least 01 months before receipt of prototype train and up to six months after commissioning of last car.



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000275



**CHAPTER 3****CO-ORDINATION WITH DESIGNATED AND OTHER CONTRACTORS****3.1 General**

- 3.1.1 The Contractor is responsible for detailed co-ordination of his design and manufacturing activities with those of the System-wide Contractors, Civil Contractors, Consultants and other Contractors whether or not specifically mentioned in the contract, who may be working on or adjacent to the site for the purpose of the Project.
- 3.1.2 All of the above parties are referred to as Designated Contractors. A list of some of the main Designated Contractors and some of the identified major interfaces are given in **Appendix 7**. The Contractor shall note that there are other Contractors, Consultants, Agencies etc, which the Employer may engage from time to time, and with whom the Contractor shall have to similarly co-ordinate. Such co-ordination responsibilities of the Contractor shall include the following, but need not be limited to:
- (i) To provide all information reasonably required by the Designated Contractors in a timely and professional manner to allow them to proceed with their Design, Manufacturing, Construction activities, and to meet their milestones and key dates.
  - (ii) To ensure that the Contractor's requirements are provided to all other Designated Contractors, in a timely and reasonable manner.
  - (iii) To obtain from the Designated Contractors information reasonably required, to enable the Contractor to meet his own design submission dates.
  - (iv) To ensure very close co-ordination with Signalling & Communication Contractor, in respect of provision of Signal and Communication equipment in the cars, and finalising the interface between the Rolling Stock and Signalling & Communication equipment.
  - (v) Where the execution of the work of the Designated Contractors depends upon the site management or information to be given by the Contractor, the Contractor shall provide to such Designated Contractors the services, or the correct and accurate information required, to enable them to meet their own programme or construct their own works.
  - (vi) To ensure that there is no interference with the works of Designated Contractors.
  - (vii) To attend regular co-ordination meetings convened by the Designated Contractors and the Engineer. The Contractor shall conduct separate meetings with the Designated Contractors as necessary to clarify particular aspects of the Designated requirements of the Works. A record of the decisions taken in each such meeting shall be furnished to the Engineer. The party who convenes the meeting shall prepare minutes recording all matters discussed and agreed at the meeting.
  - (viii) To ensure that all correspondence, drawings, meeting minutes, programmes, etc. relating to the Contractor's co-ordination with the Designated Contractors are issued to all concerned parties and four copies issued to the Engineer no later than seven calendar days from the date of such correspondence and meetings.
- 3.1.3 The Contractor shall in carrying out his co-ordination responsibilities raise in good time and provide sufficient information for the Engineer to decide on any disagreement between the Contractor and the Designated Contractors as to the extent of services or information required to pass between them.
- 3.1.4 If such disagreement cannot be resolved by the Contractor despite having made all reasonable efforts, then the decision of the Engineer shall be final and binding on the Contractor.
- 3.1.5 Where a Designated Contract is yet to be awarded, the Contractor shall proceed with the



co-ordination activities with the Engineer until such time as the Designated Contractor is available. The Contractor shall provide the Designated Contractor with all information necessary to enable the Designated Contractor to follow-on and proceed with their co-ordination.

- 3.1.6 Any claim of additional costs by the Designated Contractors as a result of the Contractor's failure to keep to specified dates shall be borne by the Contractor. The Contractor shall note that the information exchange is an iterative process requiring the exchange and updating of information at the earliest opportunity and shall be carried out on a regular and progressive basis in order for the process to be completed for each design stage by the specified dates. Employer shall have full right to impose liquidity damages on the Contractor should there be an impact of these delays in achieving the key dates. Decision of Employer shall be final and binding.

### 3.2 Dedicated Co-Ordination Team

- 3.2.1 The Contractor shall establish a dedicated co-ordination team, led by a Co-ordinator reporting to the Contractor's Project Manager. The primary function of the team is to provide a vital link between the Contractor's design and manufacturing teams and the Designated Contractors. The Contractor shall provide the Engineer with particulars of the Co-ordinator. The Engineer shall have the right to require the replacement of the Co-ordinator if in his opinion the Co-ordinator is unable to meet the co-ordination requirements of the Contract. The Contractor's attention is drawn to the need for the Co-ordinator to establish effective dialogues and communication links with the Designated Contractors. The Contractor's co-ordination team shall comprise a mix of personnel with experience in both design and manufacture of rolling stock necessary for effective co-ordination.
- 3.2.2 The Co-ordinator shall assess the progress of co-ordination with Designated Contractors by establishing lines of communications and promoting regular exchange and updating of information so as to maintain the Contractor's programme.
- 3.2.3 The complexity of the project and the importance of ensuring that work is executed within time limitations require detailed programming and monitoring of progress so that early programme adjustments can be made in order to minimise the effects of potential delays.
- 3.2.4 The Co-ordinator in conjunction with the Designated Contractors shall identify necessary provisions in the Works for plant, equipment and facilities of the Designated Contractors. These provisions shall be allowed by the Contractor in his design of the Works.
- 3.2.5 During the course of the contract, information will be obtained in a number of ways, including direct inspection, regular site meetings, the obtaining of progress reports and the use of turn round documents to obtain design and programme data. Turn round documents shall be issued to the Designated Contractors to be returned giving the current positions on their programme.



## CHAPTER 4

### PLANNING, PROGRAMME AND PROGRESS MONITORING

#### 4.1 Works Programme Submission Requirements

- 4.1.1 The Works Programme submission requirements are organised into two parts. Part One is a requirement for all Tenderers and shall be submitted as part of their Tender. Part Two describes a series of reports to be submitted by the Contractor during the execution of the Contract.
- 4.1.2 In compiling its Works Programme, and in all subsequent up-dating and reporting, the Contractor shall make provision for the time required for co-ordinating and completing the design, testing, commissioning, and integrated testing of the Works, including *inter alia*, design co-ordination periods, during which the Contractor shall co-ordinate its design with those of Designated Contractors, the review procedures determining and complying with the requirements of Government Departments and all others whose consent, permission, authority or licence is required prior to the execution of any work. The Works Programme shall take full account of the Design Submission Programme.
- 4.1.3 The computerised Critical Path Method (CPM) using the Precedence Diagramming Method (PDM) shall be employed by the Tenderer in preparing their Part One submissions, and the Contractor in his Part Two submissions as well as all other programme submissions required during execution of the Contract.
- 4.1.4 Programming software shall be Primavera Project Planner for latest Windows Version (upgradable to new version) , obtainable from Primavera Systems Inc.
- 4.1.5 Should the Tenderer wish to propose an alternative programming software, he shall demonstrate in his Tender submission the proposed software's capability for direct data exchange with Primavera Project Planner for Windows Version 10.0 or later. Such data exchange compatibility shall include, but not be limited to activity and resource coding. Full electronic data transfer to Primavera is required. The various levels of reporting and coding capabilities shall be at least equivalent to Primavera. Comparable performance between Primavera and the Contractor's proposed system shall be demonstrated. Scheduling Software and relevant instruction manuals, licensed for use in connection with the Contract, shall be provided by the Contractor.
- 4.1.6 Should the Engineer accept the Tenderer's proposed software, he shall upon ward of the Contract supply the Authority with an original copy, including manuals and approved training, of the software and any subsequent versions thereof at no extra cost.
- 4.1.7 All terminology, definitions and conventions shall be in accordance with BS 4335 (Glossary of terms used in Project Network Techniques) or the Associated General Contractor's (AGC) manual entitled "The use of CPM in Construction".
- 4.1.8 All submissions shall be as detailed in ERGS clause 5.4.
- 4.1.9 All programme submissions shall, unless otherwise specified, conform to the format and level of detail specified in Appendix 1.

#### 4.2 Part One-Submission by Tenderers

- 4.2.1 The Tenderer shall clearly demonstrate in his tender submission the following;
- (i) The scheduling approach to the design, manufacture, testing and commissioning, integrated tests, and instrumentation tests, oscillation trials and any other required tests for the prototype rake, and service trials and their inter-relationships in the form of technically logical activity networks and also in bar chart format. These shall contain sufficient detail to assure the feasibility of the Tenderer's approach to meeting the contractual obligations. The programme shall be developed as a critical path network.
  - (ii) The Tenderer's capability to manage the Execution of the Works to meet the specified Key Dates. Details are given in Appendix 3.



- (iii) A means to show the dates and periods relating to the Interfaces and Works of Designated Contractors. An Assumption Report accompanying the network should clearly indicate key dates, specific activities of other contracts, if any, which precede the commencement of activities listed in the Tender Submission.
- (iv) Show submission for review and review period for all major documentation required by the Contract.
- (v) Clearly identify the critical path in the programme and fully described in the accompanying narrative.

4.2.2 The Works Programme in the Tender shall be accompanied by a narrative statement that shall describe Programme activities, assumptions and logic, and highlight the Tenderer's perception of the major constraints and critical areas of concern in the design, organisation, manufacture, supply, testing, commissioning and completion of the Works. This narrative statement shall also indicate which elements of the Works the Tenderer intends to carry out off-shore and/or in India, with details of the proposed locations of where any such work is to be carried out, the facilities available and any third party undertaking the Tenderer may have in this regard. In particular the Tenderer must state the assumptions made in respect of the interfaces with the Employer, Engineer, Other Contractors and third parties both in detail and time, and any requirements for information on matters, which would affect his works.

4.2.3 Not Used

### 4.3 Part Two-Submission by Contractor

#### 4.3.1 Work Programme Plan

The Contractor shall prepare a plan, illustrated by sample schedules, charts, tables, etc., detailing his proposals for staff and their responsibilities to support the programming functions, for submission of works programmes for the Execution of the Works, for the design, manufacture, supply, testing and commissioning, in accordance with the key dates for co-ordinating his programmes with those of the System-wide and Civil Contractors, for measuring, monitoring and reporting progress, for revisions to the programmes to ensure completion of the Works within the specified times.

The Contractor shall submit the works programme plan as per the Employer's requirement mentioned in chapter-2 of this GS for review of Engineer. Based on the review, the Contractor shall promptly make all amendments as required by the Engineer for his acceptance of the plan.

#### 4.3.2 Preliminary Programme

The Contractor shall make a preliminary Works Programme submission in accordance with the principles set out in his accepted plan. Such submissions may make use of the tender submissions, suitably amended, to the requirements of the Engineer. The submission shall be made in accordance with the respective plans as indicated in table 2-A.

The Contractor shall note that at the time of submission of his preliminary networks and bar charts, it may be that such Programmes have yet to be co-ordinated with the System-wide and Civil Contractors. These shall not prevent the Contractor from submission of detailed preliminary programmes using approximate dates for work of the System-wide and Civil Contractors (where such dates are not available), which has impact on the Contractor's programmes. Such programmes shall be amended subsequently to take into account the actual schedules of the System-wide and Civil Contractors. It is the Contractor's responsibility to ensure timely co-ordination with the System-wide and Civil Contractors to finalise his preliminary programmes so as not to affect the progress of the Works or those of the System-wide and Civil Contractors.

#### 4.3.3 Baseline Programme

Following the Contractor's preliminary programme, submissions, no later than 90 days from the date of Notice to Proceed, the Contractor shall make re-submissions of these



000279



programmes suitably amended to take into account the programmes of the System-wide and Civil Contractors. It is the Contractor's responsibility to ensure timely co-ordination with the System-wide and Civil Contractors to review, revise and finalise his preliminary programmes so as not to affect the progress of the Works and those of the System-wide and Civil Contractors.

The resubmitted programmes when accepted by the Engineer shall form the Baseline Programme against which actual progress of the Works is measured.

As the Works progresses, it may be necessary for the Contractor to update the Baseline Programme but such updating shall only be carried out with the prior approval of the Engineer or when directed by the Employer.

#### 4.3.4 Precedence Diagramming Method Logic Network

The Contractor shall submit Precedence Diagramming Method logic network when requested by the Engineer from time to time to assist him in the analysis of the Contractor's Programmes.

#### 4.3.5 Baseline Schedule Report

- (i) The Contractor shall submit a Baseline Schedule Report in accordance with the approved format, which will quantitatively document the Baseline network and bar charts submitted. The activities in the report shall be grouped into the various phases e.g. design, manufacturing, delivery, commissioning etc.
- (ii) Also required with the submission of the Baseline Schedule Report is a narrative sufficient to explain the basis of the Contractor's determination of duration and to describe the Contractor's approach to meeting specified key dates. The reasons for the main logic links and outline method statements shall be provided.
- (iii) The Baseline Schedule Report and narrative shall be submitted together with the preliminary programme.
- (iv) Notwithstanding the above, the Engineer may at any time during the course of the Contract require the Contractor to reproduce the computer-generated Baseline Schedule Report to reflect actual activity dates and generate schedules based upon "what if" statements.

#### 4.3.6 Progress Reports

Progress reports, as detailed in Appendix 2, shall be regularly submitted by the Contractor, on a monthly basis.

### 4.4 Review Periods for Contractor's Submissions

- 4.4.1 The Engineer shall review those Contractor's programme submissions which require his acceptance and shall signify his acceptance or otherwise within 30 days. The Contractor shall, when required by the Engineer, re-submit his programmes and submission within 14 days of receipt of the Engineer's comments.

The Engineer will endeavour to review and respond to the Contractor on the adequacy and acceptability of the Contractor's submissions and re-submissions as soon as reasonably possible but the Contractor should always allow for a 30 day review period.

- 4.4.2 Unless otherwise specified, the Contractor shall allow in his programme a 30-day review period for all submissions to the Engineer.

### 4.5 Failure to Make Submissions

- 4.5.1 Failure of the Contractor to submit any programme, or any required revisions thereto within the time limits stated shall be sufficient reason for certification that the Contractor is not performing the work required in a timely manner. The Engineer may certify retention of payment under the Milestone-related Schedule of Payments proposed for the Contractor, until his programmes are accepted by the Engineer, and may also cause imposition of Liquidated Damages.



**4.6 Programme Revision**

- 4.6.1 The Contractor shall revise his programmes whenever necessary, with the consent of, or as required by the Engineer to ensure completion of the Works within the times for completion prescribed in the Contract

**4.7 Planning and Programming Staff**

- 4.7.1 The Contractor shall employ sufficient number of planning and programming staff competent in the use of the programming software and with a good knowledge of the type of work required to be performed by the Contractor under the Contract.

The Engineer shall have the discretion to require the Contractor to replace his planning and programming staff if the Engineer considers that they do not have the training or skill required for this very specialised nature of work.

**4.8 Project Calendar**

- 4.8.1 Project Weeks shall commence on a Monday. A day shall be deemed to commence at 0001 hours on the morning of the day in question. Where reference is made to the completion of an activity or Milestone by a particular week, this shall mean by midnight on the Sunday of that week.
- 4.8.2 Requirements for the computation of Key Dates are given in Appendix 3 to the Employer's Requirements
- 4.8.3 A 7-day week calendar shall be adopted for various Work Programme Schedules for scheduling purposes.
- 4.8.4 For Project purposes, the presentation shall be in "Week" units.



000281



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000282

## CHAPTER 5

### DESIGN SUBMISSION REQUIREMENT

#### 5.1 General

- 5.1.1 The objective of the design submission process is to ensure that the proposed resulting works comply with the specifications, are capable of being produced consistently to exacting quality standards, achieve low life cycle costs and can be operated safely to the satisfaction of the Engineer.
- 5.1.2 The design submissions include Design Calculations, Design Reports and Design Drawings. All design submissions shall include a 'clause by clause' compliance status to all applicable contract clauses of ERTS.
- 5.1.3 In the event that a statutory body (e.g. Government of India Ministry of Railways, RDSO, Commissioner of Metro Railway Safety, etc.) requires design information in a particular format, it shall be incumbent upon the Contractor to provide the same, as directed by the Engineer.

#### 5.2 Review of Data

- 5.2.1 As soon as practicable after Contract Award, the Contractor shall review all applicable data, criteria, standards, directives and information provided to him as the basis for design. Any apparent inconsistencies or erroneous information shall be brought to the attention of the Engineer. Such information shall not alleviate the Contractor from his responsibilities under the Contract.

#### 5.3 Format of Deliverables

- 5.3.1 Drawings and CAD data shall comply with the requirements of Appendix 4 of this General Specification: Drawing and CAD Standards. Reports, calculations, specifications, technical data and similar documents shall be provided in A4 format, and one of the copies shall be ring bound to facilitate photocopying. A3 size drawings included in documents shall be folded to A4 size.
- 5.3.2 Drawing and CAD Data Format

Within 30 days of Notice to Proceed, the Contractor shall have prepared and submitted the drawing and CAD procedures together with sample drawings and corresponding CAD data to demonstrate his understanding and compliance with Appendix 4 of this General Specification: Drawing and CAD Standards.

#### 5.4 Number of Copies

- 5.4.1 The following quantities of drawings and other documents shall be submitted to the Engineer, including preliminary, pre-final, and final design submissions, the final contract document, and all other submissions. These drawings and documents are in addition to those required for the exchange of information between Designated Contractors and other submissions to statutory, governmental and local authorities. The submissions shall be in A0, A1, A3 or A4 size, as appropriate except as may otherwise be agreed by the Engineer. In addition, the submissions shall also be made in electronic format in a medium acceptable to the Engineer.

##### A. Hard copies:

- (i) Full-size sets of paper drawings (folded and collated): one copy for each Depot plus two copies.
- (ii) FDD (Final Design Documents): one copy for each Depot plus two copies.
- (iii) 3 sets of design documents and calculations.
- (iv) 2 copies of Design Status Report and Design Statement.
- (v) 2 sets of all other submissions.

##### B. Soft Copies:



000283



- (i) Contractor shall handover and maintain at DMRC office 3 nos. of external hard disks of sufficient storage capacity for Engineer's office as directed by the Engineer, duly fed with all the details and documents specified at para A(i) to (v) above, including Presentations made by Contractor and other related agencies. The stored information shall be updated on daily basis during working hours by the contractor till issuance of Performance Certificate by the Employer as per contract conditions.

All the above mentioned submissions shall be in editable format (except catalogues and test certificates) as well as well in PDF format.

## 5.5 Design Submission Programme

5.5.1 The Contractor shall prepare the Design Submission Programme, which is to set out fully the Contractor's anticipated programme for the preparation, submission and review of the Design Packages, the Final Design Submission and the Installation and Manufacturing Drawing Submissions and for the Issue of Notices in relation thereto.

5.5.2 The Design Submission Programme shall:

- (i) be consistent with and its principal features integrated into the Works Programme, and show all relevant Milestones and Key Dates;
- (ii) identify dates and subjects by which the Engineer's decisions should be made;
- (iii) make adequate allowance for periods (minimum 45 days) of time for review by the Engineer and other review bodies;
- (iv) indicate the Design Interface and Co-ordination periods for each Designated Contractor;
- (v) include list of requisite design details for each and every component or equipment of all sub-systems and systems;
- (vi) Submission of design documentation shall be suitably staggered.

The Contractor shall update the Design Submission Programme suitably if Engineer observes any deviation.

5.5.3 For System, sub-system and components the Contractor shall submit documents and drawings describing function description, product description, interface requirement description, RAM requirement description, Life cycle calculations, Type & routine test specifications, list and details of spares, related calculations etc. The Design Submission Programme shall also include listing of various Plans, processes and other submissions.

5.5.4 The Contractor shall submit the Design Submission Programme to the Engineer as indicated in Chapter 2 of this Employer's Requirements - General Specification, and thereafter up-dated versions thereof at intervals of not more than one month throughout the Design Phase.

## 5.6 Design Process

5.6.1 The Contractor shall deploy Design staff having sufficient experience, in Delhi/Mumbai within 3 months after the date of commencement and the team shall be present up to pre-final design stage at all times to maintain liaison with the Engineer. The principal requirement of the Design Phase is to undertake the design during this phase in three stages:

- (i) the preparation of the Preliminary Design;
- (ii) the preparation of the Pre-final Design; and
- (iii) the preparation of the Final Design.

In the contract document, wherever the various details/documents are being asked to submit at Design stage, it shall mean the Pre-Final Design Stage unless otherwise



specified.

## 5.7 Preliminary Design

5.7.1 The purposes of the Preliminary Design submission are as follows:

- (i) State the design criteria;
- (ii) Design the overall system, and propose the system configuration;
- (iii) Identify the functions of each system, sub-system, equipment or other element within the overall design, and specify the relationships and interfaces between elements of the system;
- (iv) Identify the functions of each system, sub-system, equipment or other element within the overall design, and identify the relationships and interfaces between elements of the Contractor's system and those of other Designated Contractors; and
- (v) Verify the tender designs and calculations. In case of simulations, the inputs, relevant formulae, principles, assumptions, algorithm and logic followed shall be submitted with a sample calculation for each case. It shall be obligatory on the Contractor to submit any further details as required by the Engineer to approve the results. Any spreadsheet if submitted shall be supported with the linked formulae and calculations.
- (vi) Incorporate the Engineer's suggestions and changes based on the Technical Specification and/or operational requirements.

## 5.8 Pre-Final Design

5.8.1 In the Pre-final Design stage the conceptual designs (including interfaces with those of Designated Contractors of the Employer, and of the Contractor's vendors) are required to be fully developed. In this stage, each element of the system will be considered and preliminary specifications with supporting calculations developed. Preliminary electrical and control schematics shall be developed to illustrate how various operational and functional requirements are achieved. Software design and development shall also be carried out at this stage.

5.8.2 Manufacturing units will be allowed to commence production only after receiving 'no objection' advice from the Engineer. This submission shall include sufficient detail from prospective suppliers to demonstrate that they have adequate understanding of the requirements. It will include either evidence of or proposals for design verification. Interfaces with other Designated Contractors shall be finalised by this stage.

5.8.3 Development of maintenance manuals & methodology of other derived maintenance activities (as defined in ERTS 2.12.6).

## 5.9 Final Design

5.9.1 The purpose of the Final Design submission is to agree with the Engineer that the equipment is satisfactory, compliant with the specification, fit for purpose and safe. The Final Design shall be the level of design developed to the stage where all manufacturing drawings (including those received from Designated Contractors of the Employer, and Vendors of the Contractor) are fully defined and specified and in particular:

- (i) calculations and analyses are complete;
- (ii) all main and other significant elements are delineated;
- (iii) all other work, including studies, investigations and reports are complete.

## 5.10 Design Submission and Review Procedure

5.10.1 All design submissions from the Contractor shall be made under a Design Review Certificate Application (DRCA) notice. The following DRCA numbering system shall be used to identify all submissions:



000285



<Contract No.>/<Subject Code>/<Stage Code>/<Sequence No.>/<Revision No.>

- 5.10.2 The contract number shall be limited to no more than four digits and reflect the contract number only e.g. BS03, BD01 etc.
- 5.10.3 The stage code and subject codes should be developed in conjunction with the Engineer to help identify particular types of submissions, e.g. type of service or equipment. A schedule of subject codes for each contract should be submitted to the Engineer for acceptance.
- 5.10.4 The Contractor shall ensure that all submissions are correctly numbered in accordance with the schedule. The sequence code shall be a unique sequential number for each submission for each particular subject. Revision numbers shall be used when a re-submission is required, i.e. a DRCA was awarded "Not Accepted". For the initial submission the revision code of DRCA number shall be left blank.
- 5.10.5 Upon receipt of design submissions from the Contractor, a copy of the DRCA will be signed, dated and returned by the Engineer.
- 5.10.6 The Engineer shall issue Design Certificate Consent (DCC) Sheet properly dated and numbered to Contractor for each of the DRCA. The DCC will carry status as Notices of "No Objection", "Notices of No Objection, subject to...." and decisions made by the Engineer in response to a Design Review Certificate Application made by the Contractor shall be transmitted to the Contractor on a Design Certificate Consent (DCC) Sheet properly dated and numbered. The consent sheet number shall be the same as the Design Review Certificate Application number except that the letters "DRCA" are replaced by "DCC".
- 5.10.7 When significant comments are noted by the Engineer on the design submission, the "DRCA" shall be returned "Not Accepted", and signed by the Engineer. One copy of the "DRCA" shall be returned to the Contractor together with the comments on why the submission was rejected.
- 5.10.8 When minor comments are noted by the Engineer on the design submission and it is "No Objection, but Subject to Comments" the "DRCA" will have the appropriate decision indicated upon it and be signed by the Engineer. One copy of the DCC, together with comments, will be returned to the Contractor.
- 5.10.9 A submission will be rejected automatically if not signed by the Contractor's Authorised Design Representative.
- 5.10.10 Upon receipt of a decision sheet from the Engineer, the "DCC" will be signed, dated by the Contractor, and returned to the Engineer.

### 5.11 Engineer's Review

- 5.11.1 The Engineer will complete his review of the submission within 45 calendar days), after which the review comments in writing or on marked up drawings and specifications will be furnished to the Contractor. The Contractor shall then meet with the Engineer to discuss the review comments. Within two weeks of the receipt of the Engineer's comments the Contractor shall submit his proposals for implementation in the next submission. Where the comments are minor, such proposals may be clarified by calculations, part prints, etc. acceptable to the Engineer and included in the Contractor's next submission. Should the Engineer deem the submission to be unacceptable, the Contractor shall revise and re-submit the entire submission within two weeks, unless otherwise agreed with the Engineer.
- 5.11.2 After Engineer's review of the design submissions, the Contractor shall update the documentation incorporating Engineer's observations and also other design requirements. For all subsequent submissions, the Contractor shall demonstrate that all the previous comments by Engineer has been incorporated. The Comments previously issued by Engineer shall also become part of the submission. All re-submissions by the Contractor to the Engineer shall invariably include an item-wise 'Reply sheet' to Engineer's comments on previous submissions/ Minutes of Meetings.



- 5.11.3 It is Employer's understanding that the Contractor will need to depute a team of its Design Engineers for interaction with Employer's experts at New Delhi/Mumbai. Employer at his discretion may also consider deputing a team of Engineers (around six) to Contractor's design office or at Sub vendor's office for requisite duration with a view to expedite finalization of designs. In such case, Contractor shall provide office facilities and bear full expenditure towards out of pocket allowance, travel expense (as per entitlement), boarding, lodging etc. Such visit(s) as described above shall not be considered as part of inspection activity.

## 5.12 Final Design Document Delivery

- 5.12.1 To achieve agreement with the Engineer on the completion of the design and to allow the formal submission of the Final Design, the Contractor shall submit a list of all accepted Design Submissions to the Engineer for review along with self-adhesive stickers signed by the Contractor's Representative (CR). If there is no objection by the Engineer, he shall then sign and return the self-adhesive stickers to the Contractor for affixing to the amended Final Design Drawings (original) prior to their submission under the Final Design Document Delivery.
- 5.12.2 All the final design drawings shall be submitted in 3D format and shall be openable and editable in solid works latest version; wherever applicable. The Contractor shall also provide a licensed copy of latest solid works software along with its 3-D visualization CAD tools.
- 5.12.3 Based on the Engineer's review of the Final Design Submission, the Contractor shall then re-submit the entire Final Design Submission together with the following documents:
- (i) joint statements of completed design interface with the Designated Contractors of the Employer;
  - (ii) a signed statement confirming that he has incorporated all comments of the Engineer;
  - (iii) a Design Certificate duly endorsed, as shown in Appendix 5.

This above jointly will be known as "Final Design Document Delivery".

## 5.13 As-Built Drawings and Documents

- 5.13.1 As-built drawings are intended to show the works exactly as constructed. These are prepared by amending the manufacturing drawings to take into account changes necessitated by manufacturing methodology. These drawings shall be completed on a regular basis as the works progress, and not left until the completion of the Defect Liability Period.
- 5.13.2 Contractor shall submit these as-built drawings in 3D format which shall be openable and editable in solid works latest version.
- 5.13.3 At least 1 months but not more than 3 months prior to the anticipated date of delivery of the prototype rake, the Contractor shall compile and submit to the Engineer for recording purposes all those documents and drawings which in the opinion of the Contractor, constitute the complete record of the design and manufacture of the Works.
- 5.13.4 The updated compilation of the complete record of the design and manufacture of the Works shall be submitted at the end of the Defect Liability Period.

## 5.14 Manufacturing Drawings

- 5.14.1 Detailed manufacturing drawings will not normally be required for acceptance but shall be submitted for comment if the Engineer so requires.

## 5.15 Post Acceptance Changes

- 5.15.1 Changes to accepted drawings, whether they are initiated by the Contractor or the Engineer, shall be submitted through the DRCA system. The same process of submission, review and acceptance as described above shall be adopted. Upon acceptance of the post acceptance change, the Engineer shall issue a DCC to this effect.



000287



Submission as a result of a post acceptance change shall use a new DRCA number, i.e. not a previously used one.

- 5.15.2 The Contractor may propose an alternative procedure for implementing post acceptance changes (hardware and software) for review of the Engineer.
- 5.15.3 For requesting any change to the accepted design the Contractor shall submit the relevant design details for review of Engineer. The Contractor shall not implement any change without receiving 'No objection' from the Engineer.



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## CHAPTER 6

### SOFTWARE MANAGEMENT AND CONTROL

#### 6.1 Prescriptive Framework

- 6.1.1 The Contractor shall, within 75 days of the commencement date,, submit a Software Quality Assurance Plan for review by the Engineer.
- 6.1.2 All software to be developed or modified (re-engineered software) shall follow the standardisation requirements of EN 50128 (Railway Applications: Software of Railway Control and Protection Systems). The Contractor shall define within the Software Quality Assurance Plan what techniques and measures are to be applied for software development.
- 6.1.3 The Plan shall require the Contractor to provide all changes, bug fixes, up-dates, modifications, amendments and new versions of the programmes, as required by the Engineer. Engineer may also direct to provide the copy of previous version of software till such time the new version of software is proven.
- 6.1.4 The Contractor shall provide all tools, Laptop computers or any special device to upload / download the software, TCMS data, equipment, manuals and training necessary for the Project Owner, Employer and Engineer to maintain and re-configure all software provided under this Contract. The documentation of software shall be supplied after the expiry of the warranty period.
- 6.1.5 When a fault is discovered in delivered software, or an error in the associated documentation, the Contractor shall take the necessary steps to rectify such faults and errors at the earliest opportunity. The Contractor shall supply to the Engineer, full details, in writing, as to the nature of the corrective action proposed or taken. These changes shall be documented in the form of Software Engineering Change Proposal (SECP), which shall be got approved from Engineer. The documentation of software shall be supplied after the expiry of the warranty period.
- 6.1.6 It will be incumbent upon the Contractor to take responsibility for any changes required to software.

#### 6.2 Software Framework

- 6.2.1 As defined in EN 50128, all software produced or supplied for the Project shall be subject to a defined quality framework. ISO 9000-3 shall be considered appropriate for low criticality software (safety integrity level 0 or 1) whilst the application of a more stringent framework shall be required for higher criticality software (safety integrity level 2 or above). The quality framework requirements for safety integrity level 2 and above are supplementary to the requirements of EN 50128.
- 6.2.2 SIL level of all softwares used in different sub systems shall be defined and certified.

#### 6.3 Software Management Control

- 6.3.1 The Contractor shall ensure a full time Software Project Manager and Software Quality Manager are appointed for software development, if software development or modification is required under the Contract.

#### 6.4 Auditing

- 6.4.1 The Engineer shall carry out an audit of the Software. Further external independent audits may also be arranged at the Engineer's discretion.

#### 6.5 Software Acceptance

- 6.5.1 The Contractor also shall submit an Operational Safety Report (Software) for software acceptance by the Engineer.

The Operational Safety Report (Software) shall include, as a minimum

- (i) OSR(S) - Introduction



Shall describe the nature of software sufficiently to ensure that the Engineer is given a comprehensive overview of primary characteristics such as structure, functions, criticality, volume and language.

(ii) OSR(S) - Evidence of Quality Management

Shall provide evidence to demonstrate that the software development has been subject to acceptable quality assurance.

(iii) OSR(S) - Evidence of Safety Management

Shall provide evidence to demonstrate that the software development has been subject to acceptable safety management.

(iv) OSR(S) - Technical Report

Shall describe how software integrity has been achieved.

(v) OSR(S) Operation and Maintenance Report

Shall describe the Software operation and maintenance characteristics.

(vi) OSR(S) - Restrictions for Use

Shall define what restrictions are applied to the use of the software.

## 6.6 Application Software and Development Tools

- 6.6.1 With the exception of commercial, "Off the Shelf" Software, the Engineer shall be provided with full access to application software(s) and any other software /hardware tools which may be specifically required for the intended purpose specified in this specification. For commercial software, the Contractor shall provide all available documentation for the application and maintenance of that software. In case any commercially available software has been modified for being used in the train, the same shall be supplied to all Depots. Also in such case, the modification done shall ensure that the developed software shall work in the intended manner without any limitation whatsoever with the updated software versions and full backward integration shall be available.

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

It shall be possible for the Employer/Project Owner to modify/change various parameters/logics used in the software and implement the changes on trains. Full facilities including any software/hardware tools, simulation/test bench which are essential for this purpose shall be supplied within the quoted cost to each Depot. The Employer/Project Owner may depute their Engineers during the TCMS software development. They shall be fully exposed and given hands-on experience of software modification, simulation and implementation. Details shall be finalised during design. Complete set of parameters along with necessary changes that may be required to be made in the supplied software, shall be furnished so that different makes of equipment if need be, can be integrated. It shall also be possible for Engineer to connect/interface additional peripheral equipment as required by the Employer/Project Owner with vehicle/train software or TCMS, as the case may be, and implement system integration for the same. Contractor shall demonstrate to entire satisfaction of the Engineer that the Employer/Project Owner will be able to integrate peripheral equipment of makes other than that have been used by Contractor in the train. Any hardware/software tool required for this purpose shall also be supplied.



The Employer/Project Owner shall be fully trained to the entire satisfaction of Engineer and made conversant with the software and other related issues as found necessary during the contract execution. The documentation of software shall be supplied at the time of testing and commissioning of prototype trainset and this shall be considered as a pre-requisite for accomplishment of Key Date No. '4'. This document must contain logic and signal flow diagrams in detail for each TCMS output, duly linking it with the inputs. Similarly details as above shall be provided for HVAC, Brakes, PA/PIS and Propulsion etc. The final document including all changes that may be done during the currency of the contract shall be supplied after the expiry of the warranty period and this shall be considered as a pre-requisite for issue of Performance Certificate.

- 6.6.2 After loading, and the satisfactory functioning of the softwares, the Contractor shall supply two back-up copies of the softwares, including any new versions adopted. The documentation of the softwares shall be supplied at the time of testing and commissioning of prototype trainset. The final documentation of softwares including all changes that may be done during the currency of the contract shall be supplied after the expiry of the warranty period and this shall be considered as a pre-requisite for issue of Performance Certificate. Employer at his discretion may affect suitable changes considered either desirable or essential during the post warranty Period. Employer shall be solely responsible for any such changes that are made without specific written approval of the Contractor.
- 6.6.3 All software(s), irrespective of Contractor's own software or of Sub-Suppliers, shall be compatible with latest version of Windows Operating software and shall also have upward compatibility. In case, the compatibility of installed software(s) with latest version of Windows is not available, the Contractor shall replace the installed software(s) that are compatible with latest version of Windows O.S. without downgrading the train performance. Contractor shall commit to support and supply free of cost any special hardware/software required for ensuring compatibility with new version of Windows for at least a period of 5 years beyond DLP of the last train.

Beyond this period, in case of obsolescence suitable alternatives solutions shall be implemented (at mutually agreed terms and conditions) and full support shall be provided by the Contractor so as to ensure that train performance is not affected adversely.

Diagnostic tools to be provided as per the 'Cost Center G' shall include all hardware/software required for the purpose of

- i) Uploading/downloading of all softwares used in the train/system/sub-systems.
- ii) Downloading of faults and any other information required for trouble shooting and diagnostic purpose.
- iii) Data analysis and investigation tools of real-time downloads on central computer.

## 6.7 Re-Use of Existing Software

- 6.7.1 Where existing software (defined to module level) is to be re-used without modification, the Contractor shall provide acceptable evidence to the Engineer as to why that software is suitable for use in the proposed application. This evidence may be historical (certified evidence of previous satisfactory use in a similar environment and application), or it may be sought as cross acceptance from another railway authority or statutory body. Software re-use shall not be acceptable, without detailed review, where the proposed application is of the same or lower safety integrity level than the current application.

## 6.8 Re-Engineered Software

- 6.8.1 Re-engineered software may be used for applications at all safety integrity levels where the proposed application is of the same or lower safety integrity level than the current application. However, this shall be subject to quality assurance testing as defined above.



000292



**6.9 Test Software**

- 6.9.1 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 accepted international standards. Test software shall be developed and documented using structured techniques and shall be designed to be maintainable throughout the duration of the Contract. All test software shall be documented to be supportive of maintenance. Any test software, which is to be delivered to the Employer (for long term testing use), shall be fully documented to allow the Employer to maintain the software for the life of the supported system.

**6.10 Software Rights**

- 6.10.1 The Contractor shall ensure that the Employer is granted all necessary rights to use Software embodied in the equipment and there are no restrictions attached to the use of any information supplied by the Contractor which might later prevent or hinder the Employer from modifying or adopting or extending the system. The Contractor shall indemnify the Employer against claim of any party, Sub-Contractor for the unauthorised possession or use of the software supplied.



## CHAPTER 7

### INSPECTION, TESTING AND COMMISSIONING

#### 7.1 General

7.1.1 The Contractor shall submit Inspection, Testing and Commissioning Plan for Engineer's review as per schedule furnished in table 2-A. The Inspection, Testing and Commissioning Plan shall be prepared in accordance with the requirements of Chapter 15 of the Employer's Requirements – Technical Specification. This plan shall also include Integrated Testing and Commissioning of Trains in the Section and Service Trials before introduction in Revenue Service. The Plan shall contain, but not limited to, the following topics:

- (i) the Contractor's methodology for inspection, testing and commissioning;
- (ii) all Inspections and Quality Hold Points;
- (iii) the interdependency and inter-relationship with Designated Contractors and their commissioning programme;
- (iv) the objectives of each test and criteria for successful tests;
- (v) organisation chart and CV of key personnel in the Testing and Commissioning team;
- (vi) documentation for conducting tests and submission of Testing and Commissioning procedures.

7.1.2 The Engineer will then check the plans to see whether, it meets the requirements. The Engineer shall inform the Contractor in writing within a reasonable period after receipt of the above information;

- (i) that the Contractor's proposed methods of inspection, testing and commissioning (including Integrated Testing and Commissioning) have the consent of the Engineer; or
- (ii) in what respects, in the opinion of the Engineer the Contractor's proposed methods etc
- (iii) fail to comply with the Employer's Requirements and/or the Final Design Document;
- (iv) would be detrimental to the Works and/or to the other works comprising the Project;
- (v) do not comply with the other requirements of the Contract; or
- (vi) as to the further documents or information which are required to enable the Engineer to properly assess the proposed methods of inspections, etc.

7.1.3 In the event that the Engineer does not give his consent, the Contractor shall take such steps or make such changes in the said methods or supply such further documents or information as may be necessary to meet the Engineer's requirements and to obtain his consent. The Contractor shall not change the methods of inspection, testing and commissioning (including Integrated Testing and Commissioning) which have received the Engineer's consent without further review and consent in writing of the Engineer.

7.1.4 Notwithstanding the foregoing provisions of this Clause, or that certain of the Contractor's proposed methods of inspection etc. may be the subject of the consent of the Engineer, the Contractor shall not be relieved of any liability or obligation under the Contract.

#### 7.2 Sequence of Tests

7.2.1 The sequence of tests shall be:

- (i) Routine and type tests of equipment and sub-systems in accordance with



- relevant standard and specifications in Contractor/Sub-contractor's factories.
- (ii) Factory and Site Tests of complete cars in accordance with IEC 61133.
  - (iii) Testing and Commissioning of cars/trains in Depot in accordance with IEC 61133.
  - (iv) Integration Tests in conjunction with all Designated Contractors.
  - (v) Instrumentation, and Oscillation Trials on Prototype Rakes only.
  - (vi) Service Trials.



000295



## CHAPTER 8

### SUPPLY OF SPARES, SPECIAL TOOLS AND TESTING EQUIPMENT

#### 8.1 General

8.1.1 The Contractor shall supply the following items of spares:

- (i) Unit Exchange Spares;
- (ii) Consumable spares for maintenance of all trains during commissioning, service trials and up to completion of Warranty period;
- (iii) Mandatory spares;
- (iv) Recommended spares;
- (v) Overhauling spares;
- (vi) Special tools, Testing and Diagnostic equipment;
- (vii) Special Jigs, Fixtures & Gauges required for maintenance, repair and overhaul of various equipment, sub-systems in particular and the complete trains in totality;

8.1.2 The relevant list of the spares mentioned above shall be submitted in the technical bids after blanking the prices, where applicable. The financial bid shall have the price details.

8.1.3 Contractor shall submit purchase technical specifications of the items used in this project. Engineer's views, if any, shall be suitably incorporated.

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

#### 8.2 Unit Exchange Spares

8.2.1 The Contractor shall supply the Unit Exchange Spares as listed in the **Appendix 6** of this Employer's Requirements - General Specification. The Unit Exchange Spares shall be supplied in the Depot nominated by the Engineer. The delivery requirements of different lots are mentioned in the Appendix-6. These shall be delivered as per the key dates defined.

#### 8.3 Consumable Spares

8.3.1 The consumable spares shall include lubricants, oils, greases, sealants, brake pads, filter medias, gaskets, lamps, wearable parts like pantograph strips etc. and any other item, **whose declared life is less than one year.**

8.3.2 The consumable spares shall be stored at respective depots of the corridors.

8.3.3 The Tenderer shall provide a recommended list of consumable spares as noted above for maintenance, repairs and overhaul of trains. Any consumable item if required but not included in the above recommended list by the tenderer will be deemed to have been included and shall be supplied as per the provisions of this contract without any extra financial implication to the Employer. Contractor will be required to supply only the requisite quantity of spares, as required irrespective of the quantities indicated by the contractor in the recommended list. Employer's decision in determining any particular item(s) as consumable in line with 8.3.1 above will be final and binding. In case any changes are required in the supply of consumables on account of changes at design stage, the contractor shall have to supply the required consumables within the quoted cost. No increase in per unit quoted cost shall be made due to any change in the list of consumables arising due to change/modification of design.

8.3.4 Unpriced list of consumable spares shall be furnished in the Technical Package. List of consumable spares shall contain following information as a minimum:

- (i) Names, addresses, telephone numbers and other particulars of manufacturers and their local representatives;



- (ii) Models and part numbers,
- (iii) Full description of spares including a note whether it is sealed unit or an assembly or sub-assembly which can be broken down into component parts;
- (iv) Quantity installed in the system;
- (v) Expected consumption rates;
- (vi) Overall dimensions and weight including minimum packing (if any) for shelf space purposes;
- (vii) Interchangeability or otherwise with similar parts;
- (viii) Normal manufacturing and shipment lead times; and
- (ix) Shelf life.

8.3.5 It shall be the responsibility of the Contractor to maintain sufficient stock of consumable spares at respective depots of different lines.

8.3.6 The list of consumable spares recommended by system/sub-system/equipment manufacturers shall be furnished by the Contractor as part of design submission for respective systems /subsystems/equipment.

#### 8.4 Mandatory spares

8.4.1 The Contractor shall supply the Mandatory Spares as listed in the **Appendix 6** of this Employer's Requirements - General Specification. The Spares shall be supplied in the Depot nominated by the Engineer. The items and quantity required are mentioned in the list in Appendix 6. The price of these spares shall be quoted at actual.

8.4.2 No change in quoted cost of any spare will be allowed even when there is change in design of any equipment/sub-system during execution of the contract.

8.4.3 Contractor will furnish complete details during contract execution (detailed design stage) as noted below for the listed spares;

- (i) Names, addresses, telephone numbers and other particulars of manufacturers and their local representatives;
- (ii) Models and part numbers
- (iii) Full description of spares including a note whether it is sealed unit or an assembly or sub-assembly, which can be broken down into component parts;
- (iv) Quantity installed in the system;
- (v) Overall dimensions and weight including minimum packing (if any) for shelf space purposes;
- (vi) Designed and shelf life;
- (vii) Interchangeability or otherwise with similar parts;
- (viii) Normal manufacturing and shipment lead times;
- (ix) Purchase Technical Specification with relevant drawings

The information as above shall also be given for all other components/equipment etc. which may have to be changed/replaced during maintenance as decided by the Engineer based on the proposed maintenance practices of the contractor.

#### 8.5 Recommended spares

8.5.1 The Tenderer shall furnish priced list of the recommended spares, not covered under Unit Exchange Spares, consumables and mandatory spares but are expected to be required during two years after expiry of defect liability period, along with the bid as per details enclosed in Appendix 6 of this Employer's Requirements - General Specification. The Spares shall be supplied in the Depot nominated by the Engineer.



000297



8.5.2 Contractor shall supply all the spares recommended by equipment/sub-system manufacturers within the quoted cost for recommended spares. Contractor shall furnish list of spares recommended by equipment/sub-system manufacturers at design submission stage.

### 8.6 Overhauling Spares

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

8.6.2 In addition to above, Employer may procure overhauling kits (for IOH) for ten train sets.

8.6.3 Tenderer shall quote the price of the kits at actual price (not an apportioned price). The value of these spares shall form part of the evaluation. Employer may make further procurement of such kits at the quoted price.

8.6.4 Any item if required as per OEM's documents but not included in the above recommended list by the Tenderer will be deemed to have been included and shall be supplied as per the provisions of this contract without any extra financial implication to the Employer.

### 8.7 Special Tools, Testing and Diagnostic equipment:

8.7.1 The Tenderer shall provide **two** sets of recommended list of Special Tools, Testing and Diagnostic Equipment separately for preventive and breakdown maintenance, overhauling and diagnostics of various equipment provided in the cars. These shall be delivered at two different maintenance Depots of Project Owner. The unpriced list of set of such equipment together with the details and description of such equipment shall be furnished along with the bid in the technical package.

8.7.2 Any Special Tools, Testing and Diagnostic Equipment required for preventive and breakdown maintenance, overhauling and diagnostics of various equipment and recommended by OEMs shall be included in the recommended list by the Tenderer. The Contractor within the quoted cost shall supply any items that are not specifically included by the Tenderer in the recommended list but is recommended by the OEMs. List of items recommended by the OEMs shall be furnished as part of detailed design submission. This list shall however be suitably augmented based on information supplied by OEM to Employer.

8.7.3 All items of Special Tools, Testing and Diagnostic equipment supplied by the Contractor, shall be accompanied by drawings, manuals and full operating instructions to enable them to be used by suitably skilled (but not necessarily specially trained) personnel in a non-hazardous manner and to achieve the desired result in terms of accuracy and quality. Each set of these equipment will be provided along with individual set of these drawings, manuals and full operating instructions.

8.7.4 The Contractor shall provide the means and instructions which describe the parameters of each item of Special Tools, Testing and Diagnostic Equipment that are critical to their proper methods of use and which enable the staff using the equipment to achieve the proper performance and operation. Such means and instruction shall include, but not be limited to any routine checking or re-calibration, needs for the tool or test equipment itself. Demonstration of the use of these special tools, testing and diagnostic equipment to the satisfaction of the Engineer shall be provided by the contractor.

8.7.5 Relevant details of Special Tools, Testing and Diagnostic equipment on the same lines as asked for mandatory spares above shall be furnished by the contractor.

8.7.6 Employer at his sole discretion may decide to increase/decrease the quantity of procurement to any extent.



8.7.7 Delivery schedule of all items of Special Tools, Testing and Diagnostic equipment shall be linked with Key Date Schedule K.D. 6.1 as mentioned in 'Attachment to Appendix FB-1' to 'Form of Bid'. However, exemption for key date delivery of certain items may be granted to the Contractor subjected to approval of the Engineer.

## 8.8 Special Jigs, Fixtures and Gauges

8.8.1 The Tenderer shall provide **two** sets of recommended list of Special Jigs, Fixtures and Gauges separately for preventive and breakdown maintenance, overhauling and diagnostics of various equipment provided in the cars. These shall be delivered at two different maintenance Depots of Project Owner. The unpriced list of such equipment together with the details and description of such equipment shall be furnished along with the bid in the technical package.

8.8.2 Any Special Jigs, Fixtures and Gauges required for preventive and breakdown maintenance, overhauling and diagnostics of various equipment and recommended by OEMs shall be included in the recommended list by the Tenderer. Tenderer shall note that the list enclosed at Annexure PBS of "Price Bid Submission Sheet" is indicative and Tenderer is expected to incorporate any additional items which may be required during maintenance as recommended by OEMs. The Contractor within the quoted cost shall supply any items that are not specifically included by the Tenderer in the recommended list but is recommended by the OEMs. List of items recommended by the OEMs shall be furnished as part of detailed design submission.

8.8.3 All items of Special Jigs, Fixtures and Gauges supplied by the Contractor, shall be accompanied by drawings, manuals and full operating instructions to enable them to be used by suitably skilled (but not necessarily specially trained) personnel in a non-hazardous manner and to achieve the desired result in terms of accuracy and quality. Each set of these equipment will be provided along with individual set of these drawings, manuals and full operating instructions.

8.8.4 The Contractor shall provide the means and instructions which describe the parameters of each item of Special Jigs, Fixtures and Gauges that are critical to their proper methods of use and which enable the staff using the equipment to achieve the proper performance and operation. Such means and instruction shall include, but not be limited to any routine checking or re-calibration, needs for the tool or test equipment itself. Demonstration of the use of these special tools, testing and diagnostic equipment to the satisfaction of the Engineer shall be provided by the Contractor.

8.8.5 Relevant details of Special Jigs, Fixtures and Gauges on the same lines as asked for mandatory spares above shall be furnished by the Contractor.

8.8.6 The Tenderer shall note that supply of different spares, tools, equipment, jigs and fixtures etc. mentioned at different places in the ERTS and ERGS shall be over and above the spares, special tools, testing and diagnostic equipment, special jigs, fixtures and gauges to be supplied under cost centre 'G'. The cost for such items is deemed to be included in quoted price of the contract and no additional cost shall be payable.

8.8.7 Delivery schedule of all items of Special Jigs, Fixtures and Gauges shall be linked with Key Date Schedule K.D. 6.1 as mentioned in 'Attachment to Appendix FB-1' to 'Form of Bid'. However, exemption for key date delivery of certain items may be granted to the Contractor subjected to approval of the Engineer.

## 8.9 Manufacture, Delivery and Warranty

8.9.1 The major spare parts ordered under the Contract shall be manufactured, works tested and inspected in accordance with the relevant quality system, suitably packed and labelled in accordance with Chapter-13 of this Employer's Requirements General Specification "Storage, Packing, Crating and Marking" and delivered by the Contractor to the depot as directed by Engineer. All spares shall be subject to inspection by the Engineer. In the event that any item is known to be going out of production, then the Contractor shall give advance notice to the Engineer.

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



000299



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

- (i) either 24 months from the date of acceptance; or
- (ii) up to expiry of the defect liability period of trains (clause 1.8.1), whichever is later.

### 8.10 Purchase of Spares from Vendors

- 8.10.1 The Contractor shall furnish an undertaking that he has no objection whatsoever to and shall not in any way deter or obstruct the Employer, its licensee or its representative from dealing directly with the Contractor's Vendors for the purchase of the spares during the Contract period. The spares purchased shall be subject to inspection by the Engineer.
- 8.10.2 Contractor shall obtain an undertaking from vendors, OEMs etc. at detailed design submission stage that they will deal directly with Employer for supply of spares, equipment and/or sub-systems.

### 8.11 Commissioning and DLP Spares

- 8.11.1 The Contractor shall submit to the Engineer for review a list of minimum spare parts that he intends to make available during the installation, erection, commissioning and defect liability periods.
- 8.11.2 The Contractor shall keep on Site, at his own cost, throughout the installation, erection, commissioning and defect liability periods, stocks of spare parts, as per the list to enable rapid replacement of any item found to be defective or in any way in non-conformance with the Specification.
- 8.11.3 The Contractor shall generally not be entitled to use any of the Employer's spare parts during the installation, erection and commissioning periods or during the Defects Liability Period.
- 8.11.4 Contractor shall not be permitted to remove any working/healthy equipment / components / sub-systems / systems from any of the train available at any of the depot for any reason whatsoever without specific approval in writing from the Project Owner's Depot Incharge or Engineer's authorised representative.
- 8.11.5 Spares as per the agreed list shall be supplied at least three months before receipt of first train. Stocks of such spares as available in Contractor stores will be jointly checked with Engineer every three months. Certificate by Engineer confirming availability of the spares in contractor stores in Depots as per agreed list will be a pre-requisite for release of interim payments of the Contractor. However, this condition will not be applicable for six months before the expected expiry of the DLP period.

### 8.12 List of Spares

- 8.12.1 The Contractor shall ensure availability of spare parts for a period of ten year from the last date of taking over of whole of Works.
- 8.12.2 If during the period of ten years, the Contractor intends to discontinue the manufacture of spare or replacement parts for the Rolling Stock, the Contractor shall immediately give notice to the Employer of such intention. The Employer shall be given the opportunity of ordering at contracted prices such quantities of such spare or replacement parts as the Employer shall reasonably require in relation to the anticipated life of the Rolling Stock.
- 8.12.3 In the event of Contractor failing to supply the spare parts in accordance with this Clause, he shall in respect of each item of spare, furnish free of cost to the Employer, the drawings, specifications, patterns and other information to enable the Employer to make or have made such spare parts. The Employer shall be entitled to retain the aforesaid drawings etc., for such time only as is necessary for the exercise by the Employer of his rights under this clause and the drawings, if the Contractor so requires, shall be returned by the Employer to the Contractor in good order and condition (fair wear and tear excepted).
- 8.12.4 Under such circumstances, the Contractor shall also grant to the Employer, without



payment of any royalty or charge, full right and liberty to make or have made spare or replacement parts as aforesaid and for such purposes only to use, make and have made copies of all drawings, patterns, specifications and other information supplied by the Contractor to the Employer pursuant to the Contract.

- 8.12.5 The Contractor will so far as it is reasonably able to bind his sub-contractors to conform with the requirements of this Clause and shall, prior to entry into any sub-contracts, provide the Employer with full details of any sub-contractor who will not so conform in which event the Employer may direct the Contractor to seek an alternative sub-contractor.
- 8.12.6 If the Contractor fails to provide spare or replacement parts as described in this Sub-clause and these are available from the Contractor's sub-contractor, the Employer shall have the right to obtain such spare and replacement parts from the sub-contractor or any other supplier and any additional cost incurred by the Employer shall be recoverable from the Contractor.
- 8.12.7 In case the Contractor is unable to supply spares in accordance with Clause above, he shall furnish, free of cost to the Employer, the drawings, specifications, and other technical details, to enable the Employer to manufacture parts, or have them manufactured. Such drawings and technical data shall be provided free of any charge or royalty, on the understanding that the Employer will use such data and drawings, only for the manufacture of parts for his own use.
- 8.12.8 The foregoing shall hold equally good for the Contractor, any or all of his sub-contractors, and vendors.
- 8.12.9 In the event that technological progress results in improved versions of spares and replacement parts, the latest version shall have the same plug compatibility, and spatial needs of its predecessor, to avoid modifications being required, to accept the up-graded version of the part.

### 8.13 Simulator

The detailed specification is placed at Appendix -9 of ERGS.



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## CHAPTER 9

### TRAINING

#### 9.1 Training Requirements

- 9.1.1 The Tenderer shall include and price in his tender submission a comprehensive proposal to meet the complete training requirements for operation and maintenance of the Rolling stock. This shall comprise of, but not limited to, the following
- (i) Training of Project Owner's Driving Instructors and Drivers (2 man months) in operation of Trains (as per GoA2/GoA3/GoA4) off –shore and on-shore including the test track in the Contractor's Works.
  - (ii) Training of Project Owner's/Employer's maintenance personnel (10 man months) in Contractors / Sub-Contractor's Works and MRTS off-shore and on-shore.
  - (iii) Provision of Contractor's Driving Instructors (2 man months) for training of Project Owner's operating personnel in India.
  - (iv) Provision of OEM's Experts / Instructors (12-man month) for Training of Project Owner's maintenance personnel in India.
  - (v) Submission of Training Manuals (Original plus five hard copies) and in Electronic format.
- 9.1.2. As explained in the chapter-8 of ERGS, the Tenderer shall include the cost of the training in cost centre 'G' of pricing document – Annexure-PBS of "Price Bid Submission Sheet" under Lump Sum Annual Maintenance Cost. . The travel, boarding and lodging expenses for the Employer's trainees will be borne by the Employer. The contractor shall submit the different training modules, their durations, periodicity and target group of persons at the time of design approval stage. The Engineer in consultation with contractor may at its absolute discretion alter or include new training schedules while finalizing the design.
- 9.1.3 Facilities such as classrooms, overhead projectors, VCRs and video monitors will be made available for imparting training in Employer's Depots in India free of cost to the Contractor. However, for training in the Contractor's works, such facilities shall be arranged by the Contractor's at his own cost. The Contractor is however, required to provide at his own cost all other necessary training aids such as written and printed notes, video programmes, transparencies, slides, films, models and drawings, and other training aids etc.
- 9.1.4 The Project Owner's personnel required to undergo training will be qualified Electrical, Mechanical and Electronics Engineers, Technicians, Supervisors or Instructors, with relevant practical experience. The training syllabus should therefore concentrate on familiarisation with particular systems and equipment of the cars and technologies outside of their experience.
- 9.1.5 Training Instructors provided by the Contractor shall be fully qualified and experienced Electrical, Mechanical and Electronics Engineers and experts in the relevant field with experience in training of engineering graduates and Technicians to the level of competency essential for operation and maintenance of Metro trains of similar specifications. The Instructors shall be preferably English speaking. If any interpreter is required, it shall be arranged by the Contractor at his cost. The appointment of Instructors shall be confirmed only after his detailed *curriculum vitae* have been accepted by the Engineer. In the event that an Instructor is subsequently deemed not to be competent, he shall be replaced forthwith.
- 9.1.6 The Contractor shall submit a detailed Training proposal in the Technical package to meet the above requirements duly taking into consideration that it shall be the sole responsibility of the contractor to adequately train Project Owner's personnel so that they can effectively run/operate trains and can provide the desired output in terms of



000303



prescribed level of Reliability, Availability and Maintainability of rolling stock supplied by the contractor.

## 9.2 Training Objectives: Train Operating Staff.

9.2.1 The objective of training of train operating staff is that the batches of drivers and instructors who will operate the trains should be able to run the trains safely under all operating conditions. The training should also enable them to acquire full capability for identification and troubleshooting of the faults in the specified duration. In order to achieve the above objective, the Operating Staff and instructors should be trained in a similar transit railway or in the contractor's works off-shore and on a test track. It will be preferred that after classroom instructions, which include mock-ups of cab equipment, the staff are trained in actual operation of cars in a Mass Rapid Transit System or on a test track, having similar cars, to acquire the required confidence.

9.2.2 The Contractor's Instructors deployed for training of operating Staff in India shall provide training in classroom, as well as actual driving of trains during and after commissioning of trains in India under UTO mode. The instructors shall also train the operating staff in trouble shooting of the faults and emergency procedures.

## 9.3 Training Objectives: Maintenance Staff

9.3.1 The training should enable the Engineers, Inspectors and Staff to achieve the following broad objectives:

- (i) Full understanding of all aspects of the system design and functions of all the equipment including proprietary and third party equipment, software etc.
- (ii) Full understanding of all aspects of programmed maintenance and overhaul requirements of cars and equipment.
- (iii) Procedures to be followed for unscheduled maintenance and repair of cars and equipment.
- (iv) Identification of failed components and sub-systems in electronic equipment by use of special test equipment, as necessary.
- (v) Modification in the software to extend or modify the control and monitoring functions.
- (vi) Maintenance Management Information System and documentation.
- (vii) Monitoring and scheduling trains in the Progress Planning and Investigation Organisation.
- (viii) Stores inventory planning and control.

9.3.2 The training of Project Owner's personnel off shore shall include direct exposure to Engineers, Technicians, Inspectors and staff in actual repair, maintenance and overhaul of similar cars in the Depots and Workshops of an operational Mass Rapid Transit System.

9.3.3 The Contractor's Instructors deputed to train Project Owner's personnel in India shall impart theoretical as well as practical training so as to enable them to develop skill and expertise necessary for satisfactory maintenance, repairs and overhaul of cars.

## 9.4 Training Methods

9.4.1 As a general guide, training shall be based upon a "two-stage" concept:

- (i) Contractor shall depute a Training Manager for complete management of the training till the initial training requirements are completed. Contractor shall propose a comprehensive trains programme comprising of different modules and prospectus for approval. The programme shall be reviewed by the Engineer based on the operational and maintenance needs and feedback of the completed training modules.
- (ii) Stage one shall consist of training in the basic concepts and principles. These



shall include system configuration and specification, operation and control of all equipment installed in the cars, preventive maintenance procedures, overhaul and repair concepts, fault diagnostic and trouble shooting and emergency procedures. The training shall consist of class room (theory) training; computer based inter-active training and mock-up training.

- (iii) Stage two shall consist of "hand-on" site-based practical training on preventive and corrective maintenance and operating procedures.
- (iv) The Contractor shall also include the training of the staff in the correct procedures of maintenance and repair of different equipment based on the Training Manual supplied against the contract.
- (v) Contractor shall arrange the experts from the OEMs of the systems to impart the "hands on" training at site for the agreed durations during the contract execution.
- (vi) Training evaluation shall be carried out at regular intervals to monitor the progress and suitability of the training programme, and of the Trainees.
- (vii) The performance of Contractor's Instructors shall also be evaluated by the Engineer at regular intervals.

9.4.2 Contractor shall provide training for maintenance on models with CBT etc. and overhauling of the actual equipment, which shall cover, as a minimum of following work areas:

- (i) Depot Maintenance Management including Documentation. The software package used shall be in the name of the Project Owner and shall remain fully functional under the Project Owner's control after the DLP.
- (ii) Bogie, Brake & Pneumatics
- (iii) Car body including furnishing
- (iv) Doors and associated drives
- (v) Lifting of car, assembly/disassembly of equipment
- (vi) Traction Motors
- (vii) Converter/Inverter and associated controls
- (viii) Auxiliary Supply Equipment
- (ix) Transformers
- (x) TCMS / Control Electronics
- (xi) Software handling
- (xii) Air-conditioning (HVAC)
- (xiii) Stores Management
- (xiv) Any other area requiring specialist service.

## 9.5 Training Manual

9.5.1 The Contractor shall provide one original and five coloured copies of the Training Manual for use by the Project Owner/Employer for conducting in-house training. The Manuals shall cover all requirements specified in this chapter.

## 9.6 Transfer of Training Aids

9.6.1 After completion of the training, training aids and materials used shall become the property of the Project Owner/Employer to enable and further training to take place.

## 9.7 Training Location and Facilities

9.7.1 Training shall be carried out at such locations as will provide the maximum benefit to the Trainees. Such locations may be in India, or abroad, at places of manufacture, assembly



000305



or testing, or at other locations as may be necessary. All locations proposed for training shall be subject to the consent of the Engineer. Details of the facilities proposed to be provided, shall be included within the detailed Training Proposal submitted by the Contractor.

## 9.8 Administration

- 9.8.1 The Contractor shall be responsible for the reception, office facilities etc. for the trainees, when in countries other than India.
- 9.8.2 The Contractor shall be responsible for the general welfare, health and safety of trainees under his control.



## CHAPTER 10

### SITE AND SITE MANAGEMENT

#### 10.1 Access to Site

10.1.1 The Contractor will be given access to the Site in accordance with Clause 2.2 of the General Conditions of Contract.

#### 10.2 Site Facilities

10.2.1 The Contractor can be provided subject to availability, approximately 400 sq m of total space at nominated Depots for the setting up of Contractor's Site Offices and Stores at the rate of Rs. 100 per sq. m area for office space & Rs. 50 per sq. m area for storage space.. These site offices shall be built commensurate with the architecture of the surrounding buildings and after obtaining the approval of Engineer for its broad design. The structure shall be handed over to Employer in good condition after the completion of the defect liability period.

10.2.2 The Contractor shall arrange its furnishing, security etc. Charges for the electricity consumption shall be payable by the Contractor at the prescribed rates.

10.2.3 Offices shall be contained in one building and each office shall be accessible only from a corridor within the building. An external double door with reception area shall be provided to the corridor.

10.2.4 Materials used for the construction of the offices shall be new and of good quality. Materials shall be chosen such that the buildings when erected shall give good temperature and sound insulation.

10.2.5 Windows to each room shall be of an area not less than 10% of the floor area. All the rooms shall be adequately ventilated. All windows to ground floor offices shall be fitted with burglar bars firmly attached to the structure of the building.

10.2.6 The Contractor shall also arrange for the constant and hygienic disposal of all effluent, sewage and rubbish from the buildings.

10.2.7 All buildings shall be supplied with electricity 240V 50Hz that shall be distributed to each room in accordance with the Regulations. Lighting and electrical power points shall be provided to each room.

10.2.8 Firefighting equipment shall be provided in accordance with the recommendations of the Mumbai City Fire Brigade.

10.2.9 The Contractor shall provide, erect and maintain appropriate name boards as specified for each of the offices.

10.2.10 Traction power at 25kV AC will be made available to Contractor free of charge for testing and commissioning. The Contractor shall liaise with Designated Contractors for availing of the power and assuring compliance of all safety procedures. The Contractor shall provide his own EMU train drivers for Testing, Commissioning and Service Trials. A test track is installed in each of the Depot. It will be available for the testing of first prototype train. The Contractor will be allowed use of the test track free of charge.

10.2.11 The Contractor shall provide his own lifting facilities (preferably four point lifting system based on availability of space in the Depot) for unloading of EMU trains and any heavy equipment, at the port of arrival, transshipment point and depot. The Contractor shall however, be allowed to use any necessary Depot facilities free of charge for assembly, commissioning, inspection, repairs to EMU cars and equipment, subject to availability. The Employer shall, however, not be responsible for adequacy, reliability and safety of the facilities provided to the Contractor.

10.2.12 Reasonably lit access to the areas and to rail sidings will be provided by others. If Lighting is not provided in the specific areas allocated to the Contractor, he should make his own arrangements. The Contractor shall be solely responsible for the security and housekeeping of the area, plant and possessions allocated to him. The Contractor shall



000307



provide and maintain all facilities required by him in the area allocated for his exclusive use and all other work required to allow the Contractor to fulfil his obligations under the Contract.

10.2.13 The Contractor shall arrange at his own cost all Site services necessary and appropriate for the assembly, testing and commissioning of trains, which shall include, but not necessarily be limited to:

- (i) Electricity at site area (other than traction and inside the shed);
- (ii) Compressed air other than the depot inspection shed;
- (iii) Communication facilities; and
- (iv) Instrumentation.

10.2.14 The Contractor shall be responsible for making applications or requests to the concerned Authorities for availing of the above facilities. In the event that electricity or water supplies are arranged by another Designated Contractor in the Depot area, the Contractor may avail himself of those supplies from the Designated Contractor, either directly on agreed terms and conditions. The Contractor shall comply with all regulations of the utility companies and Government departments concerned.

10.2.15 The Contractor shall allocate at his Works, and those of his major sub-contractors, adequate office space, furniture and equipment for the use of the Employer's Representative's Inspection Engineers. Such accommodation shall include secure filing for Contractual and other sensitive documents, and secure telephone with net connectivity, computer and printer/facsimile facilities. Such facilities shall apply equally to the overseas and the local building phases of the Works.

### 10.3 Site Management

10.3.1 The particular use to which the Site is put shall be submitted to the Engineer for review within 120 days of the Date of Notice to Proceed. The Contractor shall:

- (i) confine his use of the areas of the Site to purposes having been reviewed without objection by the Engineer who reserves the right to extend, amend or restrict the uses to which areas of the Site will be put;
- (ii) where required under the Contract, provide and maintain fencing and lighting around and within the areas of the Site when or where necessary for the safety and convenience of the public or others or as directed;
- (iii) refrain from depositing rubbish or causing nuisance or permitting nuisance to be caused and, except where reviewed without objection by the Engineer, depositing earth on or removing earth from areas of the Site;
- (iv) refrain from felling trees, other than those specifically identified in the Contract to be felled, and refrain from depositing earth around the trunks of trees and protect all trees remaining on Site to the satisfaction of the Engineer;
- (v) except where otherwise provided, not permit any person to reside on the Site;
- (vi) unless otherwise stated, pay all rates and charges of any nature whatsoever arising out of his use of the Site and all work areas provided therein under the Contract;
- (vii) not use any part of the Site or Works for advertising purposes except with the acceptance of the Engineer.

10.3.2 The Site shall be maintained in a clean and tidy condition. Materials, including those required for Temporary Works, shall be stored in an orderly manner. The Contractor shall, throughout the period of the Contract, provide a central collection point on Site, as reviewed without objection by the Engineer, for collecting all empty cans, drums, packing and other receptacles capable of holding water. The Contractor shall ensure the regular collection and removal of such debris from the Site. After every shift of works, all work areas shall be cleaned and made tidy to the satisfaction of the Engineer.



- 10.3.3 The Contractor shall ensure that gases, fuels, explosives and other dangerous goods are stored and handled in a safe manner and in accordance with the Statutory Regulations pertaining to their storage and handling. The Contractor shall be responsible for obtaining the requisite licences at his own cost.
- 10.3.4 The Contractor shall provide all necessary protective clothing, safety equipment, hand tools, ladders, trestles, power supply, and replacement equipment for the staff engaged on Site maintenance.
- 10.3.5 Because of the multi-disciplinary nature of the Project, several different parties may require access to the same portion of the Site during the construction phase, for the installation, erection and testing of the Works.
- 10.3.6 To facilitate the organisation and co-ordination of access and occupation requirements, the Contractor shall maintain a close liaison with other Contractors.
- 10.3.7 As soon as any or all of the Contractor's installations are no longer required for the execution of the Works, the Contractor shall remove those facilities and ensure that the area is left free of debris, excess materials, and obstructions.
- 10.3.8 Deleted.
- 10.3.9 Contractor shall provide and maintain office stationary, one heavy duty photocopier at Charkop depot and a heavy duty photocopier cum colour printer etc. at the project office in Mumbai, throughout the contract period.

#### 10.4 Site Safety

- 10.4.1 The Engineer will issue to the Contractor with the latest edition of the Employer's Project Safety Manual. The Contractor shall, as a minimum, comply with the Safety Manual. However, this shall not relieve the Contractor of any of his statutory duties, obligations or responsibilities under the Contract. The Engineer reserves the right to order the immediate removal and replacement of any item of Contractor's equipment, which is deemed to be in an unsafe condition.
- 10.4.2 The Contractor shall submit, as part of his Safety Plan, a Site Safety Plan, and also designate a member of his staff as Safety Officer.
- 10.4.3 The Contractor shall establish and maintain and staff at all times when personnel are on site, a First Aid Post. Portable First Aid Boxes shall be maintained in a fully equipped state at each site work centre. The Contractor shall ensure that at least one employee on every working shift, is a trained First Aider, capable of administering First Aid competently until the arrival of professional help, in an accident situation.
- 10.4.4 The Contractor shall be fully responsible for the safety of the Works, his personnel, his Sub-Contractors' personnel, the public, and any persons directly or indirectly associated with the Works, or on or in the vicinity of the depot site. The Contractor shall treat safety measures as high priorities in all his activities throughout the execution of the work.
- 10.4.5 The Contractor shall submit to the Engineer, regular Site Safety Reports, and shall notify immediately the occurrence of an accident involving his staff or that of his sub-Contractors, or to any person within the area of the depot for which the Contractor is responsible.



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000310

## CHAPTER 11

### TRAFFIC, ROAD & APPURTENANCES

#### 11.1 General

11.1.1 The Contractor shall conform to the applicable requirements of the Motor Vehicle Act - 1988. The Contractor shall ensure compliance with the requirements regarding the licensing of drivers and the registration of vehicles. Vehicle size and load limitations shall be in accordance with all statutory requirements.

#### 11.2 Transportation to Site

11.2.1 The Contractor shall make all arrangements and assume full responsibility for transportation to the site at nominated Depots of the passenger rolling stock, and all plant, equipment, materials and supplies needed for the proper execution of the Works. Procedures for access to and from the Site shall be co-ordinated with the relevant Authorities.

11.2.2 The Contractor shall use such routes and rights of entry to the Site as may be decided by the Engineer from time to time. Routes for 'very large' or 'very heavy' loads shall be discussed with the Engineer in advance and all arrangements thereafter shall be submitted to the Engineer. In this context, the definition of the terms "very large" and "very heavy" refer to articles that cannot be transported by normal road vehicles or be handled by readily available methods. Where doubt exists, it shall be the responsibility of the Contractor to notify and discuss the nature of the load in question with the Engineer for possible solutions.

11.2.3 The Contractor shall be responsible for obtaining permission from the Traffic Police and other relevant authorities to move "very large" and "very heavy" loads and for arranging police escorts if required. The Contractor shall ensure that all roads and pavements, etc. leading to and around the Site are kept free from obstructions and shall not cause inconvenience or hindrance to traffic or persons either by its vehicle or its workmen, scaffolding, plant, materials, equipment, etc. All Workmen working on the road shall wear approved reflective safety vests at all times.

11.2.4 The Contractor shall repair damage caused to existing roads, footpaths, steps, cables, sewers, drains, etc. and shall reinstate the same at his own expense to the satisfaction of the relevant authorities.



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## CHAPTER 12

### OPERATION AND MAINTENANCE MANUALS

#### 12.1 General

- 12.1.1 The Contractor shall provide Operation and Maintenance manuals, for use by supervisory, operating and technical staff of the Project Owner, in English.
- 12.1.2 Thirty days before the date of commencement of test running of the first EMU train, the Contractor shall deliver the originals and 5 coloured copies each of the final Operation and Maintenance manuals. These manuals shall have been submitted for proof reading and training purposes prior to delivery. It is accepted that further amendments may subsequently be required.
- 12.1.3 Each and every manual shall be divided into indexed sections explaining the subject matter in logical steps. Most manuals shall consist of A4-size printed sheets bound in stiff-cover wear-resistant binders clearly and uniformly marked with the subject matter and reference number. Where alternative sizes are proposed, (e.g. A5/A6 pocket books of schematic wiring diagrams) these shall be for review and acceptance. The binding shall allow for all subsequent changes and additions to be readily effected.
- 12.1.4 Information shall be provided in pictorial form wherever whenever possible and shall include step-by-step instructions and views of the particular equipment including exploded views. Programmable equipment shall be supplied with sufficient flow charts and fully documented programmes to enable faults to be quickly identified and system modification to be undertaken at any time.
- 12.1.5 The Contractor shall provide clarifications and amendments to the Operation and Maintenance manuals as necessary during the execution of contract. Updates shall be provided for the originals and all copies.

#### 12.2 Operation Manuals

- 12.2.1 The Contractor shall provide operation manuals explaining the purpose and operation of the complete system together with its component subsidiary systems and individual item of equipment. The characteristics, ratings and any necessary operating limits of the Equipment and Sub-systems shall be provided.

#### 12.3 Maintenance Manuals

- 12.3.1 The Contractor shall provide maintenance manuals showing details of all the various systems and sub-systems from a maintenance and fault finding standpoint, with particulars of operating parameters, tools for dismantling and testing, methods of assembly and disassembly, tolerances, repair techniques and all other information necessary to set up a repair and servicing programme.
- 12.3.2 The Contractor shall provide documentation for all hardware and software for computer systems and other associated electronic equipment to meet the following requirements. Contractor shall ensure the any hardware(s)/software(s) required for the purpose as covered in the maintenance manuals are supplied free of cost. Such documents shall include but not be limited to:
- (i) manufacturers' documentation supplied as standard with the equipment;
  - (ii) hardware configuration with details of expansion capabilities and options;
  - (iii) programme loading instructions, including runtime environment configuration;
  - (iv) programme listing in hard copy and soft format, compilers and development tools necessary to modify and recompile software;
  - (v) flow charts, data flow diagrams and state diagrams as appropriate;
  - (vi) description of software modules including purpose, linkage with other modules, error routines and any special considerations;



000313



- (vii) memory maps for both internal and peripheral memory showing description of all programmes, data files, overlay areas, memory available for expansion and the like;
- (viii) loading and operating instructions for diagnostic programmes and specifically developed debugging tools; and
- (ix) programming manuals relevant to operating systems, languages, development tools, etc.

12.3.3 The documentation of software shall be supplied after the expiry of the warranty period. The manual shall also include inspection/overhaul procedure and periodicity of various inspection/overhaul schedules in detail including the tools, special tools/plants, and facilities required. The manual shall be subject to review by the Engineer.

The maintenance manual shall also include Maintenance Work Instructions (MWIs) of all major systems and sub-systems of the train in detail. The MWIs shall include details of the required materials and consumables, general tools, special tools and facilities in tabular form. All special tools and fixtures indicated in manuals shall be deemed to be included in the mandatory list of specials tools under cost centre G of Annexure PBS to Price Bid Submission Sheet. Each MWI shall be approved by the Engineer during design stage.

12.3.4 A preliminary maintenance schedule specifying the frequency of inspections and the scope of work during such inspections, including facilities, manpower and down-time required shall be included within the Tender.

12.3.5 The maintenance manual shall also include an 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:

- (i) Part number
- (ii) Description
- (iii) Name of manufacturer
- (iv) Quantity and Unit
- (v) Part number of next higher assembly (usually a line replaceable unit).
- (vi) Cross-reference to figure number.
- (vii) Category: e.g. consumable, line replaceable unit, repairable.
- (viii) Life-expected life, Mean time between failure or mean distance between failure where available.
- (ix) General or specific purpose
- (x) Purchase and technical specification

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.

And 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.

## 12.4 Electronic Manuals

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

12.4.2 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.



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



**CHAPTER 13****STORAGE, PACKING, CRATING AND MARKING****13.1 General**

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

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

13.1.3 The Contractor shall provide all packing, crating and markings. In so doing he shall comply with the following requirements:

- (i) All packing procedures shall be subject to acceptance by the Engineer.
- (ii) Spare parts shall be tropicalised in their packing for prolonged storage in accordance with BS 1133 or equivalent and shall be suitably labelled to indicate:
  - Ownership (MMRDA)
  - Shelf life.
  - Type of storage.
  - Description of item and relevant part number.
  - Serial number, if applicable.
  - Inspection Certificate number and batch number, that is, the number allocated by the Contractor's Inspector at the time of manufacture or packing.
- (iii) Protection requirements shall include but not be limited to:
  - (a) Electrical and other delicate items or equipment shall be properly protected to the Engineer acceptance.
  - (b) Tube ends, cable ends, cable entry points into equipment and other similar terminations and openings shall be blanked off to prevent ingress of dirt, moisture, vermin or insects and to provide protection against damage.
  - (c) Flanged ends shall be protected by adhesive tape or jointing material covered by a properly secured wooden blank not smaller than the flange itself. Plain tube ends shall be closed off with bungs or plugs or suitable materials firmly fixed in position.
  - (d) Particular care shall be taken to prevent damage to or corrosion of shafts and journals where they rest on timber or other supports, which may contain moisture. At such points, wrappings impregnated with anti-rusting composition shall be used. Wrapping shall be of sufficient strength to resist chafing under the pressures and movements likely to occur in transit.
  - (e) Spare ball and roller bearings and similarly protected items shall not be removed from the manufacturer's wrappings or packing.

Each case, crate or package shall be legibly and indelibly marked in large letters with the name (Mumbai Metro), address, Contract Number, "right way up", opening points and other markings as necessary to permit materials and Plant to be readily identified and handled during transit and when received at Site.

Each case, crate or package shall contain a comprehensive packing list showing



the number, mark, size weight and contents together with any relevant drawings. A second copy of the packing list shall be enclosed in a watertight enclosure on the outside of each case.

All items heavier than 100 kg shall be marked on the outside of the case to show the gross and net weights, the points for slinging, and where the weight is bearing.

- (iv) Care shall be taken to prevent movement of equipment within cases, crates or packages by the provision of bracings, straps and securing bolts as necessary. Bags of loose items shall be packed in cases and shall be clearly identified by well-secured labels on which the quantity and name of the part and its index or catalogue number have been stamped.
- (v) In order to reduce fire risk and prevent obstruction, all empty cases, crates, or packages whether or not returnable shall be removed from the Site as soon as possible. If this requirement is not complied with, after due notice, the Engineer will instruct the Civil Contractor or others to remove them and the Employer will back-charge the Contractor the costs incurred together with handling charges.

13.1.4 If sea transportation of trains from manufacturer's works to site at Mumbai is required, seaworthy packing/ treatment of Trains shall be carried out for the safe transportation of trains. It shall apply to sea transportation of spares and other materials also.



## CHAPTER 14

### PUBLIC RELATIONS MATTERS AND PROGRESS PHOTOGRAPHS

#### 14.1 General

- 14.1.1 The Contractor shall, in conjunction with the Engineer, liaise with Public Relations Officer, Project Owner on all press and public relations matters in connection with the Contract.
- 14.1.2 All press releases, press statements, articles or printed material prepared by the Contractor shall be submitted to Project Owner, in consultation with the Engineer prior to publication or release to the news media.
- 14.1.3 All press queries relating to the Contract received by the Contractor must be referred to Project Owner for clearance, in consultation with the Engineer. The Contractor is not allowed to be interviewed by the press or divulge any information freely to reporters without first seeking clearance from Project Owner.
- 14.1.4 Use of the Project Owner logo in the Contractor's publications shall be subject to approval of Project Owner.
- 14.1.5 The Contractor shall provide Project Owner and the Engineer with schedules relating to night works, traffic diversions, closure of road etc. that may cause inconvenience to the public.
- 14.1.6 The Contractor shall extend to Project Owner all the necessary assistance and co-operation with regard to requests for photo-taking, video-taking and visits to the Site by the Project Owner official photographer or appointed film-maker, in consultation with the Engineer.
- 14.1.7 The Contractor shall include a section on matter concerning Public Relation in his monthly report to the Engineer.
- 14.1.8 All hoardings and signboards put up by the Contractor shall be maintained in good condition.
- 14.1.9 All public complaints should be thoroughly investigated and acted upon by the Contractor on an urgent basis.
- 14.1.10 The Contractor shall give full support to all functions and events e.g. community talks for residents, Site visits for the media etc. organised by the Project Owner during the period of the Contract.

#### 14.2 Progress Photographs

- 14.2.1 After design, manufacturing and testing activities start, the Contractor shall furnish photographs showing the progress of the Works during the month. The actual number of photographs taken and the subjects photographed shall be as directed by the Engineer.
- 14.2.2 Each photograph shall have a forty millimetres by eighty millimetres title block in the lower right-hand corner, which shall show the following information:

PROJECT OWNER:

CONTRACT No.:

CONTRACT NAME:

CONTRACTOR:

PHOTOGRAPH No.:

DATE:

DESCRIPTION:

- 14.2.3 Two colour prints of each photograph shall be submitted. Prints shall be standard commercial quality on single-weight glossy paper 200mm by 250mm in size inserted back-to-back in clear plastic envelopes made for the purpose. Diskettes capturing Office software shall be provided together with the colour prints.



14.2.4 Detailed photographs (date and time stamped) of each train on its arrival at the depot and before introducing for revenue operation shall be archived and copies handed over to the engineer. The photographs must include all such items that are incomplete/defective etc. Complete set (soft copy) shall be submitted every month to the Engineer.



**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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**CONTENTS:**

Contents:.....	1
APPENDIX 1 .....	3
PROGRAMME .....	3
1 Time-Scaled Network/Bar Chart.....	3
2 Time Scaled Network/Bar Chart Details.....	4
APPENDIX 2 .....	5
MONTHLY PROGRESS REPORT .....	5
1 Contract Stages.....	5
2 Financial Status .....	5
3 Physical Progress.....	5
4 Programme Update (For Entire Project) .....	5
5 Milestones Status.....	6
6 Three Month Rolling Programme .....	6
7 Planning and Co-Ordination.....	6
8 Procurement Report.....	6
9 Production and Testing.....	6
10 Safety .....	6
11 Environment.....	6
Appendix 3 .....	7
PROPOSED KEY DATE SCHEDULE FOR -TENDER 'MRS1' .....	7
APPENDIX 4 .....	8
DRAUGHTING AND CAD STANDARDS .....	8
1 Introduction.....	8
2 General Requirements .....	9
2.1 General .....	9
2.2 Drawing Numbering System .....	9
2.3 Types of Drawing.....	9
3 Computer Aided Design & Draughting (CADD) Standards .....	10
3.1 Introduction .....	10
3.2 Objectives.....	10
3.3 General .....	10
3.4 Terminology & Associated Standards / Guidelines .....	10
3.5 Paper Drawings .....	10
3.6 CAD Data Creation, Content & Presentation.....	11
3.7 CAD Quality Control Checks .....	11
3.8 CAD Data Transfer Media and Format.....	11
3.9 CAD Media Receipt & Transmittal .....	12
3.10 Revisions .....	12
3.11 Block Libraries, Blocks, & Block Names .....	12
3.12 CAD Dimensioning.....	13
3.13 CAD Layering .....	13
3.14 Global origin, Location & Orientation on the Alignment Drawing.....	13
3.15 Line Thickness and Colour .....	13
3.16 CAD Utilisation of 2D & 3D Files.....	13
3.17 CAD File Numbering.....	13
3.18 CAD File Naming Convention - General.....	13
APPENDIX 5 .....	14
DESIGN CERTIFICATE.....	14



APPENDIX 6 .....	17
SPARES .....	17
6.1 Unit Exchange Spares .....	17
6.2 Mandatory Spares:.....	17
6.3 Recommended Spares .....	17
6.4 Overhauling Spares .....	17
APPENDIX 7 .....	18
DESIGN AND MANUFACTURE INTERFACES .....	18
1 INTERFACES .....	18
1.1 General .....	18
1.2 Signalling and Communications Contract: .....	18
1.3 Railway Electrification, Power Supply Contract .....	18
1.4 Track Contract.....	18
1.5 Other Contracts: .....	18
2 Interface Responsibilities .....	18
3 Scope of Work of Integrated Management Plan .....	20
4 Interfaces between MRS1 and Signalling, Telecommunication Contracts.....	20
5 Interfaces between MRS1 and Rigid OCS Contract .....	20
6 Interfaces between MRS1 and Flexible OCS Contract .....	20
7 Interface specification of MRS1 and Track Contract.....	20
8 Interface specification between MRS1 and Other Contracts. ....	20
Annexure (I) .....	21
INTERFACE FOR RIGID OCS: .....	21
Annexure (II).....	22
INTERFACE BETWEEN MRS1 AND FLEXIBLE OCS CONTRACTOR.....	22
Annexure (III) .....	23
INTERFACE BETWEEN MRS1 AND TRACK CONTRACTOR .....	23
Annexure (IV) .....	24
INTERFACE BETWEEN MRS1 AND DESIGNATED CONTRACTORS: .....	24
APPENDIX 8 .....	26
ABBREVIATIONS.....	26
APPENDIX 9.....	27
1.0 Simulator .....	27
1.1 Driving Simulator.....	27
1.2 Maintenance Simulator MODULES (MSM) .....	30
1.3 Training of Project owner's Engineers: .....	31
1.4 Warranty .....	32
1.5 Summary of Requirements:.....	32
1.6 Spares, Special Tools & Test Equipment.....	33



**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 26<sup>th</sup> day of the last month and up to and including the twenty-fifth (25<sup>th</sup>) 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 of 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 (25<sup>th</sup>) 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:

<b>File Type</b>	<b>Data Format</b>
Photo Image	Joint Photographic Experts Group (JPEG)



000328



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.



000348



- 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.



000350



**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
<b>A</b>	<b>Driving Simulator package will include the following:</b>	
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>B.1</b>	<b>Sub-system maintenance Simulator Module (SSMSM) include the following sub-systems</b>	
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



000352



12	System integration and interface (including signaling and communication) of above items for UTO	1
<b>B. II</b>	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.

