

**DEVELOPMENT AND OPERATION  
OF  
MASS RAPID TRANSIT SYSTEM  
FOR  
VERSOVA – ANDHERI – GHATKOPAR CORRIDOR**



**FINANCIAL PROPOSAL**



**Reliance Energy**  
A Dhirubhai Ambani Enterprise

**Reliance Energy Ltd**  
India



**Connex S A**  
France

**MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY**

JANUARY 2006

## Section 1



**Reliance Energy**

A Dhirubhai Ambani Enterprise

**Reliance Energy Limited**

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**LETTER OF TRANSMITTAL**

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Date: 10<sup>th</sup> January 2006

Place: Mumbai

To

Chief, Transport & Communications Division  
Mumbai Metropolitan Region Development Authority  
Bandra-Kurla Complex  
Bandra (E)  
Mumbai-400 051.

VS 10/1/06  
1/2  
10/1/06

Dear Sir,

Sub: **Development and Operation of Mass Rapid Transit System for Versova-Andheri – Ghatkopar Corridor on BOOT Basis through PPP – Submission of Financial Proposal**

Ref: MMRDA's letter No.T/MRTS/VIAG/IMPLN/2005 dated September 14, 2005

Please find enclosed the Financial Proposal in original and a copy in respect of the **Development and Operation of Mass Rapid Transit System for Versova-Andheri-Ghatkopar Corridor** in response to above referred letter issued by the Mumbai Metropolitan Region Development Authority (MMRDA).

We hereby confirm that:

1. The Proposal is being submitted by Reliance Energy Limited who is the Lead Consortium Member of the Bidding Consortium comprising Reliance Energy Limited and Connex SA, France, in accordance with the conditions stipulated in the RFP.
2. We have examined in detail and have understood the terms and conditions stipulated in the RFP issued by MMRDA and in any subsequent communication sent by MMRDA as regards Financial Proposal. We agree and undertake to abide by all these terms and conditions. Our Proposal is consistent with all the requirements of submission as stated in the RFP or in any of the subsequent communications from MMRDA.
3. The Bidding Consortium of which we are Consortium Member satisfies the legal requirements.
4. The information submitted in our Proposal is complete, is strictly as per the requirements as stipulated in the RFP, and is correct to the best of our knowledge and understanding. We would be solely responsible for any errors or omissions in our Financial Proposal.

*Smg*



5. Our Financial Proposal is firm and an irrevocable offer and shall not be revoked during the Bidding Process, shall remain valid until 12<sup>th</sup> August 2006. We agree to reasonably consider any request from MMRDA to extend further validity period beyond this date.

For and on behalf of:

SEAL OF THE COMPANY

Signature :

Name of the Person : S MOHAN GURUNATH  
Designation : Head – Business Development (Infrastructure)

Enclosures : ( i ) Check List  
( ii ) Format (As mentioned in the Respective Check-list)

## Section 2

# BUSINESS PLAN

## Mumbai Metro One

### Mass Rapid Transit System

On

Versova – Andheri – Ghatkopar Corridor

**Consortium**



**Reliance Energy  
Limited**

**Connex SA**

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Mass Rapid Transit System On Versova – Andheri – Ghatkopar Corridor



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## Summary

In the ambitious Versova Ghatkopar elevated Mass Rapid Transit System project of MMRDA, Reliance Energy Ltd (REL) is leading the Consortium with Connex SA, France.

Vast experience of Connex in Train operations and strong background of REL in Infrastructure Development and Funds Raising are brought together in this project.

The Joint Venture Company, to be formed upon the award – with REL, Connex & MMRDA as shareholders, would Build, Own, Operate the MRTS and transfer the same to MMRDA after the Concession Period. The Concession period is 35 years including Construction period.

The East West corridor is approx 11.5 km long and traverses a very dense traffic stretch. It will have two tracks, 12 stations and a Depot cum Workshop.

For bringing other international experience into the Project, MTR Corpn Hongkong are appointed as the Technical Consultants during the Bid stage.

Molinari Rail – railway Engineering Consultants group from Switzerland were involved in defining the design and features of the Rolling stock, Depot and Workshop facilities. Molinari Rail has wide experience in developing safe, efficient and Good Quality design for the Rakes. Connex are being supported by Molinari Rail in their other rail projects when it involves Trains Engineering.

In line with requirement of RFP for the development of the Mass Rapid Transit System for Versova-Andheri Ghatkopar Corridor over a thirty five year Concession, this plan is prepared so as to maximize the utilisation of the facilities and their operational performance over the entire plan period.

Based on the studies on Traffic, assumptions have been made for the growth in traffic to arrive at the investments in a phased manner for various systems in the Project. The Rolling



Stock design also takes into account the limits on the passenger per sq. meter as listed in the RFP.

A Project Implementation and Work Programme has been so developed that there will be clear definitions of responsibilities and time lines to commission the project within the period as specified in the RFP.

Bringing together the global experience of Connex in operating Metro systems and the management capabilities of Reliance Energy Limited (REL) predominantly in 24x7 service areas the operation and maintenance strategies and plans have been evolved to ensure smooth and efficient operations of MRTS. Recognising the great importance of this first PPP MRTS Project in the Mumbai all efforts are directed towards making this a very successful Project both in the construction phase as well as in operations phase – meaning thereby introduction of world class skills , equipment / technology are integral part of the Project.

The capital expenditure and financing for the Project – during the construction and operations phases, has been optimally planned keeping in mind the traffic projections, flexibility in augmentation of facilities and viable operations. While planning for various technical systems care has been taken to maximize the local contents keeping in view the required levels of Safety & Reliability of the MRTS.

The operational Expenditure is optimized through a mix of predominantly local resources and know-how reinforced by expatriate specialist inputs from Connex , the target being to create a top level self sustaining local Operations Company.

The fare box revenues and commercial revenues are planned within the guidelines of RFP.

Automatic fare collection system is envisaged keeping in mind that there will also be requirements for manned ticket counters as some sections of passengers would continue to prefer use of manual ticketing.

Passenger safety is ensured through usage of advanced train signaling system and automatic train protection backed up by tested maintenance strategy and maintenance



planning. Further, through periodic training, including usage of train simulator, the drivers of the trains would be equipped for efficient and safe operations of the trains.

The Rolling Stock design provides for very comfortable travel for the passengers including facilities like passenger information displays, PA systems etc. The design and layout of the stations would ensure smooth passenger flow, convenient access, as well as enhanced comfort levels with minimal leakage of revenue.

The Disaster Management Plan envisages various measures to be adopted to ensure safety and recovery of the MRTS are of highest order.

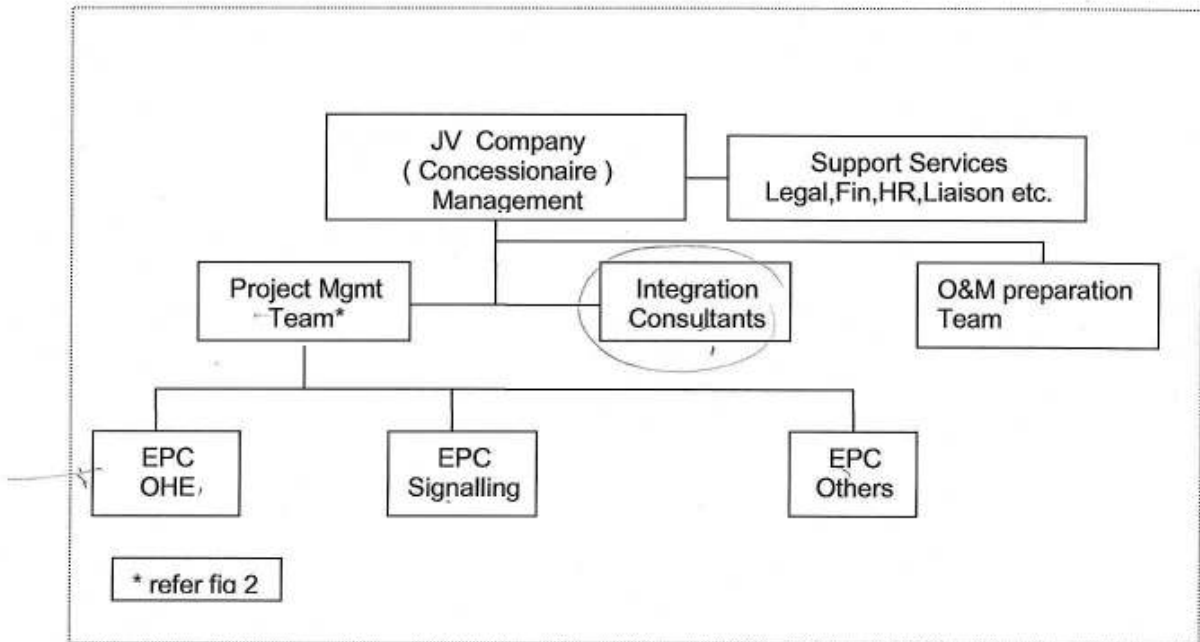
The marketing strategy is such as to harness the full potential of the MRTS facilities within the framework of the Concession Agreement.



### 7.A.1 Strategy for Project Implementation and Work Programme

It is proposed that the the Project implementation would be broadly under the structure in Figure 1 below:

**Figure 1**



1. The Concessionaire in the form of JV company ( pl refer to the organization structure given in 7.A.8)
2. An Integration Consultant of the JVC
3. Project Management (refer to Figure 2 below)
4. EPC contracts
  - a. Civil works including Track works
  - b. OHE and other Electrifications
  - c. Signalling & Telecommunication
  - d. Rolling Stock and Depot
  - e. Automatic Fare Collection
  - f. Other works

For efficient and effective execution of the above Contracts , there will be specialized Consultants involved in the respective areas of EPC. These consultants will work closely with integration consultants.



Roles and responsibilities under each of the above heads (SI No 1 – 4 above) will be well defined in order to avoid overlaps and underlaps.

The Integration Consultants would be of international repute with good experience in such MRTS projects. These consultants shall be responsible for the integration of the various sub-systems in order to deliver an operational, reliable & efficient MRTS.

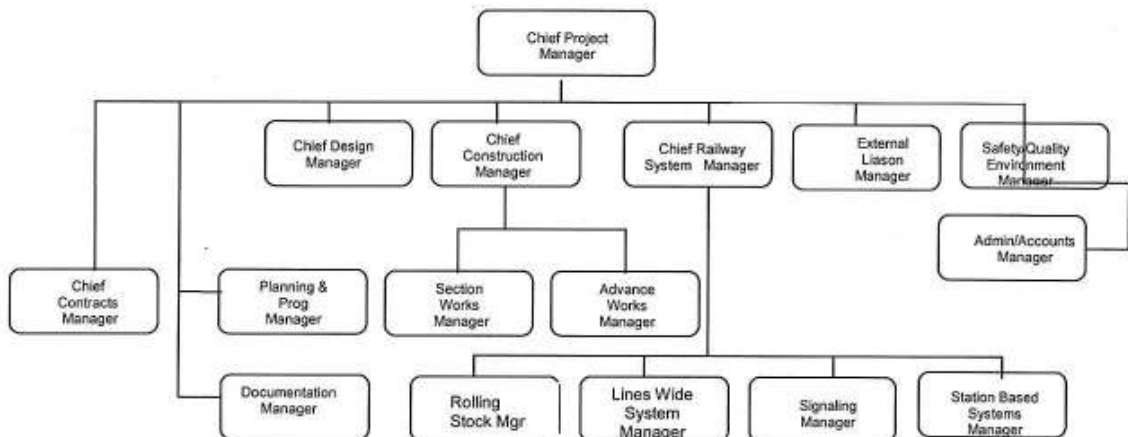
The Project Management would be responsible for managing the design & engineering, procurement, construction & commissioning of the Project. The PM will also be responsible for the necessary liaisoning with authorities and agencies and for safety aspects of the Project. The roles and responsibilities of various personnel in the Project Management group will be well defined and the measurement criteria for the outputs predetermined. It shall be ensured that the reporting lines and responsibility assignments shall not affect the flexibility of the Project Management Group.

The EPC contracts would be finalised based on the techno commercial evaluation of various reputed vendors who would be invited to participate in the construction of the Project, with detailed inputs from the Consultants, legal & commercial departments of the Concessionaire and the Project Management

The project monitoring will be based on a project management tool like Primavera planner so that timely completion of the Project is ensured. As foreseen now, the Consortium envisages 4 year completion schedule. The same has been arrived at after detailed assessment of the existing conditions – land, soil, RoW time lines as per draft concession agreement, prevailing conditions in the construction industry, discussions with vendors/Connex/Consultants etc and has been indicated by means of a PERT chart in Annexure 1. Detailed programme would evolve after award of Concession and detailed discussions with MMRDA and would be in line with the agreement with MMRDA.

**Figure 2**

Mumbai MRTS – Organisation Structure – Project Implementation



The project team will manage all activities to ensure that the Project is delivered in a safe and cost-effective manner, on time to the required quality and within a carefully controlled budget.

The aspects of Quality, Safety and Environmental matters will be the responsibility of the nominated department / persons in the JV Company. These functions shall be independent of the Project Management. The safety, quality and environment personnel within the Project Management team would be responsible for the implementation of the guidelines issued by the nominated department / persons in the JV Company.

MMRDA will be kept informed by the Concessionaire on a regular basis of the progress of all aspects of the Project. Prior to any major decisions concerning the Project being taken, MMRDA will be consulted as required under the Concession Agreement.

- **Project Review**

In addition to the project management there will be other senior managers of the JVC viz. MMRDA, REL & Connex that would form the Steering Group for the Project. The Steering Group shall monitor and review the Project progress both in terms of timelines and cost. The role of the group is primarily to monitor & support the project management team all issues of the Project including issues of strategic importance.

- **Systems & Procedures**

The JV company procedures will be developed in compliance with ISO 9001, to ensure that a systematic approach is adopted throughout the Project life cycle. Other parties, in particular the contractors, will be required to establish suitable procedures and they will be audited to ensure the procedures are appropriate and that they are being followed.

The JV Company will ensure that the various sub-systems of the Project are well integrated and interfaced in order that the MRT System meets the requirements of the Concession Agreement.

Requirements for managing interfaces will also be included in all contract documents. These will place obligations on the contractors to liaise and interface with each other in the interests of producing a properly coordinated project.

There are two aspects of interface coordination - spatial coordination and system coordination. The spatial coordination will ensure that the works are properly installed within the space designed to house them without conflict with the building structure and architectural works and finishes. This will entail extensive interaction between the vendors



during the detailed design period to ensure that the spatial requirements of the various systems and equipment are fully met.

System coordination will ensure that various railway systems are designed, developed and installed in such a manner that they are compatible with each other and provide an effective and coordinated MRTS. Much of the obligation for ensuring that this happens will be placed on the contractors and designers. Examples of such interfacing systems are :

- Signalling & Communication.
- In Cab Signalling & Communication within the Rolling Stock

Various **reporting systems** will be established for the purposes of management reporting through periodic MIS reports. Reports shall be prepared and circulated as required under the Concession Agreement / EPC Contracts. The Reports would highlight the system wise progress and cost development. Comparisons would be made with the contractual time schedules and cost estimates and necessary corrective actions will be initiated.

- Stakeholder Management

To ensure that all stakeholders are effectively managed, a stakeholder management plan will be developed. This plan shall include but not be limited to a list of all stakeholders, contact details, the degree of influence they have on the Project, the potential for them to adversely impact the Project, and arrangements for dealing with the stakeholder and the party responsible. Under the Project Management, responsibility for the stakeholder management is assigned to the External Liaison Manager.

Besides the External Stakeholders, the other important stakeholders for the project such as Steering Group and independent engineer(s), vendors and consultants will be suitably addressed by the respective responsibility areas within the Project Management group. E.g. the Chief Project Manager would be the single point of contact for the Steering Group. The Chief Design Manager, the Chief Construction Manager would be the points of contact for the Independent Engineer(s).

- Right of Way (ROW) related matters

MMRDA is responsible for providing ROW, including relocation of underground utilities, to the JV Company. The JV Company shall also interact & monitor the developments with respect to the concerned third parties and protect the RoW during the Project period.



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## 7.A.2 Assumptions

- The MRTS will be governed by the Tramways Act (Bombay Amendment), 1948.
- There will be possibility of reorganisation routes by BEST for feeder lines.
- For other assumptions refer the the sections 7.A.3 and 7.A.4 below.





### **7.A.3 Capital Expenditure & Financing**

#### **Expertise available from Consultants and consortium members**

##### ***Reliance Energy Limited (REL)***

REL, the lead member of the consortium and a large player in the Indian Corporate, has rich experience in successful implementation of large infrastructure projects.

REL brings to the consortium its proven skills of superior project management, unparalleled resource raising abilities and ability to handle and absorb cutting edge technologies.

##### ***Connex SA***

Connex SA, the "technical partner" of the consortium has a rich experience of operating MRTS system in about 25 countries across the globe. The experience of CONNEX has also been utilized while finalizing the CAPEX for MRTS Mumbai.

Connex with its operating experience provided key inputs especially in the following areas: -

- a. Rolling stock design and fleet requirement to cater to the prescribed headway including ramping-up of the services during the concession period
- b. Cost benchmarking for critical components of the Project viz. rolling stock, signaling system and tracks
- c. Design vetting related to operation of MRTS viz. Automatic Fare Collection (AFC) machines and related hardware and software (including gate requirements at the stations)
- d. Design appropriateness of the car depot and the washing yard keeping in view the prescribed train schedule and maintenance requirements
- e. Efficient layout for the passenger flows in stations

##### ***MTR Corporation***

As already indicated in the Technical Bid submitted, MTR Corporation, Hong Kong were engaged in the capacity of a "Technical consultants" to the consortium. The initial conceptual design and the critical project parameters had been developed/ vetted by MTR Corporation.

MTR Corporation's experience has been extensively utilized to arrive at a realistic and robust CAPEX plan and for finalizing the Project Implementation Plan.

#### **Capital Expenditure ( CAPEX )**

Basis for the planning of the Capex are :

- a. The RFP issued by MMRDA and various clarifications
- b. The Technical proposals furnished by the REL led consortium and the subsequent clarifications
- c. Ridership estimation undertaken through the consultants and the results from its analysis
- d. Appropriate expert opinion and prevailing local conditions.



- e. offers from suppliers & vendors
- f. international & domestic benchmarks & norms
- g. Segregation of the Capex during Construction Phase and Operations Phase
  - i) Initial Construction Phase ( the MRTS project will be commissioned as per the guidelines laid down by MMRDA)
  - ii) Augmentation , Refurbishments and replacements of the major components during the concession period in order to meet the increased traffic demand and the deliverables under the Concession Agreement . This period is after the Commercial Operations Date and extends upto the end of Concession.

#### **Adherence to the Technical Requirements**

The technical bid submitted by Reliance Consortium adequately covers all the mandatory parameters laid down by MMRDA as a part of the transaction document.

Subsequent to the submission of the technical bid, MMRDA had communicated additional requirements to be adhered to by the Bidders while estimating the CAPEX for developing the MRTS System. These have been taken note of and considered in the development of Capex.

#### **Interaction with Potential Suppliers**

The proposed MRTS at Mumbai is one of the first of its kind in the Country for the following reasons: -

- First Public-private-partnership MRTS project
- Apart from experience of Delhi Metro and to some extent Calcutta Metro, there is little experience available in the country w.r.t. development of MRTS.

Mumbai MRTS with active support from Connex and MTR Corporation and by utilizing the strong industry presence of Reliance Energy, managed to evince active interest from internationally acclaimed suppliers/ contractors. Due care has been taken by the consortium to optimize local content to optimize project cost and other implementation aspects of the project.

#### **7.A.3.i CAPEX – Initial Construction Phase**

The Initial CAPEX for the project (proposed to be incurred for initial setting up of MRTS project) comprises the following:

1. Hard costs
2. Soft Costs

Hard costs include the base equipment prices suitably adjusted for inflation during the construction period and the applicable Taxes and Duties.



Soft Costs include Pre-operative expenses, Engineering & consulting fees, Project management fees, financing costs including Interest during construction period (IDC), contingencies and other soft costs

#### 7.A.3.i.a Hard Cost

Based on offers obtained from potential suppliers/ vendors in India / abroad, international & domestic benchmarks and Project/site specific parameters, and subsequent discussions with MTR , Suppliers / experts , the base cost has been estimated. While adequate care has been taken to estimate the project cost in a realistic manner, reasonable contingencies have been provided in the project cost to ensure that there is no cost over-runs, without any compromise on quality, reliability and schedule of the project.

The CAPEX for the project is expected to be incurred in a phased manner) in line with progress of construction. An average inflation rate of 3.5% p.a. has been considered for escalating the base numbers till COD.

**Table 1 CAPEX - Hard cost (Rs Cr)**

Particulars	Standard Gauge	Broad Gauge
Rolling Stock	547	561
SCADA	17	17
Telecom	150	150
AFC	74	74
Escalator	55	55
Civil Works	573	573
OHE	63	63
Track works	113	116
Air Conditioning	9	9
Signalling	140	140
Car Shed , workshop & misc	69	69
<b>TOTAL Hard Costs</b>	<b>1,810</b>	<b>1,827</b>

The above hard costs include taxes & duties also which have been dealt with separately later.

#### 7.A.3.i.b Soft Costs

The soft costs would entail the following:

##### 7.A.3.i.b.1 Pre-operations Expenses

Implementation of the MRTS project would require the management and training of staff and the deployment of experts both from Domestic and International sector to ensure adherence to quality, reliability and timely completion. It also would entail involvement by the Operators even during the design phase.



In addition to the employment related expenses, expenses that are expected to be incurred by the Project Company during the construction period have been capitalized. The following are the major heads of pre-operations expenses: -

- a. Employee expenses
- b. Administrative & General Expenses
- c. Insurance Cost
- d. Property Taxes and Stamp duty
- e. Cost towards Power & Energy for testing the system
- f. Initial maintenance costs in pre operations period.

#### Employee Cost

It is proposed that services of the experts - both domestic and international - would be made available as and when required for the successful implementation of the MRTS project. The project management team of the JV Company would comprise about 15 experts in the various areas of MRTS who would ensure the successful implementation of the MRTS. Additionally the various sub-contractors / agencies (consultants) engaged for the project would deploy their respective manpower.

At the end of the construction period about 290 personnel are expected to be deployed in a phased manner based on the progress of the project. These personnel shall be responsible for operating the MRTS in the operations phase.

Deployment of committed and skilled personnel is crucial for successful operation of MRTS. Keeping this in view, training of the personnel is an essential success factor for the operations of MRTS, it is proposed that out prior to the commercial operation of the MRTS the key personnel like Drivers, Controllers etc would be given good exposure to the best of the systems in the world by delegations to the systems operated by Connex. Besides, a Train Simulator is foreseen to be available in the Depot to make the class room training a combination of Theory and Practicals. The man-power build up is planned to be completed prior to the commencement of commercial operation to facilitate foolproof "testing and trial run" with complete simulation with "real-life" situation.

It is to be noted that subsequent to the commencement of commercial operation, training expenses will be continue to be incurred for upgradation of the skill sets of the employees on a regular basis.

An amount of around Rs 28 Crores has been assumed to be capitalized as "employee cost" incurred in the start up phase of the MRTS. }

#### Administrative & General Cost

Various administrative expenses are required to be expended during the execution of the project. The expenses proposed to be incurred during the construction phase will, as is the normal practice in the infrastructure and industry, be capitalized and form part of the CAPEX.

#### Insurance Cost



The insurance costs for covering the construction phase of the project has been arrived at on the basis of budgetary quotations received from the insurance companies. The coverage envisaged is in line with the requirements of the RFP. The expenses proposed to be incurred during the execution will be capitalized and form part of the CAPEX. The coverage will also include the preoperation phase of the revenue operations.

Stamp Duty & Property Tax

MMRDA as part of the Transaction Document (clarification provided to the bidders) provided the relevant Notification of Govt. of Maharashtra related to the land (CTS No.866) earmarked for car shed.

Based on the clarification provided by MMRDA (on 3 January 2005), stamp duty has been considered to be part of the CAPEX for the project in line with the provisions of the Bombay Stamp Act, 1958. The stamp duty has been calculated based on the fair Market Value of the car depot land.

The REL led consortium has also considered the Property tax liability for the same land (earmarked for car depot) while calculating the CAPEX for the project and also for the operations period. The following assumptions have been considered for the purpose of "property Tax" calculation:

- a. Total area of the land – 13.8 Ha
- b. Property Tax on the land considered at Rs. 17 per sq. ft. during the construction period and Rs.7.50 per sq.ft. after the completion of the construction.
- c. These rates are charged for the constructed area. As regards the open space, separate rates are charged depending on its use for green area development, parking etc.

Costs towards Power & Energy during testing of the system

The system would be powered & Tested in the course of commissioning & trial run. The cost on account of power & energy arising out of these tests and trials have been estimated and included in the initial capex

Initial maintenance costs in pre operations period

The complete system would be in test and trial operations and would require small maintenances as recommended by different manufacturers and service providers. These costs have also been estimated and included.

**7.A.3.i.b Project management & System Integration costs, contingency and Financing costs**

Project management & System Integration Costs, contingencies and Financing Costs have been assumed as follows:



**Table 2 PM , Contingency & Financing Cost**

SI No	Particulars	Basis
1	Project Management & System Integration Costs (PM & SI Costs)	7.0% of the Hard cost (for Standard Gauge) and 7.5% of the Hard Cost (for Broad Gauge)
2	Contingency	5% of Hard cost and PM & SI cost
3	Financing Cost (up-front & syndication fees to lenders)	1.0% of Debt raised

**7.A.3.ii Taxes and duties**

The taxes and duties have been estimated based on the applicable provisions of the law . The detailed break-up of the taxes and duties under different heads are provided below as a ready reference: -

**Table 3 Taxes & Duties**

Particular	Standard Gauge	Broad Gauge
BCD	54	55
ED/CVD (incl EC)	117	118
EC on BCD and CVD	3	3
Service Tax (incl EC)	16	16
VAT/ WCT	47	47
CST	9	9
Octroi	50	51
<b>Total</b>	<b>296</b>	<b>299</b>

In addition, Stamp Duty & Property Tax on car depot land has also been considered. MMRDA as part of the Transaction Document provided the relevant Notification of Govt. of Maharashtra related to the land (CTS No.866) earmarked for car depot.

Based on the clarification provided by MMRDA (on 3 January 2005), stamp duty has been considered to be part of the CAPEX for the project in due consideration of the provisions of the Bombay Stamp Act, 1958. In line with the provisions of the Act, the stamp duty has been calculated based on 90% of the fair market value of the depot land at the applicable rates. The total stamp duty amount works out to approx Rs. 13.4 cr.

Property tax liability for the depot land both during construction and operation phase has been considered. The following assumptions have been made for the purpose of "Property Tax" calculation: -

1. Total area of the land – 13.8 Ha
2. Property tax on the land considered at Rs. 17 per sq. ft. during the construction period and Rs.7.50 per sq.ft. after the completion of the construction.



3. These rates are charged for the constructed area. As regards the open space, separate rates are charged depending on its use for green area development, parking etc.

### 7.A.3.iii Landed CAPEX

Based on the above assumptions, the landed CAPEX for the project is as given below: -

**Table 4 Landed CAPEX (Rs Cr)**

Particulars	Standard Gauge	Broad Gauge
Rolling Stock	547	561
SCADA	17	17
Telecom	150	150
AFC	74	74
Escalator	55	55
Civil Works	573	573
OHE	63	63
Track works	113	116
Air Conditioning	9	9
Signaling	140	140
Car Shed , workshop & misc	69	69
<b>TOTAL COST before soft cost</b>	<b>1,810</b>	<b>1,827</b>
Contingencies	91	91
PMC	133	144
Pre-operative Expenses	69	69
IDC	253	256
<b>TOAL PROJECT COST</b>	<b>2,356</b>	<b>2,387</b>

### 7.A.3.iv CAPEX over the construction period

The MRTS project is expected to be completed in about four (4) financial years commencing with FY 2006 – 07.

Expected phase-wise cash outflow towards Capital Expenditure is indicated below for reference.

**Table 5 CAPEX Phasing (Rs Cr)**

Particulars	Total	Year 1	Year 2	Year 3	Year 4
<b>CAPEX Incurred (Standard Gauge)</b>	2,356	290	637	930	499
<b>CAPEX Incurred (Broad Gauge)</b>	2,387	293	645	942	506



### 7.A.3.v Financing Plan

The JV Company would extensively leverage the capability and experience of Reliance Energy Limited in raising funds both in domestic and in international markets. Based on various rounds of discussions with potential lenders, a robust financing plan has been developed to optimize the cost of the project to sustain the initial down sides, typical to all infrastructure projects.

Project Cost is assumed to be funded through a mixture of debt, equity share capital and Capital Contribution from MMRDA. Debt is expected to fund about 70% of the Project Cost and the balance 30% shall be met by equity share capital and capital contribution from MMRDA.

**NOTE:**

The bid documents circulated by MMRDA indicates "the capital contribution from MMRDA" as the Bidding Criteria. Further, based on the clarification/ communication provided by MMRDA (14 September 2005) the Capital Contribution from MMRDA (being the Bidding criteria) is being enclosed separately in Envelop 2 forming part of our bid

In light of this, the break-up of 30% component in terms of actual amount of MMRDA contribution and equity share capital is not being shown in this document. However the detailed terms and conditions and other major assumptions of the financing plan are provided below. It is to be noted that as required under the provisions of the Transaction Document, the Financial Model is also being furnished.

#### 7.A.3.v.a Debt Financing

Discussions were held with various FIs with an objective to obtain comfort from the Banks for providing financing at most competitive term. The consortium obtained "comfort letter" from "Standard Chartered Bank" for debt financing with an upper limit of Rs. 1750 crores. The letter is enclosed separately as a part of the financial bid for ready reference.

Based on the discussions with the FIs and the prior experience of REL, assumptions were taken as explained below.

**Table 6 – Terms of Debt**

Sl No	Particular	Basis
1	Debt : Equity Ratio	70 : 30
2	Interest rate	8.5% per annum
3	Total term of the Debt	15 years
4	Principal Moratorium	5 Years





### 7.A.3.v.b Equity Contribution

Equity contribution shall be brought in as follows:

1. Equity from consortium members (74%)
2. Equity from MMRDA (26%)

The consortium comprising REL and CONNEX SA shall collectively bring/arrange 74% of the total equity requirement. In line with the requirements under the transaction document, Connex SA shall bring 5% of the equity and REL being a lead member would bring at least 26% of the total equity and shall arrange the balance through its Affiliate Companies.

### 7.A.3.v.c Capital Contribution from MMRDA

Article 23.3 of the Draft Concession Agreement circulated by MMRDA restricts the disbursement of the Capital Contribution to the extent of 85% during the construction period. It is stated that the balance 15% of the Capital contribution shall be disbursed within 15 days after completion of 6 (six) months of operation after the commercial operation date (COD).

The financing plan assumes that this 15% gap shall be met out of short-term bridge finance. The said Bridge Finance will carry an average interest rate of 10% and will be paid back once the 15% balance Contribution from MMRDA is received.



## 7.A.4 Projections During Operations Period

### 7.A.4.i Ridership Forecasts & Fare Rates

#### Ridership Forecasts

Ridership forecast is the most critical parameter for evaluating the viability of the Project. The Ridership forecast estimated by MMRDA and provided in the RFP and other documents of MMRDA has been validated by the REL led consortium. }

#### Traffic Consultant

Bidder has engaged M/s Consulting Engineering Services (India) Pvt. Ltd to undertake a brief Ridership estimation in the proposed corridor for the entire concession period. An integrated approach of quick primary survey and analysis and validation of secondary data available was undertaken.

#### Primary survey

The entire corridor was divided into various sections covering all the stations. Following activities were undertaken for the traffic survey:

1. Road Network Inventory Survey
2. Classified Mid-Block Volume Count and Occupancy Survey
3. Speed and Delay Survey
4. On Board Boarding & Alighting Survey
5. Origin- Destination Survey and Willingness to pay survey

#### Analysis of the data and use of TRIPS model

TRIPS model is used to estimate the peak hour Ridership in various years. Its takes into account the existing road & rail networks, the loading pattern, proposed networks in various years, the population and employment growth in the catchment region, fare structure, travel time of various mode.

Sensitivity of the Ridership with respect to headway and fare structure was examined.

#### Fare structure used in the financial model

Fare structure provided in Schedule L of the Concession Agreement is the base for the fare rates used in the Financial Model. As per the schedule the maximum fare permissible for the year 2003-2004 considered are:

1. Rs 6 upto 3 km
2. Rs 8 between 3 km and 8 km
3. Rs 10 beyond 8 km

The revision of fare is indexed @ 11% every fourth year.



### Ridership forecast used in the financial model

A headway of 3.5 min during peak hours (5 hours of morning peak and 5 hours of evening peak) and 7 min during off-peak hours is considered. The operating hours of 19.5 hours in a day as stipulated in the RFP document is considered. PHPPD in each concession year is estimated to arrive at the capacity of rolling stock.

The Ridership forecasts used in the financial model for each concession year are provided in Annexure 10 to this document.

### 7.A.4.ii Anticipated Operation & Maintenance Cost

The operation and maintenance cost for the project has been carefully projected with active participation of the experts Connex SA.

The following heads of expenses are considered:

1. Employee cost
2. Energy & Power costs
3. Administrative and general expenses
4. Maintenance expenses including spares
5. Insurance

### Employee Cost

The employee cost forecast has been carried out taking into account the following parameters: -

1. Levels of personnel considering the key requirements of the project and job content.
2. Compensation structure factoring various elements such as place of work (Mumbai being a high cost city, additional compensation being provided), involvement of private sector (compared to a public sector employment, private sector employment generally involves higher compensation package) etc.
3. Training costs for ensuring the reliability and quality of service

The following combination of employees are planned to be in place in a phased manner.

**Table 7 Employee Types**

Sl No	Details
1	CEO
2	Independent Directors
3	Operational Management
4	Senior & Middle Management
5	Supervisory staff
6	Train Drivers
7	Support Staff
8	Others



### *Compensation Package*

The compensation package has been estimated in consultation with Connex SA and local experts.

### *Training Expenses*

The proposed MRTS system would be operated through high-end state-of-art technology driven system.

Training as a part of the "Organization Culture" has been identified as one of the critical area. Accordingly the training expense has been considered appropriately as under:

1. Extensive training program just before the commencement of the commercial operation during the trial run and test runs.
2. Period training to upgrade the skill sets of the existing employees training to new entrants.

### **Energy & Power Cost**

Energy cost has been considered under the two broad heads, namely:

1. Traction power – energy requirements for running the trains
2. Station power – all other energy consumption than 1 above.

The rates for energy have been taken as per MERC's applicable rates consisting of both demand charges (leviable at Rs. 374/KVA/month) and energy charges (Rs. 3.40/kwh). These rates are existing today and have suitable escalation has been assumed on a yearly basis in energy charges.

### *Traction Power consumption forecast*

Energy consumption per trip per was computed based on load of the train, trip length, and regenerative energy during braking and other factors. The traffic forecast and MMRDA service requirements were considered to decide the headway in each year.

### *Other Power consumption*

The station load is computed considering all the equipment (escalators, station lightings, etc) and amenities provided at the stations. The contracted load and overall demand for the station consumptions has been devised keeping in view the maximum demand at the peak hours.

The car shed energy requirement has been specifically designed to cater to the day-to-day maintenance activities through power-intensive equipments. The car-wash facilities provided at the car shed has also been duly considered while arriving at the design capacity for the energy consumption.



### **Administrative and general expenses**

The administrative and general expenses forecast during the concession period covers the following broad heads:

1. House keeping expenses
2. Security expenses
3. Telecommunication expenses
4. Water charges
5. Statutory expenses
6. Miscellaneous Expenses

#### *House keeping & Security expense*

These expenses for all the stations, depot, administrative block etc have been considered as an outsourced activity and has been calculated based on the offers from various specialized service providers.

#### *Other expenses*

Expenses like office stationary, telephone charges, travel expenses, water charges etc has been estimated.

#### *Maintenance Cost*

The maintenance cost has been forecast under a three tier maintenance plan. They are as follows:

- a. Preventive maintenance
- b. Routine maintenance
- c. Emergency maintenance

A detailed maintenance-cycle-plan is developed to prepare "maintenance-calendar" for preventive and routine maintenance and has been explained in detail elsewhere in this document.

#### *Insurance Cost*

The JV Company will cover its operations by appropriate insurances as required by RFP. Detailed discussions have already been held with renowned insurance companies

### **7.A.4.iii Depreciation**

#### **Accounting Depreciation**

The assets for the purpose of charging depreciation have been regrouped and reclassified as per the guidelines provided in the relevant provisions of the Companies Act, 1956. Accordingly the rates prescribed in Schedule XIV of the Companies Act, 1956 have been considered as the applicable rates for the purpose of calculation of depreciation.



The transaction document envisages transfer of the MRTS and its assets to MMRDA at the end of the concession period, at a nominal price of Rs 1/-. The applicable accounting guidelines, under such a situation require the assets to be depreciated over the life of the assets or the utility of the assets, which ever is lower. Based on this philosophy, the assets have been completely depreciated over the concession period.

#### **Depreciation under Income Tax Regulation**

The assets for the purpose of deriving tax depreciation have been regrouped into the appropriate "Asset Category" as defined under the applicable provisions. The rates as provided in the Income Tax Act have been consistently applied for the entire concession period.

#### **7.A.4.iv Anticipated Tax Rate**

Based on provisions of the Income Tax Act, it is our understanding that MRTS projects are eligible for 80 IA and 10 (23G) benefits.

Income Tax for each of the financial year during the concession period has been calculated assuming availability of 80 IA benefits and applicability of MAT. Legal opinion confirms that these benefits are available to the project under existing provisions. It is assumed that MMRDA will provide necessary consents/ certification, if required, in relation to such benefits as above.

Corporate tax has been provided as per the rates specified in the Finance Act 2005. Full Corporate tax rate has been taken at 33.66%. MAT rate has been taken at 8.41%.

It is to be noted that while arriving at the tax liability for the JVC, all applicable provisions as provided in the Finance Act 2006, have been duly considered viz.

1. Carry-forward and Utilization of unabsorbed tax depreciation
2. Carry-forward and Utilization of unabsorbed book loss
3. 80 IA benefits
4. Utilization of MAT credit

#### **7.A.4.v Asset additions / replacement costs during concession period**

The asset addition, replacement, refurbishment cost over the concession period has been calculated based on the following:

1. Additional requirement of infrastructure to meet the demand.
2. Life cycle of key equipment as per the manufacturer's guidelines and local condition (Mumbai being a coastal city, additional precautions have been taken for asset maintenance)



3. MRTS system performance requirements in line with design and operational guidelines with respect to the reliability and quality as laid down by MMRDA;
4. The residual life of assets to be at least 3 to 5 years at the time of handover to MMRDA at the end of the concession period.

The following category of assets are the main constituents of such additions, replacements, refurbishments etc.

1. Rolling stock
2. Telecommunication
3. Signaling

Based on the head-way requirements and the traffic build-up, the rolling stock additions are proposed to be undertaken in different financial years of the concession period. As envisaged by the consultants and Connex SA, each of these acquisition of rolling stock would require 2-3 years for delivery on site. Accordingly, the CAPEX has been assumed spanning over a period of three years for each of these acquisitions.

The phasing sequence of any CAPEX spending for new acquisitions would generally be spread over a three financial year horizon: -

**Table 8 Capex during Operations**

Year	% COST
Year 1	20%
Year 2	70%
Year 3	10%

The taxes and duties as applicable during the current financial year have been considered for the purpose of calculation of Landed Cost of new acquisitions in future also. The cost of refurbishment/replacement also includes escalation on a yearly basis to reflect the inflation in economy. In the event of replacement/refurbishment (considered part of Capex) spending will be within that financial year it is undertaken.

Similar methodology has been followed in case of signaling & telecommunication also.

#### **7.A.4.vi Financial Projection**

##### **7.A.4.vi.a Summary of key financial information**

The key financial ratios are provided for reference. The detailed Financial Model is enclosed separately.



**Table 9 Key Financial Ratios**

Sl No	Particulars	Standard Gauge	Broad Gauge
1	Project IRR	9.66%	9.57%
2	D : E Ratio (at the time of project completion)	2.33	2.33
3	Average Debt Service Coverage Ratio (DSCR)	1.34	1.32
4	Minimum DSCR	1.08	1.07

Please also refer to the Annexure 9-4 for the following: -

1. Projected Annual Income Statements
2. Projected Cash Flow Statements
3. Projected Balance Sheet





## **7.A.5 Operations & Maintenance Plan**

### **7.A.5.i Approach to smooth & efficient Fare Collection**

The fare collection system attempts to achieve the following characteristics to be termed as efficient.

1. Near zero pilferage
2. Accurate collection of fare
3. Flexibility to the user
4. Minimum cost of collection

In India fare collection is traditionally manual and depends on the internal controls (manpower) to enforce the payment of fare by users. This method of collection mainly depends on the honesty and sincerity of the persons directly employed to enforce the fare collection. In high-density routes, it becomes humanly impossible to enforce collection. In a typical metro system, approximately 1000 people exit from a platform on arrival of train. To allow so many people to come out a wide exit path is required. In such case, even if many ticket checkers are employed it is impossible to check every passenger for right ticket. City transportation systems, over the years, have seen habitual ticket-less travel. This has arisen because of absence of 100% checking and multiple un-checked exits from the platforms.

In newer metro systems, the number of exits is mostly limited to one or two and there is no way to jump the fence (metros being elevated or underground). This brings down ticket-less travel to some extent. But the problem of not being able to check 100% conformance of users manually still remains.

This calls for Automatic Fare Collection (AFC) system, which is proposed to be used by the JV Company in its MRT System, wherein 100% checking will be ensured and a passenger will be allowed to enter/exit a platform only on a valid ticket. Dependence on personal traits of the employees of the system will be made redundant to a large extent by the use of automated fare collection system. The JV Company would however also provide kiosks at the stations to manually dispense tickets and also for excess travel fare collection – since it would not be possible for all the potential passengers to use the AFC. As 100% checking would be possible, the objectives for an efficient system would be fulfilled.

In terms of flexibility to the user, he should be allowed to change the destination without causing too much hard ship to him. A pre-paid system as would be introduced by the JV Company would be the right choice for providing such flexibility.

Automating the fare collection eliminates/reduces the man-power required to collect the fare from the passengers. Over a long run this proves to be a cost effective solution.

Based on the above facts, an Automatic Fare collection system based on a pre-paid card meets the basic objectives of an efficient fare collection system.

Even if the system is automated to collect fares, it is essential that the system is very reliable, secure and should have lowest maintenance cost, else the objectives are defeated. These requirements bring up the following newer constraints in selection of the system.



1. To be maintenance free, there shall be minimal moving parts
2. The transactions shall be secure and should not allow cheating by viable means
3. System availability and performance to the required standard

Contactless RF card/token based systems do not have any moving parts except for the turnstile. The crypto algorithms used in the RF interface of MiF are type of RF cards provide the necessary security over the air and for the data stored in the card. Adequate level of redundancy & sufficient pool of spares shall be maintained to ensure the availability and reliability requirements

Based on the above, the JV Company would ensure smooth and efficient fare collection by way of:

1. Automatic Ticket Vending Machines
2. Manual ticket dispensing.

However the exits will ensure 100% checking for tickets so as to lead to revenue leakage minimization. In case of a passenger ending up with excess travel than allowed by his ticket, excess travel fare collection would be undertaken at the counter provided within the Platforms.

The entry and exit to the up & down platforms shall be necessarily through the unpaid area to ensure that a passenger does not travel to and fro on the same ticket.

Our technical proposal for AFC system submitted earlier along with the technical bid has been formulated based on the above principles.

In the studies carried out by the JV Company , the passenger density is higher in certain Stations in comparison to the others.

Thus the introduction of the number of Ticket Vending Machines and the operated Ticketing Booths will be made into an optimum mix ensuring that there will not be too much of queuing at the same time the investments in terms of machines and personnel will remain optimum.



## **7.A.5.ii Approach to Quality Management, Coordination and Communication, Effective Maintenance & Efficient Operation**

### **7.A.5.ii.a Project Quality Management**

The quality management is proposed to be established in two stages :

- (i) Quality management during Construction phase & during first 2 years operations
- (ii) Quality Management during operations phase including preparations during constructions

Quality management during construction phase will be oriented towards developing quality systems to be adopted for the Project .

Amidst others , this will also require the prospective vendors and associates to prepare and obtain approval of the JVC to their own quality programs for the construction and operation phase.

The quality management systems at this stage will cover a wide range of areas such as initial investigations, designs, procurement and construction to commissioning and testing. These programmes would use professional planning software tools and comprehensive and precise network program.

Past experience of REL / Connex of a set of project management and control procedures, which are critical for multi-disciplinary projects will also be successfully adopted for this project.

Prior to operations phase, detailed quality procedures will be set for efficient and smooth operation of the project. These will cover all the aspects of operation and maintenance such as quality policy, HR, Finance, O&M, and Customer Relations etc. Here again , the international experience of Connex as MRTS operator and the Management capabilities of REL in successfully operating the infrastructure companies like Power and Telecom will be leveraged.

### **7.A.5.ii.b Co-ordination & Communication**

Coordination by JV Company with the following agencies is important from the point of view of successful implementation and operation of the Project.

- (i) MMRDA & Steering Group
- (ii) Independent Engineer of MMRDA
- (iii) EPC Contractors, integration consultants
- (iv) Govt. Authorities incl Safety Commissioner , Police
- (v) General Public
- (vi) BEST



In order to facilitate smooth co ordination and communication among these agencies, the CEO of the JVC would nominate suitable persons/teams during the construction and operations phase.

The teams would co-ordinate and control all the following basic activities:-

- i) Interfacing with different agencies entrusted with engineering, supply, erection activities, steering group, independent engineers, local authorities etc.
- ii) Material Management & Quality Assurance.
- iii) Preparation of Progress Reports & updating project schedule.
- iv) Certification of Performance Testing and acceptance in association with Consultant.

#### **Co-ordination Meetings :**

Regular meetings would be held at site among the representatives of the JV Company, Contractors, the Consultants and MMRDA to review the progress of each activity. At these meetings, slippages in progress would be identified and corrective measures taken. The problems arising out of site and material constraints would be promptly sorted out. The meetings would also be attended to by one of the senior executives of the company to facilitate on-the-spot decision. Minutes of meetings would be circulated among all concerned for necessary follow-up action.

Co-ordination meetings between the Consultants and the senior executives of the Project Authority would be held regularly for major decisions in regard to planning, designing of various plant and equipment, execution procedures, manpower deputations, industrial relations, security, etc. Steps would be taken to ensure regular interactions between the Vendors, the Consultants and Projects Department to finalise interface engineering.

#### **Reporting :**

Various reports would be generated in regard to the physical and financial progress of the project on monthly, quarterly and yearly basis for forwarding to the various Government Departments, Financial Institutions as well as for internal use. Daily progress of the major items of work, along with their weekly/ monthly targets, would be reported to the project head.

#### **7.A.5.ii.c Approach to Efficient Operation**

##### ***Operational Policies***

The operating policy will be based on the following:

- Safety
- Quality
- Environment



- Profitability
- Customer Satisfaction

These statements shall be clearly communicated to all levels of staff and unambiguously understood and adopted by them with the full commitment and support from top management.

The objectives of the MRTS shall be defined as:

1. To provide a safe, comfortable, convenient and innovative Rail based Mass Rapid Transit System to the community.
2. To develop rules and procedures that should be periodically reviewed and improved upon, based on experiences.
3. To meet the general public's traveling demand by following the government's public transport policy and proactively coordinating with all other existing transport operators to form an integrated public transport network.
4. To provide a cost-effective public transport means by working continuously on enhancing operational efficiency and reducing operational cost.
5. To deploy suitable personnel trained with adequate skills for safe and efficient operations of the MRTS

The operations management for the MRTS is planned through the pooled experience of Connex in train operations and REL in managing 24x7 infrastructure services (power & telecom). In order to achieve the optimum operational cost and revenue structure, the JV Company would enter into an operations management contract with Connex & REL on management fees basis while retaining with itself, the complete control on all other operational expenses and resources.

#### **Security, Safety & Quality**

1. Safety is a pre-requisite for everything we do.
2. Be aware of potential hazards and promptly mitigate them before accidents arise.
3. Do the right things, right at the first time and every time, whilst maintaining the integrity of the railway system.
4. A Safety Management System will be developed for ensuring the safety of the MRTS.
5. International Standard, such as ISO 9000, will be adopted for the Quality Control of the system.
6. A Passenger Security and Information System will be developed to ensure the system and the passengers are properly safeguarded.

#### **Continuous Improvement**

Continuously strive to achieve better service performance and at lower cost.

1. Optimise the use of resources and efforts to maximise value and return on investment.
2. Find more innovative ways to do more with less.
3. Prioritise investment items on the vital few.
4. Be aware of the real cost of operations and maintenance.



## Regularity

Clear standards for performance, focused and well-trained staff supported by effective equipment shall be used in maintaining a high level of reliable train service. System performance will be constantly monitored and enhanced through the continuous improvement cycle.

One of the major critical factors affecting the train service performance is maintaining a regular headway between trains. The constancy of the headway enables regular transportation of passengers during peak hours. Any unexpected minor delay of a train may result in a major service disruption.

Regularity will be achieved through the implementation of the following measures:

- Centralization of train service information so as to react as quickly as possible to disturbances and unavoidable incidents,
- Availability of rolling stock, track layout (e.g. emergency siding) and equipment design which in turn enhance the system reliability and operability.

## Convenience and Comfort

JV Company will strive to identify and pursue continuous improvement in customer services in terms of user-friendliness and added-value services. Periodic customer surveys will be used to assess performance and identify areas where improvements should be made.

There are different factors which contribute to passengers' convenience and comfort. Prior to boarding trains, passengers should have an easy access to the platform by lifts, escalators as well as easy access to any information they may need. The station signage and publications (e.g. leaflets, route maps etc) will provide a simple and clear information of available routes, identify stations, suitable exit directory and explain where and how to transfer to other transportation modes. Relevant information regarding fare collection will be displayed in a simple way to the general public. Onboard train communication will also provide information to the passengers.

The following are key constituents for passenger comfort and convenience:

*The features, layouts, colours and of the MRTS – stations and other facilities, shall be as harmonious and coherent as possible to the ambience;*

*Movement and information facilities, characterized by simple and efficient indication of path finders, and the use of escalators and visual, audio and audio-visual information facilities;*

*Rolling stock shall be so designed so as to be well lighted, well suspended, low noise, well ventilated and equipped with a public announcement system and information display system;*

*Integration and co-ordination with other public transport modes,*



*Adaptation of service according to the traffic density.*

*Providing small commercial centres in the stations*

### **Fast and Punctual**

The demand for shortened travel time between work place and home is continuously increasing in large cities. Apart from the reduction in travel time access to trains is also an important requirement.

Combining these requirements, JV Company shall constantly monitor the headway of the system and shall also try to additional benefits to the users of MRTS by aligning the operations of other transport providers through feeder services. The quality targets for the MRTS operation will be so established that will permit comparison with the best Metros of the world. ( see Table 8 )

## **OPERATING PLAN**

### ***System assumptions***

#### **Description of system to be operated and maintained**

The system to be operated and maintained shall meet the specifications and requirements of the tender documents, in particular the Concession Agreement and the Project Requirements:

- The train service will operate on elevated lines between Versova Station in the West and Ghatkopar Station in the East .Line length being approx 11.3 km.
- There shall be 12 stations on the line.
- Metro vehicles movements shall be monitored and dispatched from an Operating Control Centre.
- Average commercial speed : 33 kmph
- Expected Trip time is less than 21 mins between Versova and Ghatkopar including halt/dwell time

#### **Description of service plan for each phase**

Operation of MRTS is planned on a double line elevated rail corridor along Versova-Andheri-Ghatkopar Corridor.

For the purpose of the planning the operations are foreseen in 4 phases based on the development of the traffic and build up of the infrastructure in terms of Rolling Stock. (for details refer to the Financial Model subitted along with the bid)



### **Transport safety**

A high level of safety is a basic prerequisite for operating public transport services in the first place and being able to attract customers while also constituting a legitimate, competitive alternative to other modes of transport.

Connex has tried-and-tested systems for the safe operation of a metro service. Safety principles for all rail traffic (underground, railway and tramway) are to a large extent inherent.

Connex has extensive experience in safe operations metro, trains and light trains services in France, Sweden, Spain, Germany, Ireland, Australia, New Zealand, Czech Republic and USA, with the special requirements that this type of service demands with regard to safety.

### **Operations Manual**

In order to ensure that drivers and other personnel work according to the same uniform principles when it comes to ensuring a high level of traffic safety and punctuality as well as good customer service, JV Company will prepare a special adaptation of the Connex Service Manual successfully used elsewhere in the world, for operations in Mumbai.

The Operations Manual will be an important tool for handling the "soft questions" in a uniform way.

### ***Operations Performance Meetings (OPM)***

JV Company will set up the weekly Performance Meetings on all operational aspects on lines that have been successfully applied by Connex elsewhere in the world.

During these meetings, those responsible from the operations department, commercial department, vehicle maintenance and infrastructure maintenance meet and review any disruptions to services that have occurred during the preceding week.

Daily reports (computerised logs) from the Operations Control Centre (OCC) shall be used as a basis for the discussions at the Operation Performance Meetings.





### **Security at metro stations**

Appropriate arrangement will be made in consultation with local authorities including Police for the safety of the passengers and property of MRTS.

### **Operation Management**

#### **Performance Management Information**

The JV Company intends to adapt and apply similar system of Performance Management Information that Connex practices in other countries. The system is essentially based on the reports and information coming into the Operations Control Centre (OCC), partly via the various technical systems and partly verbally via the train drivers and mobile personnel. The OCC controller will log all abnormal operations in a computerised logging system (Incident Report Log – IRL), which will enable all incidents to be searchable in a database and will make it possible to produce statistical reports which would enable preventive/corrective actions.

The information in IRL will form the basis of the weekly Operations Performance Meetings which the JV Company intends to implement, together with other information from those responsible for vehicle maintenance and infrastructure maintenance.

Prior to each Operations Performance Meeting, the various disruptions of the previous calendar week will be compiled from IRL. All disruptions, including disruptions of order and any personnel or vehicle shortages (traffic stoppages, major delays and cancelled services in the form of cancelled departures, hours and kilometres per vehicle) will be assigned to the department primarily having responsibility for it (Operations, Commercial, Rolling Stock [Maintenance Contractor] or Infrastructure [Maintenance Contractor]). Some disruptions that are rare and out of the ordinary and are beyond the control of the operator may be treated as uncontrollable events instead of being assigned as the responsibility of a department (unit). Depending on the nature of events, the department (unit) most closely connected will be assigned the task of following up on the incident in order to prevent its repetition if possible. If the cause of any disruption cannot be ascertained, the incident will



be assigned to a pending list, containing information on the department and person responsible for further action.

No case will be taken off the pending list until the final cause of the disruption has been ascertained and the department ultimately responsible has been determined.

The Performance Reports, as endorsed at the Performance Meeting, will be compiled into a monthly Performance Report. This would form the basis of the financial balance between the various partners (allocation of fees/ penalties, etc.).

The monthly Performance Reports will be distributed to the management team. In the event of systematic and repeated shortcomings being included, the department manager in question will be given the task of producing an Action Plan in order to deal with such problems.

The intention will be to convey information as to how operations are functioning, as well as current statistics, to the staff by means of weekly local information sheets and company-wide staff information.

### ***Operating Statistics***

Operating Statistics are obtained on the one hand via the IRL reports described in section "Performance Management Information" and, on the other, via other various logs (or similar) of the technical systems for following up on Mumbai Metro operations. This is in addition to any other internal system for following up on the status of staff training and in-service training as well as staff qualifications with respect to knowledge and medical issues.

Operating Statistics can be divided into six main sections:

- Operational aspects
- Technical aspects
- Production aspects
- Customer service aspects
- Safety aspects
- Human resources aspects



Operational aspects include non-technical disruptions, incidents and near-accidents and could, for example, be a matter of staff shortages, incorrect or neglected measures by drivers or other staff, etc.

Technical aspects include disruptions and incidents of a technical nature where various technical systems of train operation on the vehicle or fixed installations along the track in any way cause disruptions or near-accidents.

Production aspects affect statistics in the sense of services carried out and expressed as kilometres per vehicle and operated hours per vehicle in relation to planned production – as well as maintenance output in respect of vehicles and installations in relation to planned output, and the number of train journeys, including ticket revenue, in relation to planned (calculated) journeys and planned (calculated) revenue.

Customer service aspects including complaints and proposals through to the "Customer Hotline", letters and emails.

Safety aspects cover statistics concerning actual accidents and near-accidents, deviance from normal procedures in the interests of safety that did not cause near-accidents, but could have done so under slightly different circumstances.

Human resources aspects concern follow-up and ongoing monitoring of the status of staff training and in-service training as well as staff qualifications with respect to knowledge and medical issues.

### **Normal Operations**

To achieve the appropriate flexibility for normal (and abnormal) operation it is intended to operate the line as a single entity, through one OCC, with all operating, depot, maintenance staff being able to be assigned to any location on the network.



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### **Operations Control Centre (OCC)**

A basic prerequisite for effective disruption-control work such as providing accurate information to the passengers is having successful and established action plans for various types of traffic situations. The Operations controllers must have a flair for rapidly switching from a monitoring and preventative traffic control role to a proactively remedial one of disruption-control.

Following a proven model from Connex elsewhere in the world, the Mumbai traffic control organisation will also comprise a mobile unit providing recovery operations (roving Team).

When recruiting, the suitability of the applicant for the role of OCC Manager or Operator will be assessed with the help of several variables. The selection process will include a work-psychology test. ( pl see Table 6 p 61)

Controllers' shifts are regulated by a work rotation that allows for good changeovers and debriefing at the end of each shift.

The OCC (situated in the depot) will take care of the ongoing monitoring of the metro service via various technical systems and will keep in contact by radio and telephone with the train drivers, the mobile personnel and the metro service vehicles. The control centre will also monitor the metro service via the CCTV systems that exist along the train line as well as answering and dealing with calls via the emergency call system at the train stations. The OCC controller will also be responsible for monitoring the other technical systems relating to the metro service such as the power supply and signal installations, in addition to lighting, as well as ticket vending machines at the metro stations.

The controllers on duty are also intended to serve as the train driver's and mobile personnel's immediate operations managers in operational service. This implies, for example, that the controller has the right to decide to withdraw staff from service if required in connection with a serious incident occurring or a near accident, or, for example, on suspicion of the influence of alcohol or other intoxicant. This right also covers all maintenance personnel.



The Operations Control Centre normally handles the trains in service on the line. The OCC shall be staffed with controllers 24 hours a day, every day of the year. Additional Controllers would be deployed if needed during rush hours . Additional controllers will also serve at the same time during special events and major maintenance or repair works along some of the lines, when additional monitoring will be required.

During the hours when metro services are not operating, the controller will compile the incident statistics of the previous service day, including disruptions, producing a finished "daily report" based mainly on IRL (see above) and the information supplied via various technical monitoring systems (logs). The controller will also prepare for the next day's services by ensuring availability of vehicles through constant contact with the vehicle maintenance personnel at the depot. In parallel with this work, the controller will also monitor the operation of the technical systems and respond to any emergency calls from the train stops during the part of the night when services are not operating.

Staffing the control centre with qualified controllers, even when no services are operating (during the night), ensures that incidents that may occur during these times do not remain without remedy until services resume the following morning, with consequential risk of disruptions.

*Ongoing work of the control centre and lines of communication*

Work in the control centre entails continuous monitoring of train services via the technical surveillance systems and via radio contact with the train drivers. An important aspect of the ongoing work is the anticipation, identification and understanding of those conditions that, further ahead (reckoned in minutes and hours), could disrupt operations. These might include suspected vehicle faults, suspected faults in other technical equipment, indicated personnel problems or indicated external disruptions; hence preventive and corrective action can be taken as early as possible.

In order to be able to respond quickly when necessary, well-established lines of communication with key functions including those outside of Mumbai Metro are needed,



such as with the police, fire brigade and ambulance services as well as the relevant highways authorities. Connex has extensive experience of setting up such well-functioning relations.

The JV Company will place a great emphasis on recruiting controllers who are capable of handling rapid changes in levels of activity at different times in the Operation of the System.

*Controller to provide technical assistance to drivers*

All controllers would also be trained and qualified metro drivers having in-depth technical knowledge of the vehicles and installations. In this way, the controller can act as the first line of "technical assistance" to the metro drivers in the event of disruptions due to vehicle faults or other technical faults along the track. The model of having controllers who are qualified drivers also implies that all controllers, at certain specified intervals, serve as train drivers for a day. This also serves to keep the controllers up to date on what is happening "out in the field", which increases the understanding between drivers and controllers.

Since the controller only provides verbal assistance to the drivers via communications radio or telephone, in the case of more complex and service-stopping technical faults, appropriate resources also need to be dispatched by vehicle to the scene of a disruption. The JV Company will make available such resources from the respective technical subcontractor.

*Remedying disruption*

An important task over and above the ongoing, somewhat "passive" monitoring and managing of services and monitoring of various systems is rapidly taking in hand and remedying disruptions that arise in the system. Disruptions may be either technical or non-technical in nature or may relate to staff failures and accidents or near-accidents. A statement of our basic principles in respect of this is reproduced in section "Abnormal Operation" below.



## Daily Vehicles Operations

Day-to-day operation of the trains is based on several aspects working in tandem. A basic prerequisite for being able to operate and offer passengers a disruption-free service in accordance with pre-determined plans is to deliver vehicles that are fit to drive, presentable and roadworthy, at the right place and at the right time. As stated above, the controller on duty is responsible in the short term (the last few hours before going into service) for checking and ensuring that the right number of trains will be delivered by the Maintenance Department at the right time and in the right place.

### *Start of transport services*

Normal procedures used by most public transport operators involve drivers coming on duty going through a standardised overall checking of their assigned vehicle before it leaves the train depot. This happens even if the vehicle has been supplied with the individual information that it has been fully "prepared" for service by the technical department. A final check will be necessary before leaving from the depot.

The following points should normally be included:

1. Give driver and line/route specific information (in-put).
2. Check that the train can be driven from both drivers' cabs and that the controls for the maneuvering and monitoring systems, including communications radio, in both drivers' cabs are working.
3. Check that the starter-equipment and braking equipment work error-free.
4. Check that all passenger doors are working normally.
5. Check that interior and exterior lighting is working, as well as the passenger information systems.
6. Check that the passenger area (including the seats) is flawless.
7. Check that the train has been properly cleaned and that there is no graffiti.
8. Check that the appropriate passenger information is made available in the vehicle.



*During the service day*

During the service day and when out driving on the line, the driver must be aware of his train and, in the event of faults being suspected, try to investigate as soon as possible whether the fault can be remedied right away and whether imminent faults can be averted. In addition of taking note of the defect, if necessary, the driver must immediately report any problem to the controller and consult with him as to how the matter should be resolved in accordance with established procedures. If necessary, the controller can send technical personnel to investigate a fault that the driver is unable to remedy.

The driver must follow up to ensure that the train is working normally as well as that the passenger area is kept in a good and presentable condition with regard to cleanliness and being free of waste. During changeover of personnel in the course of the service day, both drivers must exchange information as to the status of the train, including any faults or shortfalls.

*End of each service day at the depot*

When a train is to be taken out of service and driven into the depot, at the last stop before the depot, the driver must check that there are no passengers remaining on the train. On arrival at the depot, the same check must be carried out again, with the driver also checking that passengers have not left any items on the vehicle. If passengers have inadvertently been brought to the depot, it is the responsibility of the driver to ensure that they are appropriately helped out of the depot area. Any train faults must be reported in writing to the depot personnel before the driver leaves the train.

According to the washing plan and washing policy, the driver will drive its vehicle through the washing machine before leaving the train.





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### **Depot Operations**

Depot operation can be divided into different parts, here beginning, as an example, with the train arriving to the depot after a day of operation to be prepared for the next day of operation without special maintenance work:

**Instructions.** On arrival at the depot, the train driver will be given information by the controller where to park the train after certain activities are performed.

**Washing.** The drivers are responsible for driving the train through the train washing machine in the depot, when instructed to do so by the controller, on behalf of the maintenance department.

**Parking.** After (when requested) washing of the outside of the train, the driver shall drive his train to the appropriate parking track.

Preparation for next running shift. During the early morning hours or late evening and night the train will be checked and prepared by the maintenance technician following a special checklist. Depending on how many running hours have elapsed since the last overhaul the technician will use different checklists to fulfill his work. When ready, a special form will be signed by the technician and placed in the drivers cab including a copy to the depot log-book. During the night or when the train is at the Depot , it will be cleaned according to the cleaning schedule presented in page 91.

*Drivers last check before departure:* All drivers taking a train out from the depot on a working day will follow a special a standardised overall "drivers checklist".

*Instructions and leaving the depot:* When ready to leave the depot or depot yard, the driver asks for instructions from the controller. The controller ensures that the train will be let out on the line in the appropriate direction and at the appropriate time.



### *Vehicles movements within the depot area*

All movements within the depot areas (as well as on the line) will be supervised and controlled by the controller.

The necessary movement of the trains within the depot will be carried out on the behalf of the vehicles maintenance department.

### **Normal Operating Procedures**

The normal operating procedures are based mainly on three fundamental parts (preparation, implementation and conclusion). The complete operating procedures for normal operation do, however, start earlier and cover more than just the actual management of the trains on a particular service day.

### *Preparations and Planning*

The basis of the entire operation (normal and abnormal) is

- 1) long-term planning
- 2) short-term planning (production of timetables and service rotas),
- 3) recruitment
- 4) staff training and in-service training,
- 5) manpower planning,
- 6) planning maintenance of vehicles and installations as well as implementation and
- 7) planning and application of emergency plans for various types of abnormal operation.

1. **Long-term planning** (planning on an annual basis and longer) forms the basis and prerequisites for virtually all planning. The long-term planning establishes the rough outline of future service arrangements, which in turn govern staff needs, recruitment and staff training in various specialist areas. Long-term planning is also the basis for planning for maintenance of vehicles and installations, which to a large extent, but not entirely, depends on the scope of the service which affects and wear and tear on vehicles and installations.



2. **Short-term planning** (planning on a monthly to half-yearly or seasonal basis) involves producing timetables (internal and general) as well as roster for staff working shifts in the first instance (drivers, controllers, mobile personnel and maintenance personnel). The work set-up and work procedures for personnel not working in shifts are also governed by short-term planning with regard to when vehicles and track installations are available for maintenance purposes.
3. **Recruitment** of drivers and other personnel is a basic prerequisite to enable agreed services to be carried out. This process includes Psycho medical tests similar to the ones used in Indian Railways and other Railway operations in the world.
4. **Basic training** and in-service training are the two cornerstones of all staff training programmes.
5. **The planning of maintenance for vehicles and installations** is carried out by the department concerned, in coordination with the head of the operations. This will be done by examining current maintenance plans and individual job cards. Maintenance work carried out by subcontractors if any under its own auspices will be governed in the same way, using established maintenance plans and individual job cards.
6. **Abnormal Operation** is to be planned and handled in accordance with section "Abnormal Operations".

#### ***Implementation of the service day***

##### ***Sign-in and Sign-off***

Since the JV Company intends to allow all transport services, all personnel shall begin and end their working day at the depot by signing-in at the start of the working day and signing-off at the end of the working day at the depot. There will be no risk of a driver failing to turn up for the start of his shift without this being noticed by the operational management. At the



start of service each morning, there will be an operations team leader at the depot who will take a register of all personnel who have reported for duty and received the required instructions and directions for the working day.

*Reading orders and messages*

In addition to the room (of the operations team leader) where staff reports for duty at each depot, there will be notice boards for orders and messages to personnel. All personnel will note any new orders or messages at the start of the working day.

*Reserve personnel*

There will be sufficient numbers of reserve drivers at the respective depots during the entire service period. It is planned that in the morning, the reserve driver will arrive at the relevant depot approximately 20 minutes before the first driver is due to begin his working day, and his first task will therefore be to have a quick look to see that all trains required for going into service have been prepared by the vehicle maintenance department.

*Action taken by the driver during the service day*

The driver's first action when he arrives at the depot is to report to the operations team leader and note current orders and messages from the operational management. A check of the assigned train will follow, as described in section "Daily Vehicles Operations" above.

Before leaving the depot, it is the driver's task to ensure that his train is ready for service, both from a safety point of view and from a customer perspective. If shortfalls are discovered in either of these respects, the driver will immediately report this to the controller, who will take the necessary action.

The driver has sole responsibility for the safety of his own train and for the security of passengers. In the event of any accidents the driver will inform the controller without delay. The driver will also inform the controller of anything that has, or could have, a negative



impact on customers' experience of the transport network, such as disruption of order, damage, faulty equipment, etc.

At each terminus where the train is reversing directions, the driver will – if possible, with reference to the timetable – check the vehicle for any items left behind and any damage, etc., sustained by the vehicle.

The driver will drive the train with due regard to safety and comfort requirements and strive for smooth driving without unnecessary jerks and sharp braking. The driver will as far as possible provide passengers with information and assistance, without neglecting safety or losing track of time.

#### *Changeover during the service day*

Drivers beginning their shift by relieving another driver "on the line" will previously have reported to the operations team leader at the relevant depot.

Drivers who for any reason are not replaced at the planned changeover time, may not leave their trains, but will report to the controller via the communications radio and drive on until changeover can be arranged. If the timetable allows time for a relief driver to arrive, this is what should be done after permission has been given by the controller, if it is still possible for the train to leave at the appointed departure time. Where the driver has to continue driving because changeover has not been effected, the relief driver may arrange to take over at a suitable stop, or else when the train returns to the depot.

#### *Driving trains into the depot*

When driving trains into the depot at the end of the service day, the driver will apply what is stated in section 'Daily Vehicles Operations' above. Any faults in the train will be reported in writing to the operational management at the depot before the driver leaves the depot.



### *Different levels of Abnormal Operation*

In addition to the typical cases of abnormal operation, disruptions can be divided roughly into two categories: planned disruptions and unplanned disruptions. Typical of planned disruptions are that in these situations, the operations manager has the opportunity to pass on information about the disruption in advance through notices and advertisements as well as planning how inconvenience to passengers can be minimised.

Typical of unplanned disruptions is that they often occur without any warning in the usual sense, even though, for example, early signs of a vehicle fault or the start of problems with the power supply may give a certain amount of warning time before the disruption takes hold. As stated previously, it is therefore important for both drivers and controllers to be aware of vehicle or installations faults that could develop into stoppage faults.

The JV Company classifies emergency disruptions (unplanned disruptions) according to the following scale:

- Type 1 Disruption/fault that only needs to be reported for future action (blue faults)
- Type 2 Disruption/fault requiring immediate action w/out stoppage (blue faults)
- Type 3 Disruption/fault causing brief stoppage (4–15 minutes) (red faults)
- Type 4 Disruption/fault causing longer stoppage (15–20 minutes) (red faults)
- Type 5 Disruption/fault causing extended stoppage (over 20 minutes) (red faults)

Our evaluation based on experience of train services with new installations and new vehicles is that the emergency disruptions (after an initial testing and trial period of approximately six months with all systems in complete and normal operation) are distributed as follows according to type of disturbance level :

- Type 1 approximately 85% of disruptions
- Type 2 approximately 10% of disruptions
- Type 3 approximately 3% of disruptions
- Type 4 approximately 1% of disruptions
- Type 5 approximately 1% of disruptions



*Potential causes of Abnormal Operations*

Causes of Abnormal Operations in train services might include the following:

- Vehicle faults not resulting in stoppage
- Vehicle faults resulting in stoppage
- Power outage
- Fallen overhead cables
- Disruption of signalling system
- Bad weather

*Potential Emergencies*

Accidents can happen in any type of operation. Incidents more specific to trains include:

- Passenger colliding with the train
- Collision with another train
- Fallen overhead cables
- De-railing
- Fire
- Sabotage

Connex has valuable experience of handling all types of Abnormal Operations and Emergencies.

*Purpose of the OCC*

One of the main responsibility of an OCC is to return the train service back to normal in a safe and reliable way, as soon as possible after a disturbance. Its role is to deal with safety of the line issues from major collisions, to a door on the catch, in a method that is safe and laid down in rule books and safety manuals.



To advise customers, both internally and externally of problems with the train service and the subsequent alterations made to rectify these issues.

### *Strategies*

It may sometimes be possible to run Single line working (SLW) between the affected areas, thus allowing a train service to run throughout the corridor, but with so much a reduced service pattern that it shall remain an exception situation.

It may be possible to terminate short, depending on if there are cross-overs close to the affected point, of the scheduled destination and cross over to the other line (track) and come back, effectively terminating short. To cater for the passengers to the end of the line you can either pass on other bus routes or, as in Mumbai seems to be a better alternative, supply buses/coaches from public bus companies or private hire companies that will run exclusively between stations on the line(s) affected.

With the depot being at the end of one of the line this puts a great pressure on keeping the line open. A great deal of maintenance and observation should be kept on the line infrastructure so to keep it open for all movements.

To secure quick and efficient bus replacement in case of a disruption in the train operation the JV Company will endeavour to arrive at an agreement with local bus companies including BEST to arrange buses immediately to transportation of the stranded passengers.

### *Service Recovery Strategies*

Recovery Strategies are a part of the traffic control organisation, the purpose of which is to handle emergencies encountered by vehicles in service and where qualified handling is required at the scene. Such incidents could, for example, be accidents involving people, fires, breakdowns, derailment, fallen overhead cables or incidents disrupting order as well as all other kinds of incident, for example vandalism.

Where train services are impacted by extremely serious incidents, it is of paramount importance to get specially trained staff to the scene quickly - people who can provide





support to the train staff and the emergency services as well as generally contributing knowledge, backup and information.

Since train services operate alongside other modes of transport, there is a particularly pressing requirement for prompt intervention and other measures depending on the special risks involved, for example where an overhead cable is down.

The JV Company will have emergency services available 24 hours a day, either on duty in stand-by mode or on-call, including the period when train services are not running. This ensures prompt and competent intervention even if the cause of an incident is not attributable to the train service as such - for example, in the unlikely event of a road vehicle damaging a bridge pile causing it to pose a hazard to MRTS and other traffic.

On weekdays, from 4 a.m. until 1 a.m., at least one emergency vehicle will be available and manned. They are based at the depot, and will for some hours each day patrol the line in order to monitor and follow up on the transport service and drivers. At least one emergency vehicle will always be on stand-by during train service running time or on-call to proceed immediately to the scene of a disruption or accident.

The emergency vehicles will be manned by traffic supervisors with competency as controllers and train drivers, fully qualified to move and drive a train if necessary, for example in connection with an accident, as a result of which the driver is unable to continue driving.

#### *Emergency vehicles*

Under Swedish and German road traffic legislation, as well as that of some other EU countries, train companies are entitled to equip certain service vehicles with the same type of alarm signals as are used on fire engines and police cars. This type of alarm signal arrangement makes it possible to get the right personnel to the site rapidly, in the event of an accident or a serious disruption to traffic, to remedy the disruption, including situations in which street traffic is more or less at a standstill as a result of traffic jams (perhaps due to a train blocking the traffic). The reasoning behind these "special alarms" on some of the service vehicles is that accidents involving trains, or other serious traffic disruptions



involving the train operator's vehicles, often require specialised technical competency not normally found within the community's ordinary emergency services.

The JV Company shall apply to the relevant authorities in India with regard to such entitlement.

#### *Restoration procedures*

The procedures relating to abnormal operation in Mumbai are to a large extent based on the experience Connex has of similar train services elsewhere in the world, and are also drawn from its experience of railway transport operation. Typical of train services in comparison to bus services is that train services often mean a total stoppage of all services in a certain direction (or both directions) past the scene of an incident. However, "stoppage" in terms of a bus service often only affects one vehicle and the train service (as stated above) also requires specialist and qualified knowledge in order to prevent exacerbation of the damage or hindrance that has occurred. In all situations, it is of course important for the train company to have procedures that are well prepared and well rehearsed with the local police, other emergency services and competent highways authorities.

A number of typical cases of abnormal operations can be ascertained based on experience. Depending on where in the transport system an incident occurs, the measures taken may vary, however, when it comes to restoring normal service and if necessary replacing the disrupted train service with buses, for example. The purpose of all measures in the event of abnormal operation is to restore the situation to normal operation as soon as possible. In the event of accidents, etc., however, rescue efforts and damage-limitation measures must always take priority, which means that a return to normal operation of the train service onwards past the scene of an accident is dependent on the rescue work first having been completed. Rescue work in progress at the scene of an accident or remedial measures to remove a faulty train, for example, do not, however, need to prevent train services from being maintained on other parts of the affected line. This is, however, conditional upon a sufficient number of transition points and shunting opportunities being available. This in turn is naturally dependent upon where a disruption occurs. This has been taken into account in the Mumbai MRTS with sufficient numbers of crossings / shuntings.



### ***Bad Weather Plans***

#### **Adverse weather conditions, seasonal conditions, rainfall, flooding, wind and storms**

Large amounts of rain may in certain circumstances cause operative breakdowns, partly due to the flooding of sensitive technical equipment along the line and partly due to aggregations of water undermining the embankments.

In such a situation, other traffic in the area would also be impeded and the situation could thus be considered a case of Force Majeure.

The JV Company will ensure that the tracks, as well as track devices such as the vehicles, are manufactured in accordance with accepted and proven methods, suitable for the circumstances in which they are to be used.

#### **Wind and storms**

Winds of sufficient force to hamper train traffic are not likely to occur. In very adverse conditions of strong, gusty winds, the pantograph on the roof of the train may be exposed to extreme stress. In these circumstances, it may be necessary to reduce the maximum permissible speed of the trains temporarily.

The JV Company will draw up procedures that will, as far as possible, identify and prevent possibilities of debris being blown by high velocity winds onto the contact wires causing them to snap.

#### ***Abnormal and Emergency Operating Procedures***

Below procedures for handling Abnormal Operations and Emergencies. In all situations it is compulsory to immediately alert the Control Centre.



### *Driver assistance*

Technical first-line assistance for train drivers in the event of a disruption that the driver is unable to remedy on his own is provided by the controller via the vehicle's radio or by mobile phone. Since controllers are also qualified train drivers with supplementary training in train technology, prompt assistance is assured.

### *Faults resulting in stoppage*

Stoppage faults mean that the train cannot be driven any further with passengers (within 5 min. [level 3 to 5 see Part "Abnormal Operation above]) without some kind of repair. Experience of our partner – Connex, from Stockholm operations indicate that stoppage faults are rare (5 stoppage faults per 100 vehicle faults).

In the event of a stoppage fault, one of the emergency vehicles will in all cases be dispatched to the scene immediately. If the driver is not able to remedy the fault with expert advice from the controller, another controller and/or repairman will be at the scene within a short time to assist the driver.

In the event of such faults being so complex that the train driver and the controller are unable to fix them, vehicle technicians from the vehicle maintenance department will also be called to the scene.

### *Recovery of trains*

In certain cases, faults may arise that require the broken-down train to be towed from the scene by another train. Although recovery should be regarded as an extreme measure, this can be considered as a last resort at times.

### *Lifting trains*

It may be necessary to lift a train in the event of an accident where a person or a large object has been run over. Lifting trains may also be required following derailment.



### *Accidents*

The fire brigade carries out the raising of trains in the event of an accident occurring which involves a person who has been run over and is trapped. Operations personnel will assist the fire brigade in the rescue work and will remove the train involved in the accident following the rescue effort. There will then follow technical checking of brakes, etc., in consultation with the police.

In certain cases, the fire brigade may also be able to raise a train that has run over a large object that cannot be dislodged other than by lifting the train.

### *Derailment*

In the event of derailment where no one has been injured, the train will be lifted back onto the rails by the staff of the vehicle Maintenance department,. The vehicle maintenance department's staff may also raise a train in the event of an object having become stuck, but not normally in the event of an accident involving personal injury.

### *Fallen overhead cables*

In the event of a fallen overhead contact line, it is important to ensure as quickly as possible that the fallen overhead contact line does not cause injury to persons or damage to property. In the event of an alarm (via a technical indication or a verbal alert) concerning a fallen overhead contact line, the OCC controller will immediately effect emergency disconnection of the power to the line for the section of track in question and, at the same time,. dispatch an emergency vehicle to the scene Trains approaching the scene of the disruption are alerted via vehicle radio and ordered to stop at a safe distance from the site of the fault. For repair of the faulty cable, the next stage is to immediately alert the repair staff from the Maintenance department. ))

### *Collision between trains*

Connex experience is that collisions between trains are very very seldom. Some train systems ensure (either partially or fully) that headway is maintained between trains using e signalling systems, most of the times supplemented by Automatic Train Protection (ATP).



In other train systems, the trains are driven, "by sight" – that is, basically in the same way as cars. Connex has experience of all types of traffic operations.

The risk of damage is greatest in a "head-on" collision between trains. This risk of collision is greatest if the train system includes sections of single-file track. The Mumbai Metro train network is entirely double track, which virtually eliminates the risk of high-speed head-on collision between trains. It is actually only within the depot areas and at the crossing points at a terminus that head-on collisions can occur. Common to these locations is the fact that speeds are relatively low which further minimises the risk of collision.

Another type of collision between trains is driving into the back of another train. This type of collision can be rather serious and the JV Company will place particularly strong emphasis on this in its driver-training programme even though the ATP provides automatic emergency brakes if the train driver doesn't respect a closed signal or if a train driver runs faster than permitted.

#### *Fire*

Fire puts special demands on resourceful action on the part of all concerned. All experience shows that one of the most important first steps in the event of fire is to disconnect the power. Many fires aboard trains start with the electrical equipment and can be extinguished quite easily if the power is disconnected. Even if the fire does not start from the electrical equipment, all power must be disconnected in order to be able to carry out fire extinguishing safely.

In the event of fire, it is important for passengers to leave the train as quickly as possible. However, this must be done in such a way that the passengers are not exposed to new risks, for example trains on adjacent tracks. Depending on the whereabouts of the train, the train driver must decide on how best to carry out evacuation safely. In disaster situations, the passengers may evacuate the train spontaneously and without direction from the driver. In such a case, it is important for the train driver to inform the controller immediately to check that other trains have been stopped as a reaction to the opening of the doors.



### *Sabotage*

Sabotage to trains may consist of several different actions. For example, large objects may be placed on the track or stones or other objects may be thrown at the train. Attempts set fire to a train or start a fire along the track can happen, as well as various attempts being made to affect various technical systems.

It is important for all personnel to always be aware that sabotage may happen and to be aware of anything that deviates from the norm and to report these to the control centre.

In the design of the Rolling stock , the fire alarm system is planned. Moreover , the tracks being Ballastless Tracks and the body of the Coaches being Stainless Steel and non inflammable furnishings , the danger of accidental fire is greatly mitigated.

### *Staff care*

The general rule to be followed is that a driver who has been involved in an accident or some other serious incident is to be taken off duty immediately. The driver will only be able to return to work once a doctor and the driver's immediate supervisor have given their approval.

In certain cases, supplementary training and renewed aptitude testing may be required before a return to safety-critical work can be approved.

### *Special Safety investigators*

Based on our experience, The JV Company intends to provide special training for a number of staff as special safety investigators in order to be able to document the event at the scene of a serious near-accident professionally. These people will then be responsible for internal investigation of an accident or a near-accident in parallel with the police investigation. In Sweden, the Swedish Railway Inspection Service trains special investigators for the various railway companies in the country and throughout the Nordic region. We will propose that the same type of training should be arranged in India.



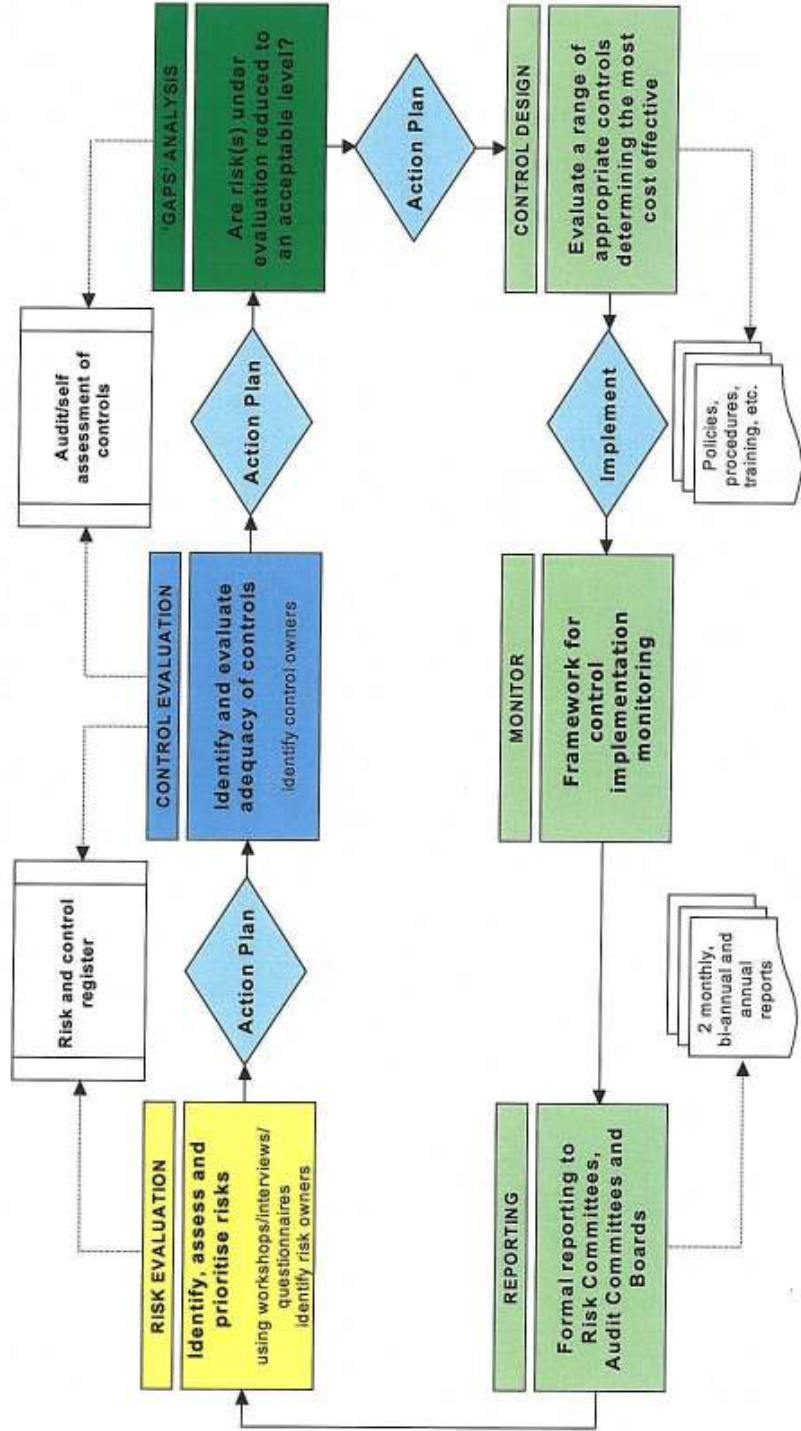
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They will act under the supervision and control of the Safety Engineer, following the RISK AND CONTROL EVALUATION PROCESS (see next page).





Figure 3  
**Risk And Control Evaluation Process**



### **Rule Book**

All types of different rail operations (Metro, Train and LRT) need for safe and secure operation a special Rule Book containing at least general rules, safety and health rules, vehicle operating rules, rules for maintenance, training and update briefing and adherence monitoring.

In the preparation of the Rule Book for Mumbai MRTS the JV Company will use safety experience and resources of Connex from its operations in other countries.

The Rule Book is a component of the proposed Safety Management System. The Safety Engineer/Manager, directly reporting to the CEO, will have the full responsibility for the Mumbai Metro Rule Book.

The Safety Management System is made up of the following components:

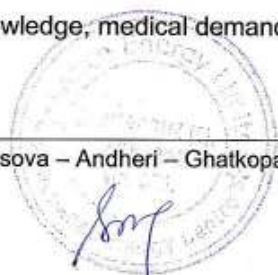
- Policy,
- Organising
- Planning and Implementing
- Measuring Performance
- Reviewing Performance.

### **General Rules**

The whole process is subject to internal management check and external audit.

The Rule Book will cover the following general rules which include :

- Glossary of terms and abbreviations
- Individual conduct
- Personal safety
- Security of premises
- Communication
- Rules for training and medical (health) examinations
- Supervision of skills, knowledge, medical demands and training
- Reporting of accidents



- Calling the emergency services
- Dealing with fallen down overhead wires
- Dealing with accidents and fatalities
- Dealing with fires and fire prevention

### *Safety Rules*

Safety rules (other than VEHICLE) shall include:

- Intervention on the line
- Electrical rules, intervention on power supply equipment
- Actions in case of Fire
- Actions in case of accidents
- Working with maintenance on infrastructure
- Working with maintenance close to the Metro
- Working as a controller in the Control Rooms
- Working in degraded situations.
- Respect of procedures

### **Vehicle Operating Rules**

Safety of vehicle rules which include:

- Preparation driving of vehicles
- Entrance into and departure from depot
- Driving vehicles in the depots
- Distances to respect, e.g. switches
- Working on vehicles (maintenance)
- Driving vehicles under normal conditions
- Driving vehicles under abnormal conditions
- Driving vehicles on the line off-street
- Driving vehicles on the line on-street
- Drivers action at accidents, fires and fatalities



### **Training and Update Briefing**

On appointment to a job covered by the Rule Book a Training Needs Analysis of the individual will be undertaken. They will receive training appropriate to their individual requirements. Rules update and reminders will be briefed through a number of media, including: notices and publications, face to face individual briefings, team meetings, news letters and Intranet.

### **Adherence Monitoring**

The Adherence monitoring will be achieved through formal management checks and audits conducted by both external and internal auditors.

Internal control and management is affected by means of contracts of employment between the CEO and reporting managers. The contract governs, in addition to responsibility for health & safety at work, responsibility for quality and quantity of production as well as responsibility for human resources.

Monitoring of drivers carried out internally is to ensure that safety and quality of the service will rest on four pillars:

- Basic training
- In-service training
- Help and support
- Monitoring and follow-up

In-service training chiefly takes place in conjunction with regular examinations on safety regulations, and focuses on safety, quality of service and vehicle knowledge.

Help and support will be available in the course of day-to-day operations. Personnel including instructors and supervisors, sitting in with the drivers as they work, observing them and conversing with them, provide this. Ongoing monitoring and follow-up is also carried out in the same way.



### *System audits*

System audits are designed to ensure that everything affecting a particular area is charted and documented. Our service structure for a certain quality area is made apparent in this way. Hence it is possible to find weaknesses and get to grips with the causes of faults. The opportunity to discuss the details of the quality area from a strategic perspective is one of the most significant aspects of this. So far, Connex in Stockholm, has carried out system audits relating to disruption information and the dissemination of safety information.

### **Protocols for Third Parties**

#### *Interaction with the outside world*

The JV Company intends to set up tried and tested channels of communication and working partnerships with the police and emergency services, as well as with other relevant organisations. This will ensure that the train service operates at a high level of safety and a consistently high level of quality. There will be ongoing co-operation with the organisations listed below as well as with others:

- MMRDA
- Police
- Fire brigade
- Ambulance service
- Other transport operators (with regard to disruption information, alternative transport, etc.)
- Event organisers
- Schools and social services for the purpose of preventing injury and violence
- Supervisory authorities (such as the Railway Inspection etc.)
- Press and media

All relationships must be characterised by professionalism and a business-like approach as well as aspiring to contribute to the overall perspective of providing safe and reliable operation of public transport in and around Mumbai.



*Transition periods / Handover to the MMRDA*

**General**

**End of Concession Period Report**

At the end of the Concession Period, the JV Company will provide a report containing a statement regarding the overall operational performance. This report will include information concerning the condition of the equipment, schedules of spares on the Site, outstanding repair orders together with a list of all documentation and information necessary for the operation of the Works.

**Handing Over of the System to the Client**

After completion of the Concession Period, the JV Company will transfer the whole of the System to the Client.

Prior to the end of the Concession Period, the Client will carry out an inspection with the JV Company to identify any defects or damage which have occurred during the Operation Period. These will be rectified prior to the expiry of the Concession Period. All up-to-date Documentation including Operation Manuals will be submitted to the Client. The JV Company will also submit complete Health and Safety Documentation, including the Safety File.

The metro will be handed over following satisfactory conclusion of Tests After Completion to be detailed in due time. Immediately prior to completion of the Operation Period, the JV Company will carry out final repairs.

*Hand-over and Transition Plan*

A well-planned and smooth phased hand-over and transition of the services to the MMRDA's control will retain the confidence of all staff, regulatory bodies and the general public. The planning process is important to avoid confusion and disruption that can occur if major change is carried out too quickly.

The Plan will ensure that complete take-over will occur in a logical and general fashion.



The key to a successful transition is to be flexible and adaptable and to be prepared to modify plans to cope with changing circumstances. Communication and information dissemination is important to ensure all employees are aware of what is happening at all times.

The Plan will incorporate the overall Business Plan Objectives into functional areas such as general management, operational aspects, financial and administration. For each area, a transition program will be developed. The main elements in developing the transition tasks are to focus on the issues such as timeframe, facilities, operational assets, ongoing work, etc.

The JV Company believes that its personnel will be able to offer skills and experience to MMRDA that will be invaluable. Consequently, considerable attention will be given to understanding and explaining the philosophy and the policies that will be adopted by MMRDA.

#### ***Relation with Police and Fire Brigade***

The main interfaces of the MRTS with the Police and Fire Brigade will be managed by the joint team of the Safety Engineer and the Operation Manager.

#### ***Information at stations***

The JV Company proposes the following:

- A general network map with connecting points, links to other transport services of the city and suburbs, landmarks and sights (in addition to information such as parking areas, wheelchair access, etc.) will be affixed to the wall.
- A route plan will highlight the routes and show clearly all stops served by the metro leaving from each platform. It must be positioned intelligently, i.e. at the point where the customer must decide whether to go left or right. Signage to and on platforms will be adequate and easy readable.
- Large timetable posters in each stop with specific departure times or frequencies at peak hours.



- Basic fare information (prices of all ticket available on automatic vending machines) located next to the ticket vending machine. A potential customer who has never been on the Metro system before will want to have a rough idea of fare prices before he gets down to calculating the price of his particular trip.
- Clear information to explain to potential customers how to get a smart card, how it works and what are its benefits, where to load and reload it on the spot and elsewhere.
- Loudspeakers and dynamic panels will also be used to inform passengers of any disruptions to the service. The real-time information displayed will include at least : the line number, the destination of the next vehicle, the number of minutes before the arrival (or departure) of the next metro and information when there is some change regarding the operation of the Metro system. Information will be displayed in three languages: English, Hindi and Marathi.
- Information at the arrival stop, especially for visitors and tourists, the customer, leaving the metro stop, will need to know where precisely he is and in which direction he should head. At each stop, we shall therefore need :
  - Platform signs with the name of the stop that are clearly visible from anywhere inside the metro vehicle,
  - A map of the surrounding area,

#### *Information in vehicles*

The JV Company will make the service user-friendly, particularly for irregular users. Passengers should be able to follow stop by stop their current location their alighting point. They will feel reassured to see on-board the Metro vehicle :

- the name of the terminal stop on the exterior front panel. This information will be set automatically.
- a route plan in each carriage to check how many more stops there are before his destination. Ideally the route plan will be displayed above the doors.
- dynamic visual information through the form of illuminated panels that indicate the name of the current stop, the name of the next stop when the vehicle doors are closed, and the terminus when doors are open. The Operator will also be able to send specific messages.
- audio information, during normal operation, the system will automatically announce the next stop name upon approach of the stop. The driver and / or the customer





relation staff will be able to send complementary messages regarding security or regarding the safety or the operation of the vehicle.

### *Other information material*

#### *Information in paper*

The JV Company will produce a series of paper documents to ensure that passengers have handy information packs adapted to their requirements. Strict rules will be applied on the preparation of these documents to ensure that they provide the information required by passengers in the best possible format.

The following will be part of the information package available on paper :

- Network map with connecting points to the buses,
- Pocket guide including the fares structure, methods of purchasing a ticket, information about the smart card, and background information on the metro. The pocket guide will include the Metro timetable presented in the form of frequencies in peak and off-peak times.
- Remote information and call center

#### *Call center*

The JV Company will put into a place a call center that will be recognized by passengers as a customer care and information phone service. A team of employees will handle calls from the general public.

The aim of each call will be to understand the customer's views / grievances and act as necessary. A call protocol will be introduced in order to provide the best customer service to customers. Call centre staff will be encouraged to elicit from callers, feedback on the service provided.

The JV Company expect that the type of questions from callers will be generally the following :

- times of departures,
- fares,
- how to use the service,
- problems encountered by the passengers,



- lost property,
- background information on the Metro system.

The call centre staff will use the internet site to source information to ensure that the answer is always unambiguous. The phone number of the call center service will figure prominently on the Internet site to ensure that passengers know where to call in case they cannot find the information they want on the Internet.

Stations Agents being in direct contact with customers on the network will be encouraged to use the customer care and information phone service if they cannot answer a passenger's question.

The call center service will be available for the longest period of the day possible. The Operator will need to analyse the travelling habits of Mumbai residents further to decide on the precise hours of operation but we would expect to open the lines daily from approximately 0500 hrs until 2400hrs. A large part of the information on the network that is available will be accessible on the Internet site 24 hours a day.

A single phone number will be communicated to customers. Calls will be handled through key pad activated menus to choose for example the language, the subject, etc. The agents will be able to speak to the customers in English, Hindi and Marathi.

The JV Company will ensure high quality service of the call centre to generate excellent word-of-mouth promotion for the network. A level of satisfaction that cannot be generated by any advertising campaign will pay for the investment in additional time spent on each call back.

#### *Customer service*

A focus will be made on the development of a customer oriented culture. The attitude of employees to the customers, and their ability to understand their travel needs will be a critical factor in making the service truly accessible.

A dedicated "customer service" will be introduced to meet potential and existing customers' expectations. The JV Company will appoint one person as "Customer Service Manager" to guarantee the level of service offered to passengers. Fundamental to the success of the



marketing strategy is the ability of staff to welcome the customer and provide courteous, helpful service.

Successfully motivating staff to embrace high standards of customer service, and to accept their responsibility and the role they play in promoting the organisation, involves substantial efforts in terms of attitude and the overall culture of the JV Company. Our commitment to customer service is illustrated in our approach to training, which results in high professional standards throughout Reliance's & Connex organisations. Connex Institutes of Urban Environment in France, UK and Australia are specialised training centres operated jointly by Connex and local authorities. Reliance Energy operates a Management institute at Mumbai to carry out in-house training and development programmes for its employees.

Our customers would equate service with people. Therefore it will be important to establish a higher profile for all staff, particularly the customer relation staff. Service staff will be mobile, and actively involved in local promotions and information sessions, giving them the opportunity to interface with and assist customers. They will wear visible uniforms so that passengers can clearly identify them and their role will be clearly identified to all as providing information and assistance to customers during their journey.

Based on the particularities of the network, the staff and passengers expectations, the JV Company will devise a customer service manual to explain to staff how to provide a friendly and efficient service. Gestures, attitudes, and key actions are some of the points we aim to pass on to our staff at our training sessions.

#### ***Information and assistance to customers in the stations***

Our customer relation agents would handle several tasks : they inform customers, help to prevent fare evasion and vandalism, monitor safety and control the level of cleanliness. During the commercial start the JV Company will focus its role on information and assistance in familiarisation of the passengers to use modern system.

Extra staff will strengthen our numbers during the first weeks of operation. They will keep a close watch on public transport newcomers and people with difficulties. Our marketing and commercial management team will be split in the main stops to coordinate them and give a hand during launch.



The JV Company will put a great emphasis on the training of staff, that we consider to be the window of the service quality. They will be trained to quickly understand people queries in order to provide an efficient, helpful and friendly service from the first day of operation.

Service staff will wear visible uniforms and badges so that passengers can clearly identify them. To inform and motivate our staff, the JV Company will present to them the actions and timing of the communication campaign in advance of its implementation.

This will also show our customers during launch that the level of information of our staff is consistent.



### 7.A.5.iii Manpower Deployment & Training Programme

#### **MOBILISATION PLAN**

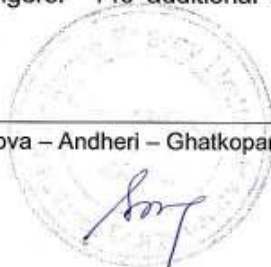
A start-up period (the mobilisation plan) is necessary for follow-up of design, construction of system, and preparation of operation, until the receipt of the Commissioning Certificate.

#### **Introduction**

Connex, has considerable experience in managing the preparation phase before the operation of a new transport system.

This experience has been gained through hands-on experience in their projects some of which are mentioned below:

- The Nancy trolleybus network which came into operation in 1985 on a network of 40km of lines with 48 articulated trolleybus vehicles, each 18m long.
- The Rouen LRT metrobus network, brought into operation in December 1994 on a network of 12km of tramway lines, increased to 15.2km with 28 Alstom vehicles, of the Grenoble type
- The Lisbon Fertagus commuter rail system which came into operation in July 1999 on a 22km network with 8 stations and 18 double-deck 4-car trains from Alstom and CAF
- The Rouen TEOR guided bus network brought into operation in January 2001 with a first stage of 12km with 38 AGORA type vehicles. The diesel-powered buses with optical guiding system were replaced progressively by 58 CIVIS vehicles from mid-2002 and the network was increased to 38km of lines
- The Nancy TVR network commenced in January 2001. This network runs vehicles guided by means of a ground-based axial rail covers a first stage of 11km with 25 TVR Bombardier vehicles, 24m long
- The Bogota Transmilenio network (Colombia) brought into operation in January 2001. The network covers 40km of bus lines (two lanes, 78 metro type stations with 1, 2 or 3 platforms and TVM equipment) and is equipped with 330 articulated buses, 18m long (brought into operation in August 2001). The network has a daily traffic of 550 000 passengers. 140 additional buses are to be provided in the



coming months to ensure an interval of 20 seconds. Connex runs 100 buses of this network in partnership with local companies

- Bordeaux LRT. The 25km long network will have six Citadis 302 train sets and 38 Citadis 402 train sets
- Barcelona LRT tramway. The 15.2km long network has 20 Citadis 302 train sets.
- Dublin LRT. Two lines (14 + 9 kilometers) 26 Citadis 302 and 14 Citadis 402.

## Staffing

### Recruitment

Recruitment of both drivers and other personnel is a basic prerequisite for implementation of the agreed transport service. The JV Company is well aware that in India and in the Mumbai area especially there is the risk of availability of manpower when it comes to qualified professionals. Our experience from other labour markets, shows that train drivers and other types of drivers in rail transport belong to a category wherein there is shortage when it comes to availability on the labour market.

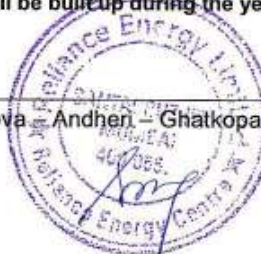
The risk of a shortage of manpower makes it necessary to have extra foresight and planning when it comes to recruitment of personnel for Mumbai Metro. The time from advertising for personnel to the start of the driver's course, (the recruitment time) will take upto five months. The recruitment entails amid other things aptitude testing and verification of medical suitability. The time for completing the training of drivers would be atleast another 4-5 months.

As foreseen now, the deployment of manpower for the MRTS (at the operating level) is as depicted in Table 8 below:

**Table 10 Manpower Deployment**

Year	1	2	3	4
Train Drivers	1*	2*	31*	56
OCC Manager/Staff		3*	17	17
Station staff			66*	110
Fare and Ticket collection Staff			4*	13
<b>Maintenance</b>				
Maintenance Staff		1	3	3
Rolling stock			21	21
Signalling			12	12
Fixed Installations			16	16
Stock			3	5
<b>Total</b>	<b>1*</b>	<b>6*</b>	<b>173*</b>	<b>253*</b>

(Note : \* denotes that the manpower will be built up during the year)



### **Basic training and in-service training**

Basic training and in-service training are two corner stones in the training programmes for all staff training programmes. When it comes to staff performing safety-critical assignments (drivers, controllers, maintenance personnel and certain operational managers), special basic training plans will be produced, stating minimum times for the various sections of training. The training plans will give certain fixed minimum service time spans for different safety-critical work tasks that must not be exceeded without repeat training being undertaken.

All staff (including relevant contractors' personnel) doing safety-critical work tasks will undergo regularly recurring in-service training in order to ensure that the required level of knowledge is kept up to date. Implementation of in-service training is suggested every two years. For the year in which in-service training does not take place, it is proposed instead that personnel carrying out safety-critical work tasks should undergo a knowledge examination that includes both practice and theory elements as well as sections on safety.

### **Training plans**

All staff whose work impacts safety will be trained in accordance with specially developed training plans, which will be detailed to MMRDA and the Safety Commissioner or other agency appointed by MMRDA well in advance of services commencing.

### **Training resources**

The JV Company will rapidly be able to link in various tried and tested training resources from Connex's operations in other countries, for the train service in Mumbai. This will guarantee initial training for test drivers, for example, and additional staff could quickly be drafted in for trial exercises. For the final training of drivers and other staff employed in ongoing operations in Mumbai, the JV Company envisages setting up a Mumbai Metro training unit in Mumbai.



## Fundamental personnel requirements

Staff competency and training are crucial in terms of the quality provided. Descriptions of our key categories, drivers and controllers, are reproduced below. The fundamental requirements for all categories of employees involved in train operations are:

- Approved training for the role in question.
- Fulfilment of medical requirements stipulated in regulations set by the authorities.
- Fulfilment of all requirements as to aptitude for the post.
- A strongly service-oriented approach and a good grasp of the requirements of working in the service industry.
- English, Hindi and Marathi language knowledge
- Understanding of vehicle theory, appropriate to the type of work in question.
- A good temperament and high stress tolerance.
- Accuracy and punctuality.

### Operations Control Centre (OCC) staff

All quality in service operations begins with appropriate recruitment of staff in managerial positions. Careful recruitment is crucial to major aspects of the way the service is operated in years to come. Over a period of many years, Connex has developed a training programme for controllers and other traffic control personnel operating in various countries. Connex's experience from training and developing the competency of traffic control staff in other countries will form the basis of the recruitment and training of controllers for the new train service in Mumbai.

### Train drivers:

#### *Training programme for train drivers*

The basic training for Mumbai Metro train drivers, which includes sections on both theory and practice, is individually tailored and is estimated to take 4 to 5 months.

The training programme for train drivers is made up of a number of basic elements as summarised below:





### *Traffic technology*

The employee learns the rules, regulations and instructions pertaining to Mumbai Metro Rule Book as well as the legislation outlined in various handbooks applicable to trains and public transport. In addition, the employee learns the practical skills required for driving trains.

Bearing in mind the special risks involved in driving trains in "mixed" traffic, extra emphasis is placed on driving in these conditions.

### *Vehicle knowledge*

During this part, drivers learn how to operate the train and in addition, learn how to troubleshoot problems affecting the vehicle. The aim is for drivers themselves to be able to correct the majority of faults out on the line in order to minimise delays and other problems faced by customers. Examples of troubleshooting and dealing with vehicle faults are door faults, traction faults and towing faulty vehicles. Vehicle knowledge also includes, for example, basic electrical theory and the principles of replacing fuses.

### *Practical aspects and exercises*

Training as a train driver consists largely of, in addition to theory, various practical exercises and practice sessions. The best way to remember something is to have it said to you, to read it and above all else, to perform the task yourself. Train driving is in many ways a practical "trade".

### *Service and quality*

Service and quality form an important and integral part of the training to be a train driver. The objective of this aspect is that after completing the course, the employee should have the "right" customer values and practical skills in five key areas:

- Train announcements (approaching stations)
- Disruption information
- Smooth driving
- Safe boarding and alighting



- Recovery from disrupted operations
- Punctuality.

### **Station Staff**

#### **Profile of requirements**

The Stations Mumbai Metro staff will principally be recruited and trained in accordance with the same principles as Connex staff for other MRTS systems elsewhere in the world. Great emphasis will be placed on personal aptitude and a high level of motivation for the relevant assignments.

#### **Assignments for Station staff include the following:**

##### Information

- Excellent knowledge of the Mumbai Metro fares system and network
- Knowledge of the Mumbai Metro organisation.
- Knowledge of local geography and of one's own section of line and adjoining lines
- The ability to distribute timetables and other information to passengers
- Giving information about disruptions affecting train services
- Passing on information about disruptions received by pager
- Ensuring that current information is deployed in stations
- Providing general information about train services.

##### Order and security

- Alerting the emergency services as required - ambulance, police and fire brigade
- Familiarity with authority and procedures with reference to security work.

##### Ticket sales / securing revenue

- Inspection of ticket machines to ensure that they are working.

##### Vandalism / graffiti / cleaning

- Documenting, photographing and reporting damage and graffiti
- Where necessary, reporting damage and graffiti to the police
- In an emergency, if possible removing, repairing and replacing damaged equipment
- Carrying out straightforward spot cleaning in an emergency.



*Training programme for station personnel*

The basic training course for station personnel, which includes sections on both theory and practice, is individually tailored and takes approximately one month. The course culminates in an examination, taking the form of a final written and oral test.

*In-service training for all staff*

The purpose of in-service training is to keep staff up-to-date with the skills and knowledge that are not used every day, but are nevertheless important when needed. For example, ongoing information to our customers in the event of any disruption to operations, as well as handling various types of irregularities in the provision of transport services, including those occurring under very stressful conditions.

At present, in connection with ongoing safety examinations for drivers and controllers, there is an in-service training module with an emphasis on quality and safety. The course includes reinforcement of vehicle knowledge as well as the reason for good treatment of customers by all categories of staff that the passengers may come across while travelling. Training with regard to disruption information is intended to give all staff the motivation and knowledge required in order to be able to give "their" passengers information in a positive way if the service does not go as expected.

In-service training of the mobile field personnel will be partly co-ordinated with in-service training of drivers and controllers in order to promote reciprocal exchange of knowledge between categories of staff.

The management (middle and top) will also undergo training, so as to enable them to understand and adopt the best international practices being adopted by the metro rail systems all over the world. This will be done through various workshops – organised all over the world, seminars etc.

The technical advancements in the world of metro rail systems would be imbibed in the organisation through special brochures, study material. The technical personnel will be encouraged to attend seminars, workshops on technical issues & aspects of operating and maintaining the metro systems.



#### **7.A.5.iv Detailed Maintenance Strategy**

The maintenance strategy for the MRTS project will be based on the following philosophy and objectives:

- To maintain the equipment/systems such that they can support safe, reliable, efficient and cost-effective MRTS service and station operations.
- To recover from the faults affecting train service or station operation in a minimum time and to assure compliance with the performance requirements as specified in the Concession's Agreement.
- To implement maintenance works in time and with minimum costs.
- To streamline the maintenance works by continually reviewing and modifying the maintenance procedures whilst ensuring that asset life is optimised.

#### **MAINTENANCE CONCEPTS**

The systems or equipment of the MRTS shall be designed to maximise their availability. Systems architecture and technology shall be such as to minimise the maintenance required and to facilitate rapid fault rectification. All maintenance activities except ad hoc (event that occurs and not planned in advance) and urgent repairs will be published in the Traffic Notice (TN) to be accessed by relevant parties that may be affected by the maintenance activities.

#### **Line Replacement Unit (LRU)**

There are basically three levels of maintenance for line replacement unit equipment:

- First level – with all main sub-systems exchangeable on a unit or modular replacement basis.
- Second level – at the workshop for overhaul or repair of non-exchangeable items.
- Third level – component repair. In general, equipment shall be modularised to the level where it is more economical to dispose of a faulty module than to repair it.

#### **Preventive Maintenance (PM)**

Preventive maintenance is the method of maintaining the railway equipment or systems in sound operation condition by carrying out pre-determined service such as general



inspection, functional check and the like on the equipment or systems according to a determined time interval.

Overhaul maintenance of railway equipment or systems is performed according to the condition of the equipment, measured on or at a pre-determined period of time from an engineer assessment or recommendation.

#### ***Condition Based Maintenance***

Condition based maintenance is based on the built-in monitoring system of the equipment or systems. The monitoring system consists of a number of sensors fitted at the strategic location to monitor any abnormality in temperature, vibration, frequency level, air velocity and concentration, etc. Such actions can be taken before failure occurs.

For civil and architectural assets, condition based maintenance system (CBMS) is in the form of scheduled inspection to record the operation status.

Any equipment with the CBMS facility shall be recorded in the operations and maintenance manual in order to take into account when planning maintenance schedule.

#### ***Corrective Maintenance (CM)***

Corrective maintenance is the action taken to restore failed equipment back to its operable state. There are two types of corrective maintenance. The first is to rectify failures arising from PM or modification work, and the second is to handle the failures arising from services. This is also known as recovery maintenance.

#### ***Emergency Repair***

Emergency repair is the recovery action due to a failure caused by equipment or plant, which:

- results in an initial delay or disruption to passenger train service, and showing no immediate resumption of service, and
- requires the closure of a station or part of the running line
- resulting in personal injuries.

When the Traffic Controller determines that the engineering staff should immediately attend an incident, the relevant maintenance contractors would immediately proceed to the site to:



- determine the nature and extent of the problem
- assess the action and manpower required to recover the service, and
- rectify the failure or defect with the objective of resuming the train service at the earliest possible time. A safe temporary repair might be applied. The definitive repair could be done later during engineering hours or off peak hours.

The Shift Engineer would also be informed through the Maintenance Management Centre to act as an Incident Engineer to provide technical support to the Incident Officer.

### ***MAINTENANCE STRATEGY***

Maintenance of the MRTS can be executed in three ways, namely in-house resources, outsourcing or a combination of the two. A brief discussion on the benefits and deficiencies of in-house resources and outsourcing maintenance are given as follows:

#### ***Maintenance by in-house resource***

Having in-house staff to assume all maintenance works is the traditional way of railway maintenance.

This approach provides a direct control of all skills, equipment spares for railway operation under the Concessionaire.

#### ***Maintenance by Outsourcing***

Employing contractors to carry out a part of the maintenance works is sometime cheaper than in-house resource because of the comparative large size and speciality of the contractors.

The benefits of outsourcing are:

- Minimise operating costs
- Improve company focus
- Access to world-class capabilities
- Free resources for other purposes
- Accelerate re-engineering benefits
- Share risks

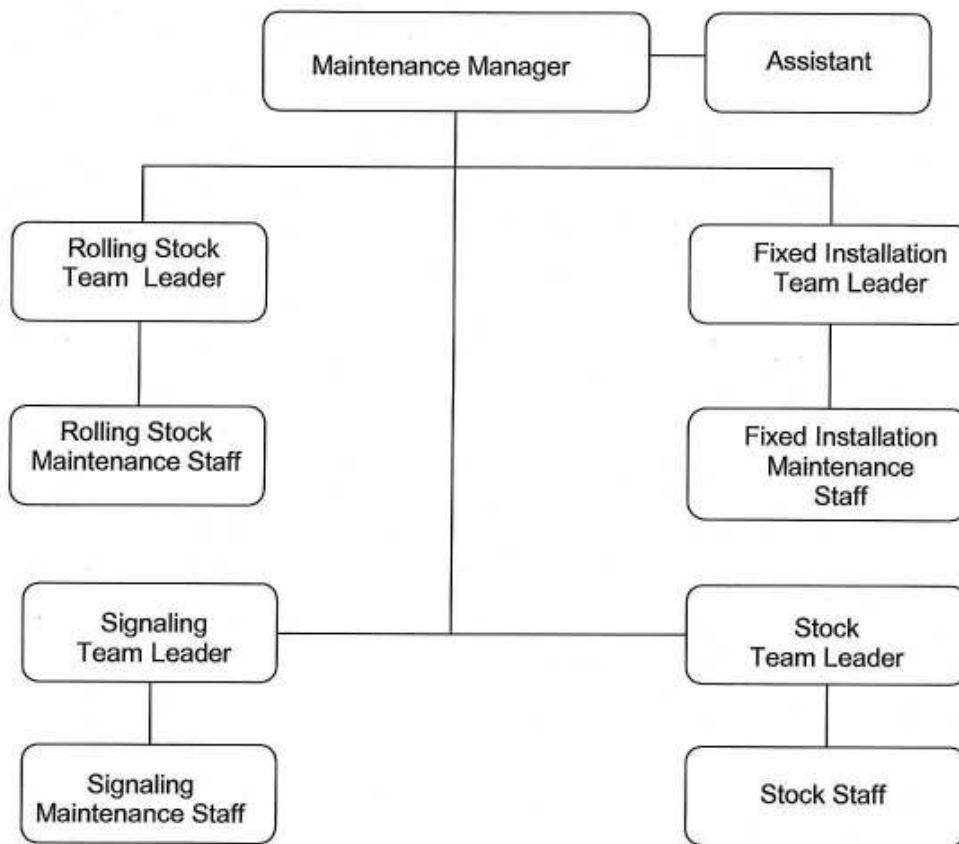


**MAINTENANCE ORGANISATION**

**Overall Maintenance Management Organisation**

For a total maintenance outsourcing strategy including in-house and possible outsourcing, the typical maintenance organisation is outlined below:

**Figure 4 –Maintenance Organisation Chart**



**Roles and Responsibilities of Maintenance Personnel**

**Maintenance Manager**

The Maintenance Manager shall oversee all maintenance works for the MRTS, who is supported by the maintenance specialists for Rolling Stock, Fixed Installations (civil, trackworks etc). signalling etc and their respective assistant engineers.



**Fixed Installation Teamleader**

The civil, structural and trackwork maintenance will be under the responsibility of Fixed Installation Team Leader who will be responsible for overall management of the maintenance contractor(s) for the civil infrastructures including the stations and depot structures as well as the architectural assets and trackwork, lifts, escalators etc.. He will be supported by civil and maintenance officers (appearing as staff in the above chart).

**Civil & Structural Maintenance Officers**

The Civil & Structural Maintenance Officers report to the Fixed Installation Team Leader, and assist him of the daily management of the maintenance contractors including the stations and depot structures as well as the architectural assets and trackworks lifts, escalators etc.

**Rolling Stock Team Leader**

The Rolling Stock team leader would be responsible to maintenance of the rolling stock in every aspect. He will be experiences in the various modules / systems of rolling stock and in all probability would be from the Indian Railways – trained on the rolling stock being adopted for Mumbai MRTS. He will oversee the workings and be assisted by the Rolling Stock Maintenance Staff.

**Rolling Stock Maintenance Staff**

Reporting to the Rolling Stock team leader, the Rolling Stock maintenance staff would be qualified experienced personnel who would actually carry out the maintenance activities on the Rolling Stock under the guidance and supervision of the Rolling Stock team leader.

**Signalling Team Leader**

Signalling is one of the most important package of the MRTS system that affects the safety and reliability of the entire MRTS system. This finction shall be headed by a qualified and an experienced person. Overseeing the functioning of the Signalling maintenance staff, the Signalling Team Leader would ensure that the Signalling system performs flawlessly. Operating from the OCC, the Signalling Team Leader would run periodic diagnostic tests and checks on the signalling system to ensure that system is in perfect working order at all times. Any errors / failures will be informed and attended to immediately by the Signalling maintenance staff.





**Stocks**

This function shall be under the control of the Stocks team leader who would ensure the maintenance of adequate inventory levels of key spares at workshop. The team leader would be assisted by the staff who would carry out the actual task of classification of the inventory and maintenance of the records.



### **7.A.5.v Satisfy the requirements of Reliability & Efficiency**

#### ***PROPOSED TARGET OF SERVICE QUALITY***

The quality of service is very important to provide passengers with the feeling and knowledge that they may use the MRTS everyday for their commuting or for any special purpose without having to take too much extra time to cope with unpredictable events delaying them.

However, one knows that the cost of too high a quality may not be reasonable. Military, space satellites or plane specifications are so high that they require duplication of systems as well as top level certification of components which makes them very expensive.

From this point of view, the quality of service has to be determined as regards to the economy of the system.

Mumbai MRTS being one of the first systems under a BOOT scheme in India, has the unprecedented privilege to require a top level quality and reliability level (in order not to be criticized as "second class system") and a best adjusted system as regards its cost (in order not to burden the new economic BOT model to be followed later in other cities in India).

This proposed target is 99.5%, which means 0.5% of non-quality. This provides the passengers with one "chance" every 200 trips to encounter a delay in their travel time, i.e. one "chance" every 3 to 4 months if they commute everyday.

In the 90's the above target was considered impossible by manufacturers. Since the last decade it is seen as a requirement by many local authorities in their terms of reference for LRTs and metros.

#### **Non Conformance to Quality**

Ignoring failures due to adverse weather conditions (extreme winds, extreme rains...) non conformances to quality can be a consequence of direct breakdowns, mistakes, misbehaviour of - the equipment, staff or passengers.



Misbehaviour of passengers (mainly preventing doors to close) is unavoidable. Therefore it is usually taken into account by adding ten percent of the running time to the time at terminus. With approx 21 minutes running time, 2 minutes due to above plus the time required for the driver to change cabin would result eventually into adding one train to the fleet. This would be a high cost option. In order to achieve the same goal without having to add a train to the fleet, the following are being adopted:

- A "jockey" driver at the terminus, to take in charge the train in reverse direction without having to wait the incoming driver to walk all along the train.
- Maintain an average dwell time in stations of 30 seconds, (from stop to start), a figure considered as high in metros where 25 seconds is very common
- Maintain a maximum turn around time of 2 minutes at terminus and approx 21 minutes running time.
- Organize passengers at the two busiest stations (Andheri and Ghatkopar) into queues to board – wherein the boarding numbers will be regulated thereby avoiding trains being fully packed at these places. This situation would otherwise prove critical for alighting/boarding passengers at subsequent stations and may result into frequent delays.

From the above, non conformance to quality due to passenger behaviour will be limited.

As regards breakdowns statistics from existing operations, indicate the non conformance to quality originates 60% from the rolling stock, 30% from the fixed components of the system and 10% from the operating staff.

Targeting 99.5% quality gives us a tentative distribution of non-quality as follows:

- Rolling stock 99.7%
- Fixed components 99.85%
- Operator's staff 99.95%

These are the figures that will be used for the definition of the system.



### ***How to Measure the Quality of Service***

There are many ways to measure the service quality. This is because there are many small changes in the theoretical services that one could call "non-quality". As a matter of fact, there are too many such small events, e.g.:

- Train departs on time arrives late
- Train depart late arrives on time
- Train departs late arrives late
- Train departs too early arrives on time
- Train departs too early arrives too early
- Train departs on time, runs late arrives on time
- Etc. etc.

Some of the above "events" could be positively considered by some passengers!

The basis for the measurement of quality of service should always be: a simple measurement, giving the operator the capacity to implement corrective measures. If the measurement is too complicated, the user would not be able to comprehend the result and the same will not reflect the corrective measures taken to improve the quality.

We therefore propose a simple measurement based of the "lost kilometres".

The service is defined as theoretical either in number of services or in planned kilometres. Therefore any event which would result into a reduction of the number of services or produced kilometres is easy to measure, easy to attribute to its initial cause (rolling stock, system equipment, operator, passenger, weather), and easy to connect to the corrective measures that shall be undertaken to improve the service.

The most important part of the day is the morning peak hour. It is also the more representative of the overall quality. It is where the service will suffer from lack of trains or from no-show driver. Off peak hour and afternoon peak period are more protected as there are usually either less trains required or more trains available (after the daily maintenance) as well as ready to go drivers at a moment's notice.

It is proposed to measure the % of lost services during the morning peak hour (LSMPH).



Morning peak hour (MPH) : from 8H00 to 13H00

Theoretical services during the MPH (e.g. say at 4 min headway) :  $15 \times 5 = 75$  round trips

Monthly theoretical services during the MPH :  $75 \times 25$  (Sundays excluded) = 1,875

Monthly theoretical kms during MPH :  $1,875 \times 22,7$  km/round trip = 42,562 km

Every lost km during the morning peak hour (except Sundays) will be recorded and compared to that figure of 42,562 km thus providing a % of quality.

For example when a train has a breakdown and is unable to make the run trip it was supposed to do, thus leaving 22.7 km lost, this gives a 0.05% non quality or reduces the quality to 99.95%.

We do propose to target 99.5%, i.e. a maximum of LSMPH of 0.5% (212 lost km or 10 lost run trips). An internal review mechanism is expected to analyse the reasons for lack of conformance to quality and the means to identify and rectify the causes of the same.

**Table 11 Extract from RFP on Service Quality**

Description	Mean time between "service affecting failures"
Delay to agreed System headway exceeding 2 minutes, or fault preventing vehicle entering service as scheduled	1 failure per month
Delay to agreed System headway exceeding 5 minutes, or closure of one station	1 every 2 months
Delay to agreed System headway exceeding 20 minutes, or need for single line working for 1 hour or more	1 every 12 months
Severe service disruption	Unlikely to occur



It is being brought to the attention of MMRDA that the above table appears to be requiring review and modifications to meet normal international practices in such MRTS projects. The reasons for such observations are as follows.

**Table 12**

Description	Mean time between "service affecting failures"	Comment
Delay to agreed System headway exceeding 2 minutes, or fault preventing vehicle entering service as scheduled	1 failure per month	Such delay has not the same effect if it is during the peak hours or during off peak hours. Even at peak hour the headway being say 3.5 minutes, a 2 minutes delay may occur without having an effect on the service delivered. In itself it is not fully representative of the "non-quality". By comparison the fault preventing vehicle entering service will result in lost kilometres, a more detrimental non-quality event. However, one such event occurring per month (if it is the only non-quality event accepted) would result in a quality of service of 99.95 %, a figure highly unusual in metro systems, which, if it would be taken for granted would highly affect the efficiency of the system.
Delay to agreed System headway exceeding 5 minutes, or closure of one station	1 every 2 months	Such delay has not the same effect if it is during the peak hours or during off peak hours. At peak hour the headway being say 3.5 minutes, a 5 minutes delay automatically results into the lost of the next service to be delivered. One such event occurring every other month (in addition to the one event above) would result in a quality of service of 99.93 %, a figure highly unusual in metro systems, which, if it would be taken for granted would highly affect the efficiency of the system.  On the other hand closure of station is an unlikely event and should not be accepted every other month but rather on a once every other year basis.
Delay to agreed System headway	1 every 12 months	Such an incident, if at peak hour would result into a loss of 5 round trips. As accounted for one



**Mumbai MRTS**

exceeding 20 minutes, or need for single line working for 1 hour or more		<p>year, this results into a quality of 99.98%. If added to the two above figures, this results into a total quality of 99.91%, a figure highly unusual in metro systems, which, if it would be taken for granted would highly affect the efficiency of the system.</p> <p>Single line operation is not something easy to implement as we would first need to empty the line from trains then start a shuttle service which, depending of the length of the single line between two points, could be of no less than 20 min to 40 min headway. It is more likely that in case of severe disruption of service, we shall call bus companies to provide enough vehicles to carry our passengers along the disrupted part of the line.</p>
Severe service disruption	Unlikely to occur	Yes, unlikely to occur, may be only once every 5 years.

Instead it is proposed that the following may be adopted which are generally practised internationally :

**Table 13 Proposed Service Quality**

Description	Mean time between "service affecting failures"
Delay to agreed System headway exceeding 2 minutes and less than 3.5 minutes, without effect of lost kilometres, during peak hours, morning or afternoon	1 failure per day
Delay to agreed System headway exceeding 5 minutes and less than 7 minutes, without effect of lost kilometres, during off peak hours	1 failure per day
Fault preventing vehicle entering service as scheduled, all other lost kilometre (during morning peak hour)	Target of 99.5% of LSMPH
Closure of one station	1 every 2 years
One to two hours disruption of service	1 every 12 months
Severe service disruption	1 every 5 years

**The above will be finalised in consultation with MMRDA.**



#### **7.A.5.vi Handling the Traffic**

##### ***Handling of Passengers***

The expected number of passengers of the MRTS in Mumbai is very high and requires a high degree of efficiency. We shall describe hereunder the normal operations and the degraded operations both for regular stations and for the two main stations of Andheri and Ghatkopar.

##### ***Normal operations***

Regular stations do not require specific attention in normal operations. The staff shall be usually busy, one in the selling booth, located at the end of the barrier line and the second employee standing nearby the barrier line watching the entering and the departing passengers ready to help them in case of need.

The second employee may tour the station in order to check the status of the station and report any non-functioning item (lights, escalators, passenger call points) or any damage (broken tile, broken glass etc.). He may also be in a position to call for an emergency cleaning if need be.

In addition a small team of roving agents will be touring the line, usually two teams of 2, with service car, ready to reach any station in less than 10 minutes to help assist the stations agents if need be. Apart from interventions, its role will be to survey the stations as regards equipment functioning, possible damages, assistance to secure the maintenance team.

Andheri and Ghatkopar stations require additional staffing to handle the queues. Those two stations will be by far the heaviest and could create an overloading phenomenon. The trains could be filled to capacity at Ghatkopar departure station. When the train leaves the first station filled to capacity, the passengers at following stations will face difficulty in accessing. This will result in delays which eventually reduces the maximum capacity of the system. In order to avoid this situation, we propose to handle the queues both at Andheri and Ghatkopar stations.

Passengers will be allowed to access the platform only up to a maximum number of approx. 70% of the train load in Ghatkopar (1,000 passengers per batch) and approx. 50%





in Andheri (750 passengers per batch). These figures shall be adjusted per the actual situation to be encountered.

In order to prepare the next batch and have passengers to wait orderly in line, the intermediate level of Andheri and Ghatkopar stations will have a queuing system (as one may find in Mumbai airport to access the immigration) and a third employee will organize the queue during peak hours and have the duty to limit the access to the platforms.

### ***Degraded operations***

In simple degraded operations (but not in emergency), like a temporary disruption of service, a stopped escalator, a passenger requiring assistance, the staff will be trained and organized to respond to the situation most efficiently. In some cases they will act by themselves and in other cases they will call the assistance of the roving team to join them.

*Procedures may include:*

- Temporary disruption of services off peak hour: second employee to inform passengers
- Temporary disruption at peak hour: both employees to inform and direct passengers
- Temporary disruption at station of service is limited: both employees + roving team
- Need to restart a stopped escalator at off peak hour: call the roving team
- Need to restart a stopped escalator at peak hour: second employee acts alone
- Someone stuck in a lift: second employee to secure the person and call maintenance
- Abnormally dirty location: second employee to call cleaning team
- Need to check an alarm per request of the OCC : second employee to check
- TVM out of order: either of the two employees to place signal on the TVM

The general idea is that the first employee who is in the selling booth will leave the booth only under special circumstances, as it may have to secure its cash before leaving the booth. The second employee is more free to move, especially at off peak hours in the order of magnitude that should not be over 10% of its time in station. The roving team is called for interventions especially when the need to inform and direct the passengers is important, i.e. if the degraded situation is a heavy one occurring at peak hour.

Of course, emergency operations require more personnel, would it be firemen, police, emergency services, maintenance. This is explained in the chapter on emergency.



### **7.A.5.vii Detailed Approach to Maintenance**

The most critical component of any MRTS system is the rolling stock which determines the efficiency of the entire system and the safety of the system is based on the efficient and smooth functioning of the rolling stock. Although there would be other systems that would be key components of the entire MRTS system, the maintenance of the same would be on the basis of the detailed maintenance strategy enumerated in 7.A.6.iv and has been briefly outlined herein below:

#### **7.A.5.vii.a Trackworks, Power System (*Overhead Catenary System, Sub-Station*), Communication and Information Equipment, Security Systems**

Regular maintenance of the system will be conducted in accordance with the Maintenance Plan which would be prepared for the individual sub-system of the MRTS. This Maintenance Plan will be incorporated into the System Maintenance Plan during the Development Period.

Routine maintenance activities will be planned to limit any disruption to the operation of the MRTS with the highest level of attention applied to ensure the safety of any maintenance employees working on or near the track.

An unexpected failure on the System will be managed in accordance with our maintenance concepts outlined in the Business Plan.

In general, most routine maintenance tasks will be performed in the off-peak periods and at night at the cessation of normal service operations.

All regions and associated surrounding areas will be kept clean and tidy. These activities form part of the system maintenance plan in general and Track Maintenance Plan in particular.

In addition, the JV Company will ensure that the Asset Database is adjusted in accordance with any work done in this areas and monitor closely the Spare Parts Inventory as spares are used for replacement.



For safety and security purposes, access to the Depot sites, in particular the Central Control Room, will be restricted to authorised personnel only. This will be managed by the strict issue of passes and surveillance of usage.

Incidences of vandalism and intrusion will be reported to the local police authorities for their follow-up action.

#### **7.a.5.vii.b Buildings**

Regular inspections of the buildings and structures of the System will be conducted in accordance with the Buildings and Structures Maintenance Plan. This Plan will be incorporated into the System Maintenance Plan during the Development Period.

All buildings and structures will be maintained in a condition to meet regulatory and safety requirements.



*Source: Connex Light Rail Operation Sydney, Aust.*

Cleaning will be included in the Buildings and Structures Maintenance Plan and comprises:

- Keeping System paths clean of debris and litter.
- Removal of all rubbish (including the emptying of litterbins).
- Keeping the surrounding areas of all buildings and structures clean of debris and litter.

All work shall be performed to limit any disruption to the System operation or road users.



### **7.a.5.vii.c Maintenance of Rolling Stock:**

#### **Introduction**

The maintenance of the rolling stock of the Mumbai MRTS includes all preventive and corrective maintenance work for the whole fleet for the entire concession period. During the concession period all necessary wheel turning – depending on mileage – and all necessary revisions shall be carried out.

In our concept we have foreseen a new workshop to be build and operated to carry out the maintenance activities in the best way. The workshop infrastructure includes besides the necessary equipment for maintenance, the installation of a through passing external train wash plant as well as a underfloor wheel lathe for the wheel set re-profiling.

With the purpose to guarantee during the contract period a safe and reliable operation of rolling stock, the following services are also included:

- Responsibility for the maintenance of the fleet
- Set-up of the rolling stock for the daily operation as foreseen in the rostering schedule
- Internal and external cleaning of the rolling stock
- Preventive maintenance of the rolling stock as foreseen in the manufacturers technical handbook
- Corrective maintenance of the rakes including troubleshooting and failure elimination, repair/exchange or substitution of faulty components and replacements.
- Prescribed revision of the rolling stock during the contract period of 30 years and the foreseen overhaul works.
- Shunting and set-up of the vehicles inside the workshop.
- Set-up and updating of the maintenance history of all vehicles.
- Certification of the workshop according to ISO 9001 and necessary successive audits during the train operation concession period.
- Periodical inspections of the vehicles following the indications of the authorities and the manufacturer.
- Engineering-support of the vehicle manufacturer.
- Continuous update of the maintenance documentation and software.
- Continuous training of the maintenance staff.
- Operation and up keeping of the maintenance workshop.



### **Rolling stock – Operation and maintenance**

The operational concept and as well as the cost calculation are based on the following assumptions:

- The maintenance operations are carried out in the workshop (D.N.Nagar) during the weekdays.
- The cleaning of the EMUs takes place in the D.N. Nagar depot

### **Operations concept – Mumbai MRTS**

The realisation of an efficient and economical operation and maintenance of the rolling stock begins with a close and clear collaboration between train operation and maintenance. In particular the interface between the organisations should be regulated in a clear and simple way following the best practice and best effort principles. The optimised system layout is possible when the resource scheduling and the maintenance and cleaning layout are well coordinated.

The availability of the vehicles is the result of an optimised coordination between the operational needs and the maintenance. Thereby the operation is the pushing factor. The availability must be agreed and scheduled between operation and maintenance and be in line with the contractual requirements.

As indicated a certain number of rakes is every day in service and at least one rake is ready to be used in case of a vehicle break down and the others are in maintenance or in revision.

The maintenance organisation of Mumbai MRTS will make sure that during the operating hours the necessary number of rakes is available, especially during the peak hours: morning peak takes place from 08:00 to 13:00 and the evening peak from 17:00 to 22:00.

During the off-peak hours the unutilised rakes will be used for maintenance, if necessary, or be ready as operational reserve.

See also Annex 2 for the graphical presentation of the roster and the “maintenance window” available during the day. The same is indicative and shall be firmed up by the JVC at the time of commencement of operations.



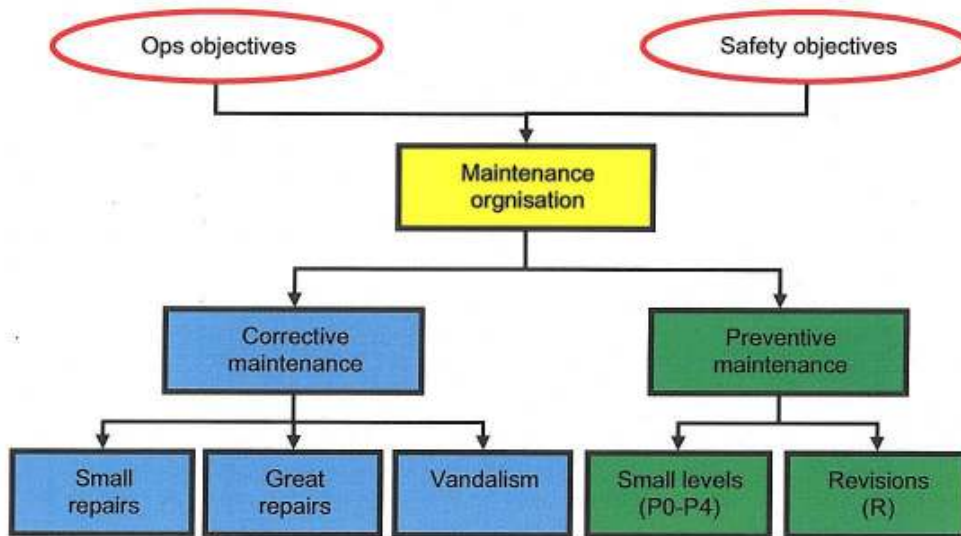
**Maintenance and cleaning**

**Principles of maintenance**

The maintenance concept for the vehicles should minimise the operational costs and the life cycle costs and simultaneously optimise the safety and the customer satisfaction. The maintenance is subordinated to the operation needs, the rational execution according to the needs.

The following chart presents the different correlations and types of maintenance:

**Figure 5 – Types of Maintenance & their Corelation**



The objectives of maintenance are the following:

- Safety in operation
- Reliability in operation
- Availability aligned to the operation
- Simple processes of the maintenance

The safety in operation for the passengers and the staff is hereby the most important point.

**Preventive maintenance**

The preventive maintenance concept is laid out in such a way to achieve the following objectives:

- Minimise failure and ensure components availability
- Maximise life of the equipment components
- Minimise maintenance costs



➤ Optimised availability

The required availability normally results from the operational concept of the vehicles. As this is not the case, some assumptions must be made. The maintenance department of Mumbai MRTS is responsible for the complete preventive maintenance of the EMU fleet. Based on the manufacturer's maintenance manual all necessary operations will be carried out in the maintenance workshop to guarantee a smooth train operation and the necessary operational availability as agreed.

The maintenance terms for each maintenance level for rolling stock are as in Table 12 below:

**Table 14 Maintenance Terms for different levels of Maintenance**

Description	Term (km)	Term (Days)
Lf		1
P0	---	7
P1	12'500	30
P2	37'500	90
P3	75'000	180
P4	150'000	360
R0	150'000	360
R1	1'050'000	2'520
R2	2'250'000	5'400

See also Annex 3 for the more detailed maintenance matrix. The same is indicative and shall be firmed up by the JVC at the time of commencement of operations.

All terms have allowances to permit, that for any vehicle the corresponding activity can be carried out according to the operational situation and its mileage. Depending of the usage of each vehicle either the time or mileage criteria reached first will trigger the respective maintenance activity. The execution of the maintenance operations will be planned by the maintenance workshop in coordination with the train operation management, to allow the same can enter in the vehicle dispatch.

A table with the sequence of all maintenance activities over a period of 30 years of operation is included in Annex 4. The same is indicative and shall be firmed up by the JVC at the time of commencement of operations.



## **Description of maintenance activities**

### **General**

In the following chapter all activities in the respective maintenance levels are described. In each level the activities of the lower maintenance level are included and have to be carried out as well. This means for example that in level P2 all activities of P0, P1 and P2 will be carried out.

An indicative table with all activities is included in Annex 5.

### **Lf – Daily check**

On a daily basis the train drivers will check the train every time before the train is put into commercial service in order to make sure that the train systems are working perfectly.

### **P0 – Interval: weekly**

The following activities will be carried out in this maintenance level:

Visual and functional inspection:

On the pit:

- Condition and fixing rail guard
- Condition and fixing coupler
- Condition and fixing magnets, function check
- Condition wheel set contact surface
- Condition bogies including brake elements
- Condition primary and secondary springs

Along the vehicle:

- Condition and function check sanding device, refill if necessary

In the vehicle:

- Condition passenger compartment (seats, push bottom door control, internal illumination)
- Function check windscreen cleaner
- Brake test

On the roof:

- Condition pantograph: check uniform wear of sliders

### **P1 – Interval: 12'500 km or approx. every 30 days**

The following activities will be carried out in this maintenance level in addition to those of level P0:





**In the pit:**

- Traction system gear: check oil level and leak tightness
- Condition and fixing magnetic rail brake, remove slate deposits
- Grease occasionally automatic coupler
- Wheel flange lubrication: function check and refill wheel flange lubrication oil

**Along the vehicle:**

- Function check external displays and loudspeakers
- Driver's cab air condition: filter pads substitution, grid high pressure cleaning

**In the vehicle:**

- Function check internal displays, emergency interphone and loudspeakers

**On the roof:**

- Visual check for damages of the roof
- Pantograph: check all connections, condition, fixing and suspension of compensator
- Circuit breaker: condition of insulators, contacts and sealings
- Pressed air cleaning of oil and water coolers
- Air conditioner: filter pad substitution; external grid high pressure cleaning
- Compressor: oil level check

**P2 – Interval: 37'500 km or approx. every 90 days**

The following activities will be carried out in this maintenance level in addition to those of levels P0 and P1:

**In the vehicle:**

- Extinguisher: condition, fixing and seal

**On the roof:**

- Air conditioner: air inlet and outlet trenches cleaning, if necessary
- Compressor: function test
- Air dryer: regeneration test

**P3 – Interval: 75'000 km or approx. every 180 days**

The following activities will be accomplished in line with this maintenance level in addition to those of levels P0 to P2:

**On the pit:**

- Wheel set contact surface: wheel flange thickness
- Wheel flange spray pattern check, visual check
- Brake: Function test, check of all clearances and settings, brake covering substitution if necessary
- Traction motor: visual check for external damage, of cool air emission, filter
- Automatic coupler: fixing, locking mechanism and height tolerance check, electric contact cleaning, air coupling leak check

**In and along the vehicle:**

- Corrosion protection check
- Converter: condition sectionator contacts
- Visual check gangway between the coaches
- Entrance doors: check for damages, retighten of all screwing, cleaning and lubrication of bearings, function check



- Driver's cab: check of seat screwing and function, check of safety and signaling devices
- Transformer: check of oil level, air dryer, Insulators and connections

**On the roof:**

- Heat exchanger (oil, water) high pressure cleaning
- High voltage roof installations visual control and cleaning
- Circuit breaker: operate water and oil separator
- Pantograph: contact pressure measuring

**P4 – Interval: 150'000 km or approx. every 360 days**

The following activities will be accomplished in line with this maintenance level in addition to those of levels P0 to P3:

**On the pit:**

- Magnetic rail brake: check electric cable, pressure pipes and connections
- Wheel flange lubrication: check condition of pipes, screwing and oil tank
- Check of damper and fixings
- Lift-off locking: check lift-off wires, split pin connection and parallel pin
- Motor bogie: visual check of parallel pin and split pin

**In and along the vehicle:**

- Wheel set bearing: visual check of wheel set bearing fixing, tightness
- Earthings: check for tightness of earthing cable
- Vehicle batteries: Measuring of acid density, if necessary exchange battery, cleaning and lubrication of connections, battery charge check
- Gangway between coaches: condition and fixings check
- Air condition driver's cab and passenger compartment: maintenance, cleaning and function check

**On the roof:**

- Traction converter: visual and tightness check of the cooling system
- Cleaning and treatment of the insulators
- Gangway between coaches: electric and pneumatic connections check
- Circuit breaker: check of high voltage and earthing connections and fixing screws
- Radio antenna: general condition and fixing check

**Revisions**

The revisions will be carried out after a certain mileage or time. The work included in this section range from wheel set re-profiling up to a small and a big revision.

Shortly before the end of the operations contract and the operation is handed over to MMRDA a small revision will be carried out on the coaches in order to assure the operation of all coaches beyond the end of the operations period of MRTS.

**R0 - Wheel set profile turning**

The wheels of the rakes have to be re-profiled. The foreseen period for this operation is at 150'000 kms and is based on the assumption, that tracks and permanent way is laid out and maintained following the UIC regulations. We have also assumed normal climatic conditions.



The right moment for the wheel set profile turning will be determined by the maintenance management considering the wear of the wheel tire.

The installation of an under body wheel set lathe in the new maintenance workshop is foreseen for the wheel set profile turning

**R1 – Small revision, interval: 1'050'000 km or every 7 years approximately**

The maintenance concept foresees the small overhaul after a mileage of respectively 1'050'000 kms. The complexity of the respective overhaul is assessed to guarantee the operation safety as well as the vehicle's life cycle as established in the operation contract

The operations during the small revision include amongst others:

- Substitution and overhaul of the bogies
- Substitution and overhaul / rediscing of the wheel sets
- Substitution and overhaul of the automatic coupler
- Substitution and overhaul of the brake components
- Substitution and overhaul of the pantographs
- Substitution and overhaul of the compressor
- Substitution and overhaul of the rubber cushions in the drive
- Substitution and overhaul of the damper in the drive
- Substitution of the bearings of the rotating parts

**R2 – Major revision**

A major revision is necessary after a mileage of 2.25 million kms or 14.8 years approximately. The complexity of the respective overhaul is assessed to guarantee the operation safety as well as the vehicle's life cycle as established in the operation contract

The operations during the major revision include amongst others the activities of the R1 described above as well as the refurbishment of the interior and the exterior painting of the coaches.

**Corrective maintenance**

The maintenance concept includes all operations of corrective nature for the fleet of the rolling stock, in other words those operations that occur in an unprogrammed way. The maintenance includes in particular:

- Trouble shooting and elimination in all stations of the network of the tender specification
- Repair of failures and damages resulting from defective components or subsystems as well as of vandalism

Depending of the nature and the effect a failures has, the maintenance organisation decides on the spot if the corresponding activity has to be carried out immediately or during the next planned stop of the rake accordingly to the operational situation an its mileage. The execution of the maintenance operations will be planned by the maintenance workshop in coordination with the train operation management to allow coordinate the maintenance operations with the rostering planning.



## Cleaning

### **Internal cleaning**

Concerning the cleaning activities, the rolling stock will daily and periodically be cleaned and prepared for operation in the maintenance workshop.

The internal cleaning schedule terms are defined as follows:

**Table 15 Internal Cleaning Schedule**

Denomination	Interval (days)
Small cleaning (KR)	1
Basic cleaning (GR)	7
Basic cleaning 1 (GR1)	60
Basic cleaning 2 (GR2)	120

#### **Small cleaning (KR), Interval: daily**

The following activities will be carried out daily in line with the small cleaning level in the maintenance site:

- Empty all garbage bins
- Collect visible dirt
- Clean windows and frames
- Clean seats and backrests

Furthermore the following activities will be carried out:

- Inspection of the vehicles, refill of sand tanks and repair minor damages.

#### **Basic cleaning (GR), Interval: 7 days**

The following activities will be carried out weekly in line with the basic cleaning level in the maintenance site:

- Clean windows & frames completely
- Clean completely the divisory walls, frames
- Clean seats and backrests punctually
- Wipe humid floor covering
- Empty all garbage bins

#### **Basic cleaning 1 (GR1), Interval: 60 days**

The following activities will be carried out every 60 days in line with the basic cleaning level 1 in the maintenance site:

- Clean floor covering exhaustively
- Spray, wipe and air well ceiling
- Empty and wash out all garbage bins



***Basic cleaning 2 (GR2),***

***Interval:120 days***

The following activities will be carried out every 120 days in line with the basic cleaning 2 level in the maintenance site:

- Clean divisory walls
- Apply manually on wagon body external, corners, front end

A table with all activities is included in Annex 6 wherein an overview of the sequence of the cleaning activities is included. The same is indicative and shall be firmed up by the JVC at the time of commencement of operations.

***External cleaning***

The external cleaning is carried out every 7 days in the pass through washing plant

***Wear and substitution limits***

The wear and substitution limits of the singular parts, components and devices are listed in the maintenance manual. This manual will be compiled by the JV Company.

***Usage of pits and tracks***

For all maintenance and cleaning activities the necessary planning of track and pit occupation has already been done. In Annex 7 (maintenance) and Annex 8 (cleaning) the track occupancy for the respective activities is being planned and indicated. The same shall be firmed up by the JVC at the time of commencement of operations.

The rakes will be moved between the various tracks and pits by the shunting personnel of the depot.

***Procedure in case of failure during operation (defects etc.)***

***Introduction***

The quick resolution of events that cause interruptions is of central interest to the operator that is operating on high quality levels. The effective work of the emergency management envisages a close and constructive collaboration between the departments of:

- Providing Infrastructure
- Passenger information
- Sales department
- Maintenance management
- Vehicle and train driver management

In case of interruptions the client's satisfaction can increase if provided specific and needed information.



To regulate the collaboration and to guarantee the most important functions – which can easily be forgotten in the stress to overcome the interruption – it's necessary to describe the flows in a process diagram and to introduce it in the organisation.

The purpose of the interruption management is to overcome the events in an efficient and effective way increasing the users satisfaction.

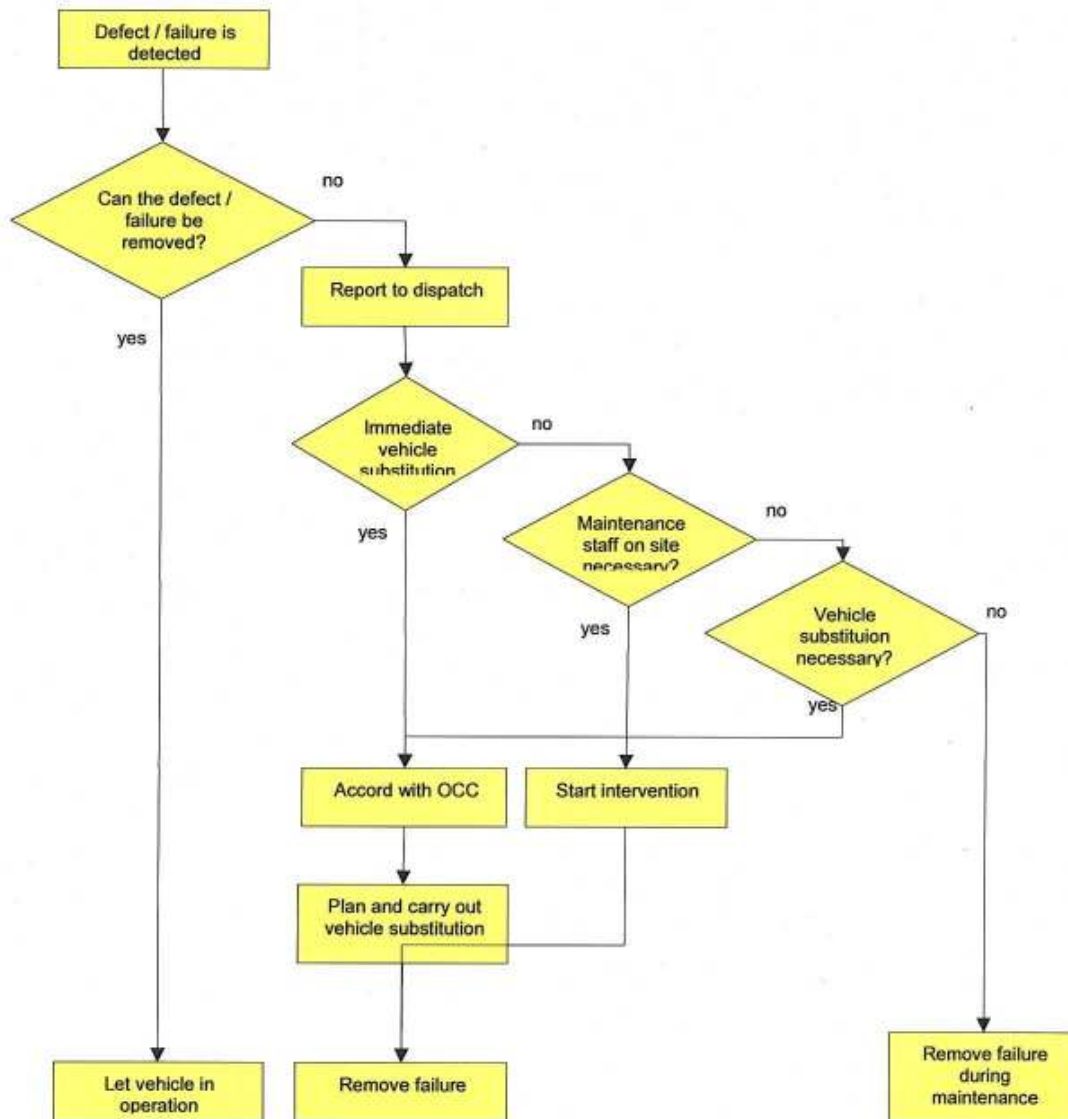
Hereby even the maintenance is an important sector. The rational and early resolution of disruptions is the focus of all efforts.

***Process description***

The maintenance reacts to the disruption reports on basis of the importance and the urgency. Thereto following process flow will be introduced at commencement of operations.



**Figure 6 Disruptions - Process Flow**



**Quality management**

The quality monitoring system is based on the achievement of the ISO 9001 certificate. This certification will be obtained at the shortest possible time after commencement of operations.

**Customer satisfaction**

The basis of customer satisfaction is the contact person. For MMRDA, contact points will be periodically defined and determined in line with the contract terms. Thus upcoming problems can be solved in the shortest possible way involving the concerned person. In addition MRTS offers periodic coordination talks for the achievement of the customer satisfaction,



which can be carried out in short intervals namely in special situations like in the start up phase or during optimising passes.

**Organisation**

**Introduction**

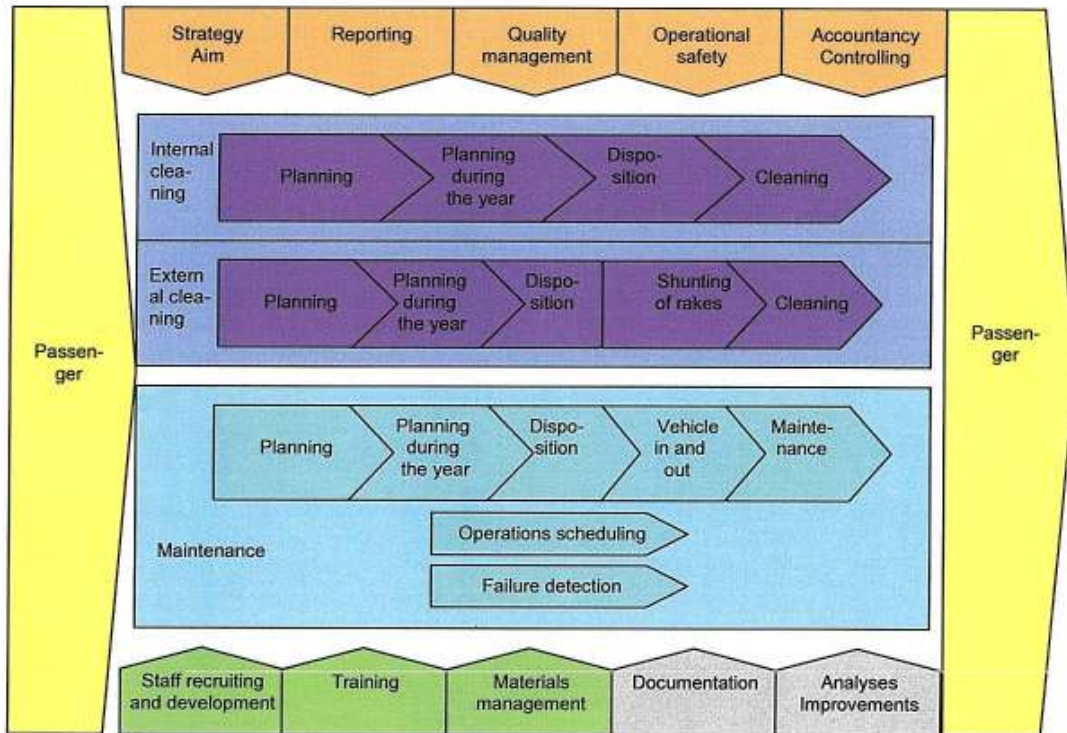
The maintenance organisation has the objective to put at disposal the vehicles in the right number, the right quality, the right moment and the right site. Obviously this task should be carried out as efficient as possible.

**The process landscape**

The customers of the maintenance organisation are on one hand the operating team, which employs the vehicles, and on the other hand the passengers. Depending on the organisation form and the installed measuring system the passengers are indirect customer.

In consideration of the objectives of the maintenance organisation the process landscape of the maintenance can be presented as follows:

**Figure 7 Maintenance Organisation – Objectives**



**Maintenance organisation structure**

The structure of the maintenance department on one hand follows the processes and on the other hand the strategy and orientation of the company.





All maintenance activities are under the lead of the maintenance officer which is responsible for the maintenance of the rolling stock of MRTS.

The necessary training for the newly recruited staff will be in line with the jobs to be performed on the vehicles and the related systems (maintenance software etc.).

The training needs of all involved staff categories will be determined and the training periods identified

To cover all needs, the training will be prepared in modules and all needs will be introduced in a matrix:

**Table 16 Training Matrix**

	Maintenance Mechanics	Maintenance Electricians	Cleaning staff	Shunting staff	Maintenance Back office	Station staff
Electrical basic principles	X	X		X		
Mechanical basis principles	X	X		X		
Electric traction components	X	X		X		
Energy supply, overhead wire	X	X		X		
Dangers of electric current	X	X	X	X	X	X
Brake system	X	X		X		
Vehicle construction	X	X		X		
Mechanical part, coupler	X	X		X		
Electrical part, traction concept	X	X		X		
Brakes (pneumatics, spring brake)	X	X		X		
Doors	X	X				
Communication, passenger information	X	X		X	X	
Equipment and components	X	X		X	X	
Diagnostic systems	X	X		X	X	
Safety equipment	X	X		X	X	X
Suspension system	X	X				
Handling of the vehicle (driving)				X		
Movement of the vehicle	(X)	(X)		X		
Coupling / uncoupling	X	X		X		
Trouble shooting via diagnosis	X	X		X		
Trouble shooting	X	X				

The details will be established later on.

### Planning and Control

The importance of the maintenance organisation and the processes involved should not be underestimated during the construction and start up phase and are decisive in the introduction of a maintenance software. A holistic view of the environment and the



interaction with all departments of the firm as well as of local circumstances should be considered, for the achievement of the contractual benchmarks like availability and reliability.

The JV Company will establish the processes from the beginning and introduce them at the start up phase. For this reason a Workflow Management System (WMS) for the maintenance of rolling stock enables the integration of all processes of fault recording, troubleshooting, cost recording and evaluation in a single tool and make it easier for employees in the workshop through the simultaneous optimization of processes. WMS builds on existing work processes in the maintenance area and helps avoid media breaks and duplicate data acquisition.

The WMS is set up so as to simplify work processes for job tracking and failure analysis as well as the input of data on the individual rail vehicles. This enables more efficient planning and control of the maintenance tasks as well as flexible preparation of evaluations and reports.

The WMS helps the maintenance organisation to plan and carry out its tasks:

- **Up-to-date:** All data remains permanently located in the database, thus allowing comprehensive evaluations over longer time periods. The only limitation is in the capacity of the server. This can latter be expanded if needed. The database is equipped with security and alarm functions so that possible expansions can be conducted in time.
- **Analysis:** For analysis and data evaluation, the possibilities are endless. In addition, the analyses is largely simplified or even automated. Evaluations no longer have to be carried out from lists (limitation of MS Excell!), but can be computed directly in the database.
- **Media breaks:** With the system's seamlessly joined desktops, media breaks and the associated potential sources of errors are eliminated.
- **Workflow:** The application constitutes an optimal foundation for a smooth, high-grade workflow, allowing a marked increase in the efficiency and quality of performed jobs.

The following work process describes the WMS with its input and output data. With the "Planning & Control" component, the WMS supports the employees' daily work processes in the areas of maintenance:

**Figure 8 WMS Process Map**



The heart of the workflow management system is the central SQL database. All operational details are administrated and controlled by this database. The level wise data elaboration guarantees, that the right information will be at the right moment in the right place and that the objective oriented dialogue will be maintained.

The WMS features the following modules:

**Figure 9 WMS Components**



The above modules and work processes are indicative and will be selected and prepared during the set-up phase of the workshop.



### **7.A.6 Disaster Management Plan**

A Disaster/Hazard Management System is essential for managing operational safety risks and ensure that MRTS assets are safe to operate throughout their asset lives . International benchmarking will be conducted to ensure that this new metro line is able to meet highest standards in terms of its performance, safety and service reliability.

During the development phase, the specific safety requirements and hazard assessment are stipulated in the contract documents. These requirements describe clearly the required analyses and tasks that must be performed to accomplish the safety objectives.

Consultants and contractors are required to identify safety and service hazards relevant to their designs and review relevant hazards identified by REL. This task provides valuable inputs to the system specifications, and involves the following:

- Determining previously achieved safety performance of similar/relevant equipment,
- Reviewing relevant entries in existing hazard registration system,
- Evaluating relevant in-service safety data,
- Conducting HAZOPs to identify major inherent hazards, and
- Compiling hazard logs.

Quantitative Risk Analyses or high-risk complex scenarios and Cost Benefits Analyses on remedial actions that are costly or have significant impact on railway operations will be carried out as needed in order to identify cost-effective mitigation measures using the As Low As Reasonably Practical [ALARP] principle.

A Project Hazard Registration System [PHRS] will be established for registering and tracking all hazards identified during the project stage. The PHRS records the causes and impact of a hazard and the status of the design measures for mitigating the hazard.

To support the safety management and operation of the MRTS, a System Safety Report will be produced to provide an overview of the safety management systems and the key safety issues in the design, construction, commissioning and operations. It would provide documented evidence to demonstrate whether appropriate safety management processes and arrangements are in place, hazards are systematically identified and controlled, risk to passengers, staff and others are ALARP, and the operator is prepared to manage all residual hazards and foreseeable emergency situations.

A manual titled "Accident, Incident and Emergency Procedures Manual" will be produced to describe various kinds of disaster, risks, hazards and requisite procedures to be followed by the front line staff in handling such emergency situation. This manual will contain, inter alia, detailed operational information and procedural guidelines relating to the following key areas and major types of incidents.



- Reporting incidents and action required.
- Major incident control (roles and responsibilities of different parties, set up of investigation team, preservation of evidence etc.)
- Minor accident and incidents (e.g. electric shock, unconscious/injured person)
- Person/object hid by train.
- Train divided.
- Detrainment.
- Handling threats/attack of bombs and unidentified gas/substance.
- Incidents involving flooding.
- Incidents involving fires or fusing.
- Handling fires in depot.
- Evacuations for station, viaduct and depot.
- External accidents.
- Handling overhead line or power supply failures.
- Handling door/signalling irregularities.
- Handling hijack of train.
- Handling earthquake and other natural disasters.
- Conveying police and fire services to incident location.

The following section contains definitions and examples to help the operating staff of Mumbai MRTS to identify various types of incidents and accidents which may occur on the operating railway.

**Undesired event**

It is an event or a series of events which deviate(s) from the intended mode of operation, situation or status.

**Incident**

It is an undesired event which results in :

- disruption to service or process, and/ or
- damage to property or environment.

**Minor Incident**

it is an undesired event which results in :

- short delay of less than 5 minutes to the train service, or
- small amount of damage to the property of the operating railway



**Serious  
Incident**

It is an undesired event which results in :

- delay to the train service :
  - of 5 minutes or more, but
  - less than 20 minutes, or
- severe damage to the property of the operating railway.

**Major  
Incident**

it is an undesired event which:

- result in an initial delay or disruption to passenger train service :
  - of 20 minutes or more, and
  - showing no immediate opportunity for resumption of service, and

requires the closure of the station or part of the running line.

**Example:** The following may be classified as major incidents, provided the above definition applies.

- immobilised train
- trackside fire
- train divided
- overhead wire breakage or displacement
- broken rail requiring immediate replacement
- serious flooding
- any occurrence causing widespread public concern, or
- action by police and fire brigade

**Accident**

It is an undesired event which is likely to result in the injury to person (s).

- derailment
- collision
- train fire

**Minor  
accident**

It is an undesired event which results in minor personal injury requiring first aid or emergency service assistance, e.g. scratch or bruise.

**Serious  
accident**

It is an undesired event which results in :

- fatality, or
- serious injury



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**Near miss** It is an incident in which some equipment or safety measures have failed, and could have resulted in an accident but didn't.

---

**Amber alert** Amber alert is defined as an early warning for an incident which could lead to a serious disruption of service. The recipient of an 'Amber alert' should alert its emergency unit, prepare for possible emergency action in short notice and keep in touch with the source operator.

**Note:** For mainline train service, a "serious disruption of service" means:

- reduction in the capacity of any line by 20 % or more during the peak, or
  - closure of stations for 10 minutes and above, under circumstances not covered in the previous sections.
- 

**Red alert** Red alert is defined as a signal to indicate that a serious disruption has continued or is expected to continue for over 20 minutes, and emergency transport support services from other operators are required. Upon being alerted, the recipient should urgently mobilise their resources to provide appropriate supporting services as quickly as possible.

---

**Emergency** An emergency is an unexpected, difficult or dangerous incident which

- requires immediate action
- the staff feel unable or incapable of controlling, or
- could lead to serious injuries.

---

**Assault** An assault is a sudden attack against a person or his/her rights involving :

- verbal threat, or
- physical violence.

---

**Dangerous** A dangerous occurrence may also be classified as a minor, serious or major incident, depending on :

---



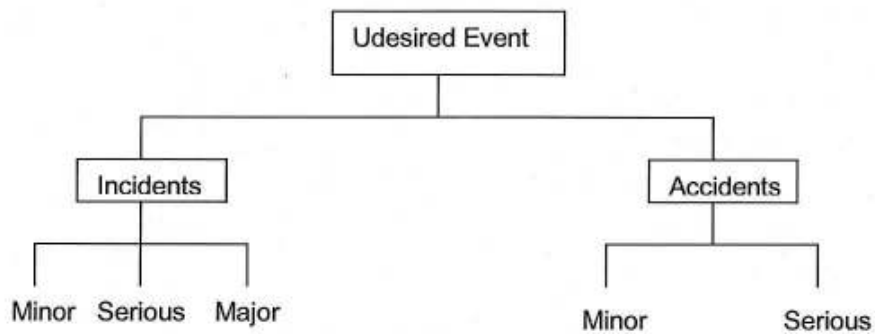
**occurrence**

- the level of damage incurred.
- any resulting personal injuries, or
- any train service interruption

Dangerous occurrences are defined in the relevant railway ordinance or occupational safety and health regulations.

For clarity the following pictorial representation is provided:

**Figure 10**



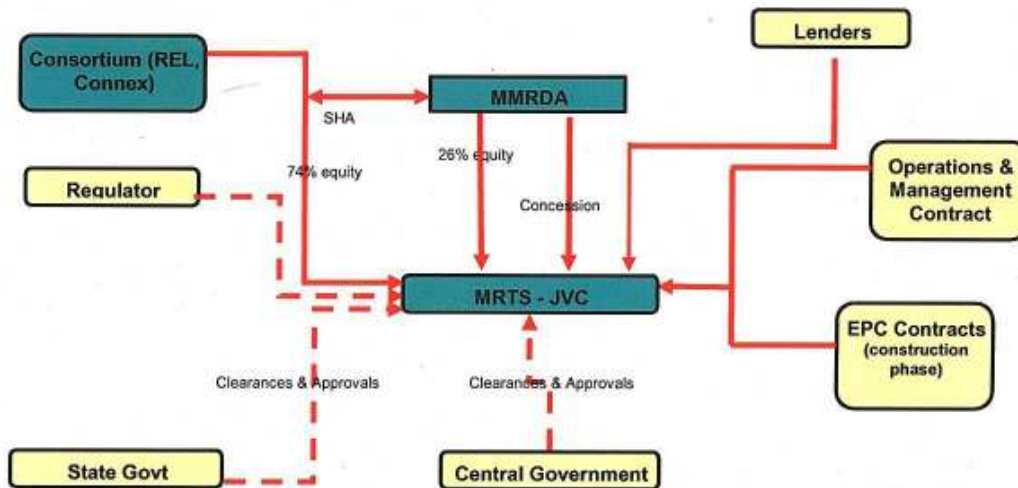


### 7.A.7 Institutional Arrangement

To Mumbai MRTS is expected be operational within 5 years from the date of signing of the concession agreement between MMRDA and the preferred bidder.

The Reliance – Connex JV Company will set up a JV company with 26% shareholding of the MMRDA. The contractual structure is expected to be in the form as depicted in the chart below:

Figure 11 Institutional Interfaces



REL and its associates shall hold 69% and Connex shall hold 5% equity in the JV Company (JVC). The balance 26% shall be subscribed to by MMRDA. The shareholding shall be governed by the Shareholders agreement between the JVC and the shareholders.

MMRDA shall execute the concession agreement with the JVC. The JVC shall enter into EPC contracts for construction & Operations and Management (O&M) contract for operating the MRTS. The O&M contract may be a single contract covering the entire aspects of the MRTS including maintenance etc. Several small sub-contracts will cover individual areas like security, housekeeping etc within the guidance and supervision of the O&M contract.

The lenders to the project will provide funding to the JVC under the loan agreements.

The JVC being an independent entity shall execute the project and perform the obligations as envisaged in the concession agreement between the JVC and the MMRDA.

The MRTS system is expected to be operated by a specialist group in Train Operations eg Operating Company (OC). To optimise the Operations cost, a combination arrangement of management fees to the OC for their expertise and inhouse internal administration & controls of all other functional areas shall be adopted.



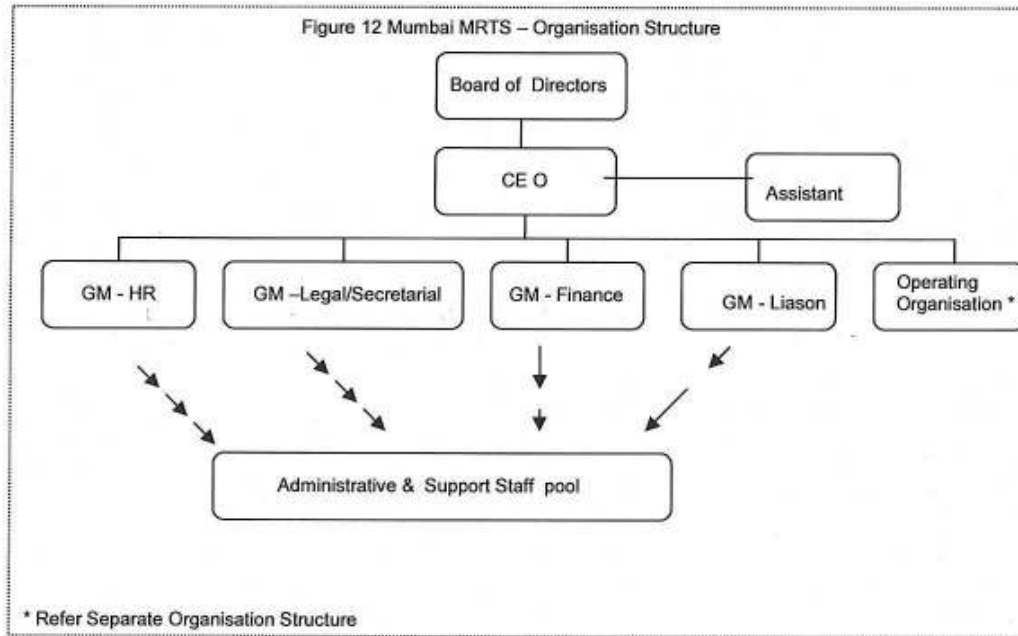
The Operation Company could also be a joint venture between REL & Connex by pooling their experiences & capabilities. Excepting the train operations, REL shall take care of all other aspects of the above mentioned joint venture. Connex shall be responsible for the complete train operations and training and development of the drivers, operations controllers and such critical personnel.

The MRTS will function within various policies and guidelines (labour, working hours, law and order, pollution, waste disposal, licensing agreements with various concessionaire etc) issued by the State / Central Government. Additionally the regulator is also expected to oversee / guide the fare fixation for the MRTS.



### 7.A.8 Organisation Structure & Manning Schedule

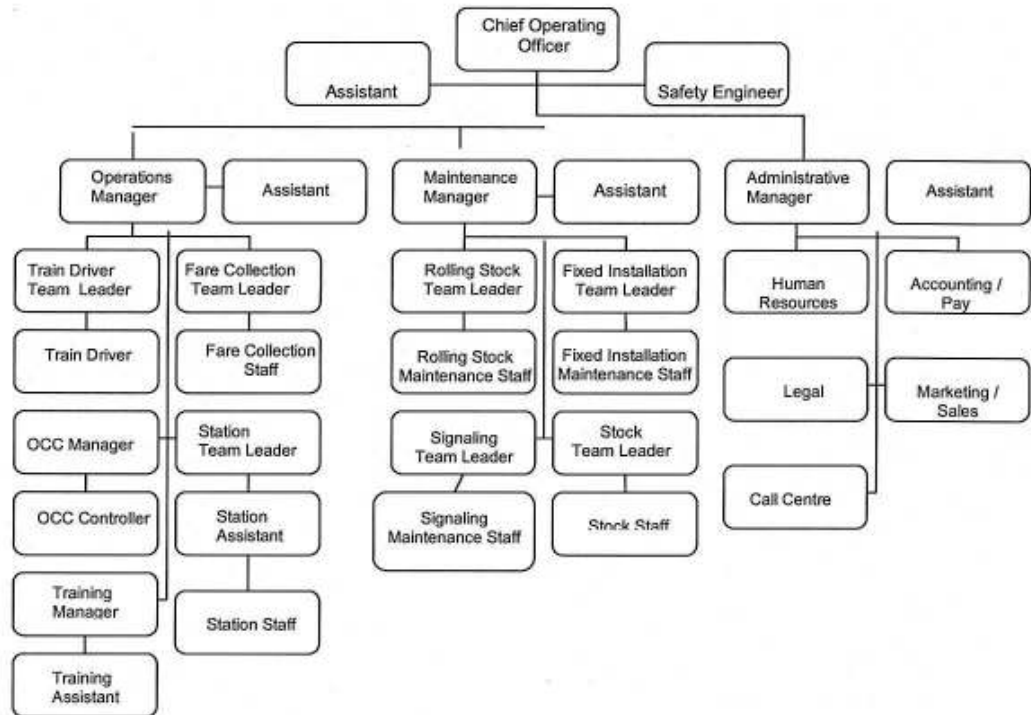
#### Organisation



Various General Managers (GM) would report to the Chief Executive Officer (CEO) for their areas of responsibilities. The CEO would be the single point of authority, reporting to the Board of Directors.



Figure 13 Structure - Operating Organisation



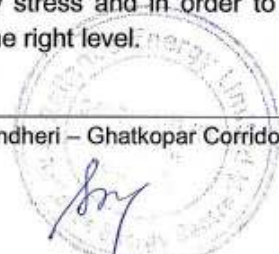
This organisation would assume wherever its is economic to do so, certain level of sub-contracting, like the cleaning of stations and trains.

The operating structure will be headed by a Chief Operating Officer (COO) , who for the initial few years, will be an expatriate from Connex, having vast experience in the field of operations of MRTS or similar and shall be replaced later by a CEO from India , with possibly first experiences gained in India.

The Safety Engineer will directly report to the Chief Operating Officer in order to guarantee the maximum freedom and objectivity in this particularly sensitive question. His duty will be mainly safety (safety case, incident reports organisation, incidents analysis, validation of procedures).

He will also be involved in training as training and qualification are key factors of a safe operation.

The organisation will be process-oriented when it comes to routine operation of services, but is in other respects function-oriented to ensure that the train service has adequate management capacity both for normal operation and on such occasions when the organisation is faced with extraordinary stress and in order to apportion responsibility for safety and the working environment at the right level.



## **GENERAL TEAM ORGANISATION**

The proposed staff organisation will provide the required organisational, maintenance and scientific roles necessary to ensure regulatory compliance standards and treatment performance guarantees are achieved.

The MRTS will be operated with standards, systems and procedures promoting operational and maintenance best practices.

Health and Safety employee training and development policies appropriate to this contract will be implemented.

The organisational structure to operate the works will be based around multi-disciplined personnel and team flexibility.

Continuing development and instilling a sense of responsibility in all personnel is the key to building an effective staffing strategy. The transfer of skills and the development of a multi-skilled, self-governing and monitoring workforce are paramount to JV Company's approach to long-term operations management.

All personnel will be expected to take responsibility and accountability for their work. This philosophy will be actively encouraged by the JV Company and reward self-initiative and commitment. This approach tends to promote greater job satisfaction and an improved working environment.

Personnel will be required to provide 24-hour cover in the OCC with other personnel being either present or on-call at home under a turning schedule.

The on-duty operator will act as the first-line response to alarm situations. The operator will call the Manager depending on the nature of the situation.

The qualifications and experience of the staff will comply with the Tender requirements objectives.

The JV Company in consultation with the operator will develop full operational guidelines, standards and policies in line with those developed for other Metros operations worldwide.

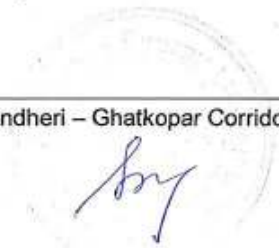
### **Manning Schedule**

The Board of Directors and the CEO of the JV Company shall be established immediately on formation of the Company. The first level reports of the CEO shall be inducted into the JV Company within 2-3 months of execution of Concession Agreement.

  
*[Handwritten signature]*

The personnel required for construction (refer figure 2) of the MRTS project shall be deployed within a period of 3-4 months of signing the Concession Agreement. These personnel shall be experts in their respective areas and shall, post commissioning of MRTS, could form a part of the MRTS.

The operations organization as seen in the Figure 11 above shall be gradually built up from later part of year 2 of construction. All the positions will be filled up well in time before the commencement of trial runs.



### 7.A.9 Marketing Strategy

The traffic problem has tremendous effects on the way of life of citizens of an area, causing both physical and mental stresses. The environmental impact from the Mumbai traffic, especially air pollution, not only causes health problems, but also economic losses, such as wasted energy and opportunities. There are certain immeasurable costs of the quality of life that are becoming more and more critical and are now being given increased weightage by the local population.

The MRTS project is one such project that is expected to provide multi faceted benefits, main among them being:

- Reduced travel time between Versova to Ghatkopar (from 1 hour by bus and 40 minutes by auto) to 21 minutes
- Convenient, comfortable and safe mode of transportation.
- Reduced pollution due to reduction in the frequency and number of busses / cars / autos etc.
- Increased economic activities – near and at the stations.
- Local area development

The survey conducted at the time of ridership estimation shows that the local population is willing to use the MRTS so long as the fare is in the range as available in public modes of transport. Due to the benefits enumerated above the MRTS will also be a self marketing project. Improved connectivity in the area would spur further development that would in turn result in increased usage of the MRTS.

JV Company shall monitor passenger needs, changes in the operating environment and market competition. Market research and customer surveys will be regularly conducted to gauge customers' view of the service standards and image. Marketing campaigns will be implemented to promote patronage on the MRTS, new services and the operator's corporate image/identity, similar to the approach adopted by operators / developers worldwide. Information on passenger travel that is collected from the AFC and smart card system will be used to develop promotions customised for different passenger groups. Rechargeable and pre-paid cards would be introduced for the convenience of the regular users of MRTS.

Operational promotion comprising the following initiatives shall be undertaken to improve customer service and hence support revenue growth forecasts.

- Clear communication of brand values through the promotion of the operator's clear, strong identity.
- Improve the profile of the MRTS through station managers developing stronger links with the local community.
- Direct advertising to existing customers through timetables, literature and posters at stations and on trains.
- Direct advertising to existing and potential customers through local media channels, principally newspaper and radio.
- Frequent liaison with public bodies and passenger groups, including the establishment of face-to-face "Meet the Manager" sessions and a formal Passenger Liaison Group.
- Improved public relations and customer contacts.



The competing modes of transportation will co-exist. It is intended to regularly interact with the BEST so that BEST starts / provides additional services from the various stations to the different destinations (feeder services). This will ensure improved connectivity to the passengers of MRTS and at the same time provide commercially viable increased loads to the BEST.

The stations provide an excellent additional resource generation opportunity due to the movement of the large number of people. The Concession agreement permits 100 mt<sup>2</sup> of area to be utilized per station for commercial activities. The JV Company envisages beverage stalls, refreshments / snack counters, infoservices kiosk (mobile, photocopy, STD/ISD, travel agency, one minute photoshop), etc to be set up at various stations depending upon the originating / departing traffic.

Preliminary layouts of the stations have already been furnished to MMRDA alongwith the Technical Bid,

The large number of people using the MRTS corridor for their daily commuting provide a captive audience for the advertisement displays. This potential shall be harnessed considering some revenue from hiring out of space at platforms for advertisement hoardings. Additional revenue from advertisement rights within the trains is also being considered as a source of revenue for the JV Company.

The MRTS would provide a complete and satisfying traveling experience to the users, thereby setting benchmarks for future MRTS systems in the country.





## Conclusion

Established and operated by a combination of high level development, operation and management capability of Reliance and Connex together with MMRDA, the Mumbai MRTS would set standards and benchmarks which could be used to assess future MRTS projects.

Additionally the international expertise of Connex will be available to the JVC to ensure that the procedures and plans as used in Mumbai MRTS are the continually improved/updated resulting into high standards of Safety and Reliability.

Commercial utilization of the permitted space, innovative advertisements, co branding possibilities on Smart Cards , proactive interactions with BEST etc would enhance the viability of the MRTS Project.

Reliance and Connex are fully committed to making this MRTS Project a big success and the system a world class system through fullest commitment of their strengths , capabilities and management support.



## Annexures



**Annexure 1**

**Construction Schedule (PERT Chart)**



Activity Name	Original Start	Planned Start	Week
<b>PRINCIPLE CONCESSION AGREEMENT</b>			
A1000 LETTER OF INTENT FROM BARRON	01-05-Feb-06	13-Mar-06	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
A1010 FINALE CA	01-11-Feb-06	13-Mar-06	
A1020 EXECUTE CA	01-14-Mar-06	13-Mar-06	
<b>FINANCIAL ARRANGEMENT</b>			
A1030 NEGOTIATIONS FOR FINANCIAL ARRANGEMENT	180 14-Mar-06	08-Sep-06	
A1040 FIN-FINANCIAL CLOSE	0	08-Sep-06	
<b>DESIGN &amp; PROCUREMENT</b>			
A1050 APPOINTMENT OF CIVIL PROOF CONSULTANT	32 11-Feb-06	14-Mar-06	
A1060 PREPARATION OF CIVIL TENDER DOCUMENTS	36 16-Mar-06	13-Apr-06	
A1070 TENDERING & AWARD OF CIVIL CONTRACT	46 18-Apr-06	12-May-06	
A1080 GEO TECHNICAL INVESTIGATION	36 11-Feb-06	12-Mar-06	
A1100 APPOINTMENT OF PM CONSULTANT	46 11-Feb-06	11-Apr-06	
A1110 TENDERING FOR ROLLING STOCK & AWARDS	120 12-Apr-06	09-Aug-06	
A1120 TENDERING FOR ONE & AWARD	120 12-Apr-06	09-Aug-06	
A1130 TENDERING FOR SIGNALING & TELECOM & AWARDS	90 12-Apr-06	10-Jul-06	
A1135 TENDERING FOR APC SYSTEM & AWARD	90 12-Apr-06	24-Jul-06	
<b>CIVIL CONSTRUCTION</b>			
A1140 DETAILED ENGINEERING	180 15-Jan-06	22-Sep-06	
A1145 CONSTRUCTION COMMENCEMENT	0 10-Sep-06	09-Dec-06	
A1150 WAY STRUCTURE	720 10-Sep-06	29-Aug-06	
A1155 CAR DEPOT	360 10-Sep-06	09-Sep-06	
A1160 STATION BUILDINGS	640 08-Mar-07	29-Aug-06	
A1170 SERVICE BUILDINGS & SHEDS	720 10-Sep-06	29-Aug-06	
A1180 TRACK WORK IN CAR DEPOT	160 10-Oct-07	07-Mar-08	
A1190 TRACK WORK ON WAY STRUCTURE	360 25-Sep-07	28-Sep-08	
<b>ROLLING STOCKS PROCUREMENT T&amp;C</b>			
A1200 DESIGN & DEVELOPMENT	360 10-Sep-06	08-Aug-07	
A1210 MANUFACTURE OF FIRST TRAIN PROTO TYPE	180 04-Aug-07	02-Feb-08	
A1215 PROTO TYPE TESTING & FINAL DESIGNS	60 04-Feb-08	05-May-08	
A1220 DELIVERY OF FIRST TRAIN SET	120 04-May-08	02-Sep-08	
A1225 DELIVERY OF BALANCE TRAIN SETS	180 19-Feb-09	17-Aug-09	
<b>OH ELECTRIFICATION &amp; GENERAL ELECTRICAL WORKS</b>			
A1300 POWER SUPPLY AGREEMENT	17 14-Mar-06	20-Mar-06	
A1330 SS CIVIL WORKS & CABLE LAYING	180 10-Sep-06	04-Apr-07	
A1340 TRANSFORMER DELIVERY & INSTALLATION	160 10-Oct-06	07-Apr-07	
A1350 SS COMMISSIONING	26 08-Mar-08	07-Apr-08	
A1360 CAR DEPOT ELECTRIFIED	120 08-Jan-08	09-May-08	
A1365 WAY STRUCTURE ELECTRIFIED	362 20-Oct-07	24-Oct-08	
A1370 ELECTRICAL SERVICES FOR STATIONS & BUILDINGS	160 01-Jan-08	27-Nov-08	
<b>SIGNALING &amp; TELECOMMUNICATION</b>			
A1400 DESIGN OF SIGNALING SYSTEM & TELECOM INTERF.	120 14-Mar-07	21-Sep-09	
A1405 MANUFACTURING OF SIGNALING	270 14-Mar-06	03-Dec-06	
A1410 SIGNALING & TELECOMMUNICATION INSTALLATION	720 24-Jan-07	04-Sep-07	
A1415 DELIVERY & INSTALLATION OF OOC EQUIPMENT	720 24-Jan-07	13-Jan-08	
A1420 DELIVERY & INSTALLATION OF TELECOM EQUIPMENT	720 24-Jan-07	13-Jan-08	
A1430 DELIVERY & INSTALLATION OF APC EQUIPMENT	720 24-Jan-07	13-Jan-08	
A1440 SYSTEM INTEGRATION TEST	90 23-Jan-06	21-Sep-06	
<b>TEST AND TRIAL RUNNING</b>			
A1580 TEST RUN COMMENCEMENT	0 01-Oct-08	20-Dec-08	
A1590 TEST RUN	90 01-Oct-08	20-Dec-08	
A1591 TRIAL RUN	90 20-Dec-08	20-Dec-10	
A1600 COMMERCIAL OPERATION	0	21-Mar-10*	

Actual Work █ Critical Remaining Work █ Summary

Forecasting Work █ Milestone ●

Page 1 of 1 Task View All Activities

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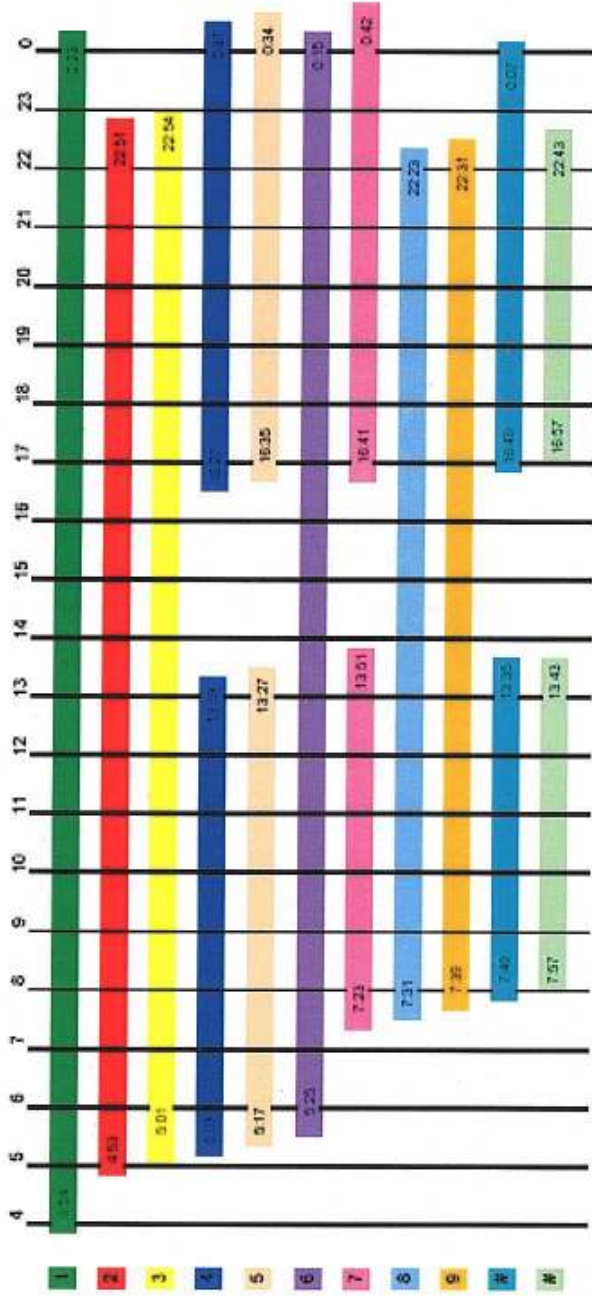
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**Annexure 2**

Rooster & Maintenance Window during the day



**Roster for start of operation**



Note: Operation start times are on the timeable sheet



**Annexure 3**

**Maintenance Matrix**



**Maintenance Matrix for 4- and 6 coach rake**

Level	Term		Includes the works of										
	[km]	[Days]	Lf	P0	P1	P2	P3	P4	R0	R1	R2	R1+	
Lf		1	x										
P0		7	x	x									
P1	9,511	30	x	x	x								
P2	28,534	90	x	x	x	x							
P3	57,068	180	x	x	x	x	x						
P4	114,137	360	x	x	x	x	x	x					
R0	114,137	360							x				
R1	798,957	2,520								x			
R2	1,712,052	5,400								x	x		
R1+	3,081,693	9,720								x		x	

Mileage figures based on first year of operation





**Annexure 4**  
**Sequence of Maintenance Activities (30 Years)**



Mumbai Metro One

**Annexure 4**

**Succession of maintenance activities over 30 years**

Year	Month	Mileage [km]	Maintenance level															
			Lf	P0	P1	P2	P3	P4	R0	R1	R2	R1+						
1	1	9,644			1													
	2	19,287			1													
	3	28,931			1	1												
	4	38,574			1													
	5	48,218			1													
	6	57,861			1	1	1											
	7	67,505			1													
	8	77,148			1													
	9	86,792			1	1												
	10	96,435			1													
	11	106,079			1													
	12	115,722			1	1	1	1			1							
2	13	125,366			1													
	14	135,009			1													
	15	144,653			1	1												
	16	154,296			1													
	17	163,940			1													
	18	173,583			1	1	1											
	19	183,227			1													
	20	192,870			1													
	21	202,514			1	1												
	22	212,157			1													
	23	221,801			1													
	24	231,444			1	1	1	1			1							
3	25	241,088			1													
	26	250,731			1													
	27	260,375			1	1												
	28	270,018			1													
	29	279,662			1													
	30	289,305			1	1	1											
	31	298,949			1													
	32	308,592			1													
	33	318,236			1	1												
	34	327,879			1													
	35	337,523			1													
	36	347,166			1	1	1	1			1							
4	37	356,810			1													
	38	366,453			1													
	39	376,097			1	1												
	40	385,740			1													
	41	395,384			1													
	42	405,027			1	1	1											
	43	414,671			1													
	44	424,314			1													
	45	433,958			1	1												
	46	443,601			1													
	47	453,245			1													
	48	462,888			1	1	1	1			1							



Mumbai Metro One

Annexure 4

Succession of maintenance activities over 30 years

Year	Month	Mileage	Maintenance level																		
5	49	472,532			1																
	50	482,175			1																
	51	491,819			1	1															
	52	501,462			1																
	53	511,106			1																
	54	520,749			1	1	1														
	55	530,393			1																
	56	540,036			1																
	57	549,680			1	1															
	58	559,323			1																
	59	568,967			1																
60	578,610			1	1	1	1														
6	61	588,254			1																
	62	597,897			1																
	63	607,541			1	1															
	64	617,184			1																
	65	626,828			1																
	66	636,471			1	1	1														
	67	646,115			1																
	68	655,758			1																
	69	665,402			1	1															
	70	675,045			1																
	71	684,689			1																
	72	694,332			1	1	1	1													
7	73	703,976			1																
	74	713,619			1																
	75	723,263			1	1															
	76	732,906			1																
	77	742,550			1																
	78	752,193			1	1	1														
	79	761,837			1																
	80	771,480			1																
	81	781,124			1	1															
	82	790,767			1																
	83	800,411			1																
	84	810,054			1	1	1	1													
8	85	819,698			1																
	86	829,341			1																
	87	838,985			1	1															
	88	848,628			1																
	89	858,272			1																
	90	867,915			1	1	1														
	91	877,559			1																
	92	887,202			1																
	93	896,846			1	1															
	94	906,489			1																
	95	916,133			1																
	96	925,776			1	1	1	1													



**Mumbai Metro One**
**Annexure 4**
**Succession of maintenance activities over 30 years**

Year	Month	Mileage	Maintenance level																		
9	97	935,420			1																
	98	945,063			1																
	99	954,707			1	1															
	100	964,350			1																
	101	973,994			1																
	102	983,637			1	1	1														
	103	993,281			1																
	104	1,002,924			1																
	105	1,012,568			1	1															
	106	1,022,211			1																
	107	1,031,855			1																
	108	1,041,498			1	1	1	1													
10	109	1,051,142			1																
	110	1,060,785			1																
	111	1,070,429			1	1															
	112	1,080,072			1																
	113	1,089,716			1																
	114	1,099,359			1	1	1														
	115	1,109,003			1																
	116	1,118,646			1																
	117	1,128,290			1	1															
	118	1,137,933			1																
	119	1,147,577			1																
	120	1,157,220			1	1	1	1													
11	121	1,166,864			1																
	122	1,176,507			1																
	123	1,186,151			1	1															
	124	1,195,794			1																
	125	1,205,438			1																
	126	1,215,081			1	1	1														
	127	1,224,725			1																
	128	1,234,368			1																
	129	1,244,012			1	1															
	130	1,253,655			1																
	131	1,263,299			1																
	132	1,272,942			1	1	1	1													
12	133	1,282,586			1																
	134	1,292,229			1																
	135	1,301,873			1	1															
	136	1,311,516			1																
	137	1,321,160			1																
	138	1,330,803			1	1	1														
	139	1,340,447			1																
	140	1,350,090			1																
	141	1,359,734			1	1															
	142	1,369,377			1																
	143	1,379,021			1																
	144	1,388,664			1	1	1	1													



**Mumbai Metro One**
**Annexure 4**
**Succession of maintenance activities over 30 years**

Year	Month	Mileage	Maintenance level																		
13	145	1,398,308			1																
	146	1,407,951			1																
	147	1,417,595			1	1															
	148	1,427,238			1																
	149	1,436,882			1																
	150	1,446,525			1	1	1														
	151	1,456,169			1																
	152	1,465,812			1																
	153	1,475,456			1	1															
	154	1,485,099			1																
	155	1,494,743			1																
	156	1,504,386			1	1	1	1													
14	157	1,514,030			1																
	158	1,523,673			1																
	159	1,533,317			1	1															
	160	1,542,960			1																
	161	1,552,604			1																
	162	1,562,247			1	1	1														
	163	1,571,891			1																
	164	1,581,534			1																
	165	1,591,178			1	1															
	166	1,600,821			1																
	167	1,610,465			1																
	168	1,620,108			1	1	1	1													
15	169	1,629,752			1																
	170	1,639,395			1																
	171	1,649,039			1	1															
	172	1,658,682			1																
	173	1,668,326			1																
	174	1,677,969			1	1	1														
	175	1,687,613			1																
	176	1,697,256			1																
	177	1,706,900			1	1															
	178	1,716,543			1																
	179	1,726,187			1																
	180	1,735,830			1	1	1	1													
16	181	1,745,474			1																
	182	1,755,117			1																
	183	1,764,761			1	1															
	184	1,774,404			1																
	185	1,784,048			1																
	186	1,793,691			1	1	1														
	187	1,803,335			1																
	188	1,812,978			1																
	189	1,822,622			1	1															
	190	1,832,265			1																
	191	1,841,909			1																
	192	1,851,552			1	1	1	1													





Mumbai Metro One

Annexure 4

Succession of maintenance activities over 30 years

Year	Month	Mileage	Maintenance level																	
21	241	2,324,084	1																	
	242	2,333,727	1																	
	243	2,343,371	1	1																
	244	2,353,014	1																	
	245	2,362,658	1																	
	246	2,372,301	1	1	1															
	247	2,381,945	1																	
	248	2,391,588	1																	
	249	2,401,232	1	1																
	250	2,410,875	1																	
	251	2,420,519	1																	
	252	2,430,162	1	1	1	1	1	1	1	1	1									
22	253	2,439,806	1																	
	254	2,449,449	1																	
	255	2,459,093	1	1																
	256	2,468,736	1																	
	257	2,478,380	1																	
	258	2,488,023	1	1	1	1														
	259	2,497,667	1																	
	260	2,507,310	1																	
	261	2,516,954	1	1																
	262	2,526,597	1																	
	263	2,536,241	1																	
	264	2,545,884	1	1	1	1	1	1	1	1	1	1	1	1						
23	265	2,555,528	1																	
	266	2,565,171	1																	
	267	2,574,815	1	1																
	268	2,584,458	1																	
	269	2,594,102	1																	
	270	2,603,745	1	1	1	1														
	271	2,613,389	1																	
	272	2,623,032	1																	
	273	2,632,676	1	1																
	274	2,642,319	1																	
	275	2,651,963	1																	
	276	2,661,606	1	1	1	1	1	1	1	1	1	1	1	1						
24	277	2,671,250	1																	
	278	2,680,893	1																	
	279	2,690,537	1	1																
	280	2,700,180	1																	
	281	2,709,824	1																	
	282	2,719,467	1	1	1	1														
	283	2,729,111	1																	
	284	2,738,754	1																	
	285	2,748,398	1	1	1															
	286	2,758,041	1																	
	287	2,767,685	1																	
	288	2,777,328	1	1	1	1	1	1	1	1	1	1	1	1						



Mumbai Metro One

**Annexure 4**

**Succession of maintenance activities over 30 years**

Year	Month	Mileage	Maintenance level																		
25	289	2,786,972			1																
	290	2,796,615			1																
	291	2,806,259			1	1															
	292	2,815,902			1																
	293	2,825,546			1																
	294	2,835,189			1	1	1														
	295	2,844,833			1																
	296	2,854,476			1																
	297	2,864,120			1	1															
	298	2,873,763			1																
	299	2,883,407			1																
	300	2,893,050			1	1	1	1							1						
26	301	2,902,694			1																
	302	2,912,337			1																
	303	2,921,981			1	1															
	304	2,931,624			1																
	305	2,941,268			1																
	306	2,950,911			1	1	1														
	307	2,960,555			1																
	308	2,970,198			1																
	309	2,979,842			1	1															
	310	2,989,485			1																
	311	2,999,129			1																
	312	3,008,772			1	1	1	1							1						
27	313	3,018,416			1																
	314	3,028,059			1																
	315	3,037,703			1	1															
	316	3,047,346			1																
	317	3,056,990			1																
	318	3,066,633			1	1	1														
	319	3,076,277			1																
	320	3,085,920			1																
	321	3,095,564			1	1															
	322	3,105,207			1																
	323	3,114,851			1																
	324	3,124,494			1	1	1	1							1	1					
28	325	3,134,138			1																
	326	3,143,781			1																
	327	3,153,425			1	1															
	328	3,163,068			1																
	329	3,172,712			1																
	330	3,182,355			1	1	1														
	331	3,191,999			1																
	332	3,201,642			1																
	333	3,211,286			1	1															
	334	3,220,929			1																
	335	3,230,573			1																
	336	3,240,216			1	1	1	1							1						





Mumbai Metro One

**Annexure 4**

**Succession of maintenance activities over 30 years**

Year	Month	Mileage	Maintenance level																		
29	337	3,249,860			1																
	338	3,259,503			1																
	339	3,269,147			1	1															
	340	3,278,790			1																
	341	3,288,434			1																
	342	3,298,077			1	1	1														
	343	3,307,721			1																
	344	3,317,364			1																
	345	3,327,008			1	1															
	346	3,336,651			1																
	347	3,346,295			1																
	348	3,355,938			1	1	1	1													
	30	349	3,365,582			1															
350		3,375,225			1																
351		3,384,869			1	1															
352		3,394,512			1																
353		3,404,156			1																
354		3,413,799			1	1	1														
355		3,423,443			1																
356		3,433,086			1																
357		3,442,730			1	1															
358		3,452,373			1																
359		3,462,017			1																
360		3,471,660			1	1	1	1													



**Annexure 5**

**Indicative Table of Preventive Maintenance**



**Annexure 5**  
**Work specification of preventive maintenance**

Term Description	Level	Subgroup Description	Code	Description	Term (Days)															
					1	4	7	14	30	60	90	180	360							
Inspection	LT	4 coach rake	0010	Visual control																
		Wheeler axle	0020	Visual control																
		Complete wheel	0030	Visual control																
		Magnetic rail brakes	0040	Visual control																
		Brake calliper unit	0050	Visual control																
		Brake leverage	0060	Visual control																
		Brake discs	0070	Visual control																
		Master control O	PO	4 coach rake	0010	Condition, fixing														
				Rail guard	0020	Condition, fixing, wiring, functional control														
automatic train control, ZUB, Indusl. AFI	0030			Condition, fixing, wiring, functional control																
Axle speed sensor	0040			Condition, fixing, wiring, connectors																
Axle bearing box	0050			Screwing, absence of from outside visible grease and oil																
Wheel sets	0055			Visual control of contact surface for damage or chubbings																
Trailer bogie	0060			Visual control: screwing, central pin, lemmiscate, transverse bumper, curve limit stop, level indicator and anti-roll bar																
Motor bogie	0070			Visual control: screwing, lift-off locking, central pin, level indicator, trailing link, steering rod, anti-roll bar and axle bearing guide																
Primary suspension	0080			visual screwing and fixing control: spring condition, absence of damage or fracture																
Secondary suspension	0090			condition of the pneumatic equipment, air leak and control level indicator																
Pantograph	0100			Visual control pantograph, thickness, uniform wear of the slider, impact hits																
Rearview mirror, video equipment	0110			Cleaning, functional control																
Condition passenger compartment	0120			Seats, head rest, arm rest, function of interior lighting, condition of lamps and coverings, replace missing signs and pictograms																
Windscreen wiper system	0140			Refill cleaning water, control function, control orientation and fixing spray valve																
Sander	0150			Refill cleaning water, control function, control orientation and fixing spray valve																



Mumbai Metro One

Annexure 5

**Work specification of preventive maintenance**

Term Description	Level	Subgroup Description	Code	Description	Term [Days]															
					1	4	7	14	30	60	90	180	360							
Master control 1	P1	4 coach rake	0010	Visual control of speed sensor and earthing brushes, wiring protective resistance and earthing cable										X						
		Axle bearing speed sensor and earthing	0020	Visual control of fixing of box and sprayer. Control of lubricant consumption, control of sprayer direction											X					
		Wheel flange lubrication	0030	Visual control: air conduction secondary suspension, transversal and vertical damper, cross bar, wheel contact surface and wheel flange															X	
		Bogies	0040	Visual control and leak tightness															X	
		Traction system: gear	0050	Remove metal deposits on sectional magnet															X	
		Magnetic rail brake	0060	Control of oil level at compressor standstill (in warm condition, measure 10 minutes after standstill), control of operation															X	
		Compressor	0070	Cleaning															X	
		Safety device pedal	0080	Dewater air tank (waste water may contain oil: deplete as prescribed)																X
		Air tank and air pipes	0090	Relight side handrail with square box wrench, control light barrier, control function and justification crush protection																X
		Entrance door	0100	Control wiper blade																X
		Windscreen wiper system	0110	Condition of guide rail, sealings, clating device																X
		Windows	0120	Control function of loudspeakers, microphone, emergency vox installation, internal and external display																X
		Added	0130	Condition of devices, air leak control, oil and water residuum control																X
		Railvox installation	0140	Fixing of roof equipment, control roof cables, insulators and lacing																X
		Pneumatic table	0150	Control of connections, control condition, fixing and suspension of compensator, lubricate wire rope																X
		Roof	0160	Condition of insulators, contacts and sealings, clean and treat																X
		Pantograph	0170	Exchange floor pad																X
		Circuit breaker	0180																	X
		Air condition	0190																	X
Master control 2	P2	4 coach rake	0010	Control condition of electric connections and cables; control air inlet trench for pollution and clean if necessary														X		
		Air condition	0020	Internal space of drive components: control for cleanliness														X		
		Drive components	0030	No gear oil disposal on bogie and attachments, no wheel flange lubrication oil or grease disposal on bogie and attachments														X		
		Bogies	0040	Powder extinguisher in passenger compartment: condition, fixing, expiry date and seal (usually revision term 3 years)															X	
		Extinguisher	0050	Control function and regeneration operation															X	
		Compressor, air dryer	0060																X	



Mumbai Metro One

Annexure 5

Work specification of preventive maintenance

Term Description	Level	Subgroup	Description	Code	Description	Term [Days]														
						1	4	7	14	30	60	90	180	360						
Master Control 3 (P3)		4 coach rake		0010	Control for crack or other damages														X	
		Boogie frame		0020	Direction of sander pipes														X	
		Sander		0030	Functional test, control of all clearances and settings and components (leverages, discs, pipes...)														X	
		Brakes		0040	Functional test.														X	
		Automatic train control		0050	Control for cracks and damages, control all screwing for deep seat, control damper for pollution, oil leak, damage														X	
		Gangway between coaches		0060	Visual control: central pin, lemmiscate, trailing link, trailing link bearings, curve limit stop, anti-roll bar and traverse, visual control of pipes and screwings, level regulation valve and overflow valve, visual control of anti-roll bar, trailing link.														X	
		Bogies		0070	Control motor for external damage, visual control of cool air exit															X
		Power transmission, motor		0080	lubricate, control locking mechanism, control centring, electric coupling clean contacts, control general condition, control all cables and connections, control earthing leasing, control air coupling for leaks, control all screwings, push pull mechanism c															X
		Automatic coupler		0090	Control for rust stain, control fixing of roof fitting															X
		Railcar body		0100	Clean ventilator motor, radiator and box, external cleaning, control screwings, visual control of motor areation ventilator															X
		Cooling tower		0110	Control compressor valves (ear protection), control air filter for pollution and clean it.															X
		Compressor		0120	Control for damages and pollution, control of opening and closure time, reighten and clean screwing, lubricate, control all functions including inside and outside emergency opening repair damage, streat rubber profiles															X
		Entrance doors		0130	Driver's seat control of all screwing, driver's cab's doors control door sealings, oil articulation and lock, control function of safety devices (train control)															X
		Driver's cab		0140	General visual control															X
		Traction converter		0150	Control oil level, air dehumidifier, insulations and connections															X
		Transformator		0160	Clean															X
		Roof equipment		0170	Grease slightly sanitation table															X
		Earthing switch		0180	Operate water and oil separator															X
		Circuit breaker		0190	Clean air-pipes, poject condition of hydraulic, grease occasionally, measure contact-power, control pneumatic engagement, control pneumatic stopping, control dropping over the damper.															X
		Paradiagraph		0200																X



Mumbai Metro One  
 Annexure 5  
 Work specification of preventive maintenance

Term Description	Level	Subgroup	Description	Code	Description	Term (Days)																
						1	4	7	14	30	60	90	180	360								
Master control 4	P4	4 coach rake	Control condition of pipes, screwing, oil tank, dirt trap, support	0010																X		
		Wheel flange lubrication	Control of electric cable, control pressure pipes, connections and actuator for leak tightness, control pole shoes and final sections of sectional magnet for wear, control clearance of guidance bogie / magnetic rail brake (attachment)	0020																	X	
		Magnetic rail brake	Earthing axle bearing control fixing, contact disc, earthing cable	0030																	X	
		Brakes	Brake lever/fixing on bogie, clearance of brake leverage	0040																	X	
		Damper	Primary and secondary damper/control of damper and fixing	0050																	X	
		Air suspension	Visual control of layer spring and air spring bellows	0060																	X	
		Lift-off locking	Visual control of lift-off wires, split pin connection, parallel pin, visual control of parallel pin for lift-off locking	0070																	X	
		Wheel set bearing	Visual control of wheel set bearing fixing	0080																	X	
		Anti roll bar	Visual control	0090																	X	
		Bogies, axle guide	Visual control of axle guide bottom part, of protective coating of axle guide bearing, treat rubber parts with Tectyl	0100																	X	
		Motor bogie, trailing link	General visual control, control tightness of cooling system	0110																	X	
		Gangway between coaches	Visual control of motor aeration ventilator motor, motor aeration air channel, screwing, visual control of motor fixing, motor bearing, motor cables, control gear box, control fastening torque of linking screws, exchange lubricant oil, discharge oil at	0120																	X	
		Traction converter	Measure acid density of all cells, if necessary exchange battery, clean and lubricate connections, oil amercuation, control battery charge	0130																	X	
		Power transmission:	Treat roof insulators	0140																	X	
		Vehicle batteries	General condition, fixing	0150																	X	
		Roof equipment	Treat insulator with silicone	0160																	X	
		Radio antenna	Clean and treat insulators	0170																	X	
		Insulation insulator	Control of high voltage connections, earthing connection and fixing screws, change vacuum tube of circuit breaker after XX switching cycles	0200																	X	
		Pantograph	Control electric and pneumatic connections	0210																	X	
		Circuit breaker	Control channels for tightness, control for damages and clean roof ventilator	0220																	X	
		Gangway between coaches	Control for tightness air connections supply air (raicar body) and recirculation air channels, before cooling period: control condenser and vaporiser; control for friction and pollution ventilator unit, electric cabling; control mechanical condition of c...	0230																	X	
		Air condition system	Water downpipe; control outlet in air conditioner; control cooling circuit, before cooling period: control condenser and vaporiser	0240																	X	
		Air condition passenger compartment		0250																	X	
		Air condition driver's cab		0260																	X	
		Profiling																				
				4 coach rake	Reprofiling of contact surfaces	0010																X
				Wheel sets		0020																X



**Annexure 6**

**Cleaning Schedule - Overview**



Mumbai Metro One

**Annexure 6**  
**Succession of cleaning activities over 30 years**

Year	Month	Mileage [km]	Cleaning terms			
			KR	GR	GR 1	GR 2
1	2	19,287			1	
	4	38,574			1	1
	6	57,861			1	
	8	77,148			1	1
	10	96,435			1	
	12	115,722			1	1

30	350	3,375,225			1	
	352	3,394,512			1	1
	354	3,413,799			1	
	356	3,433,086			1	1
	358	3,452,373			1	
	360	3,471,660			1	1

Official stamp of Reliance Energy Mumbai Metro One with a handwritten signature over it.



**Annexure 7**

**Track Occupancy – for Maintenance**

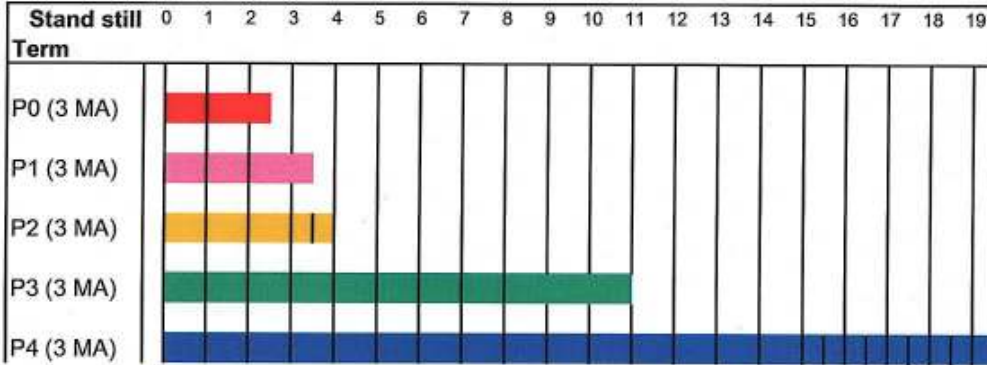


Mumbai Metro One

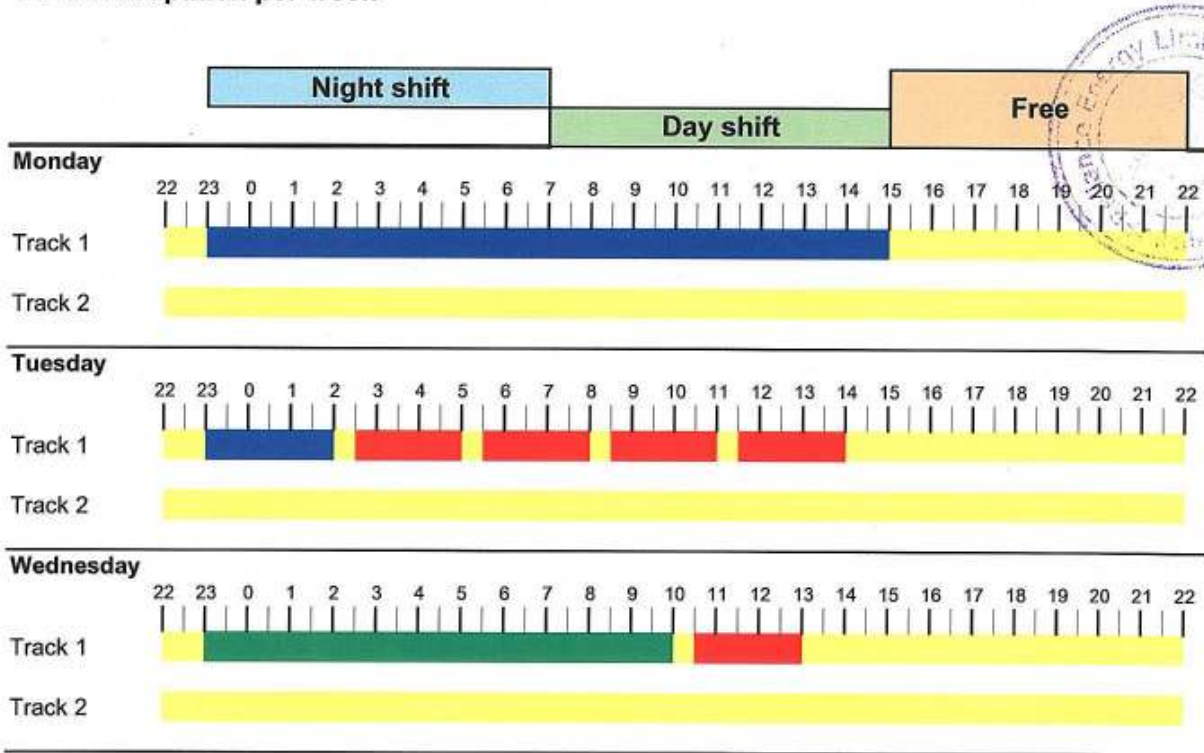
**Annexure 7**

**Track occupation maintenance**

**Stand still time per term**



**Track occupation per week**

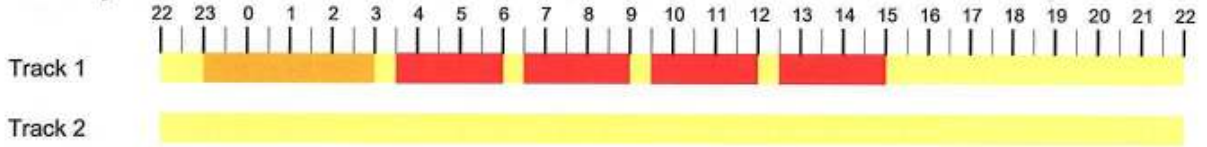


Mumbai Metro One

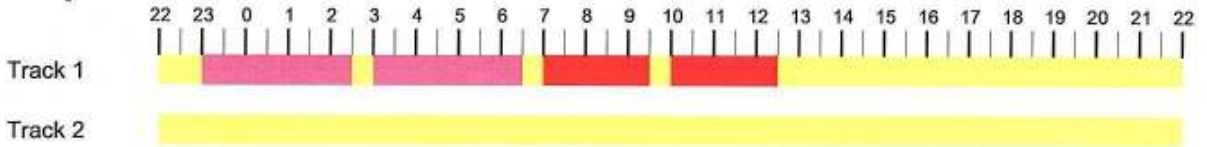
**Annexure 7**  
**Track occupation maintenance**

**Stand still time per term**

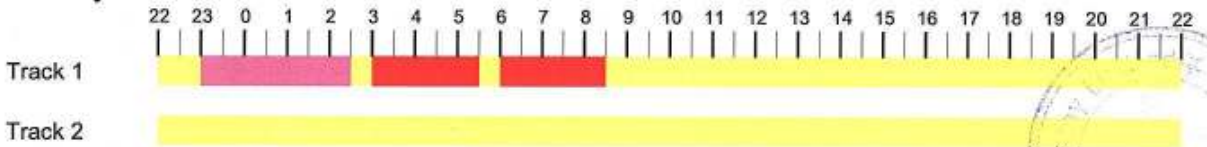
**Thursday**



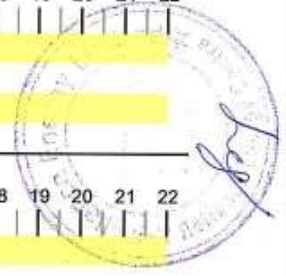
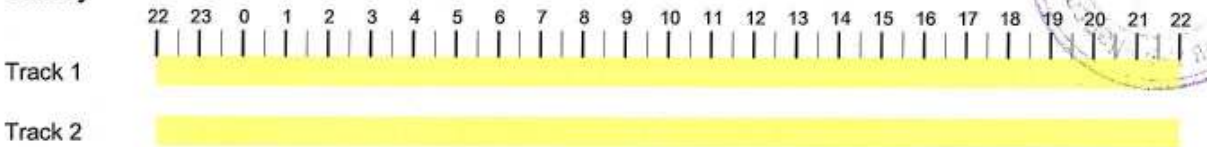
**Friday**



**Saturday**



**Sunday**



**Annexure 8**

**Track Occupancy – for Cleaning**

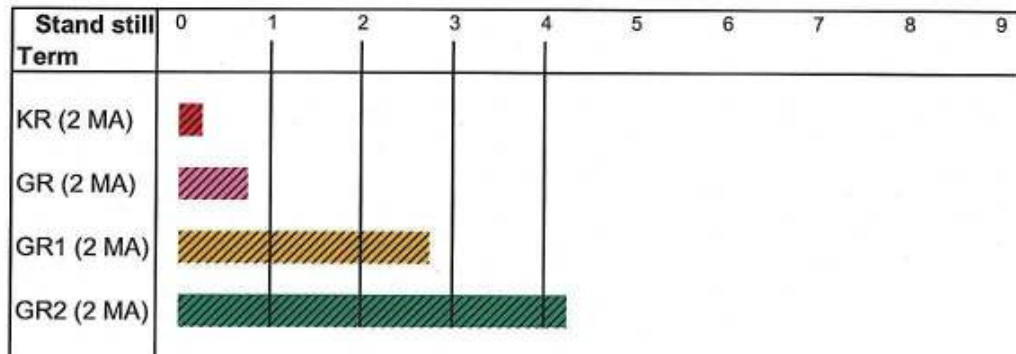


Mumbai Metro One

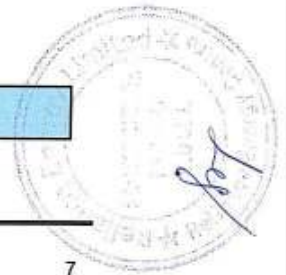
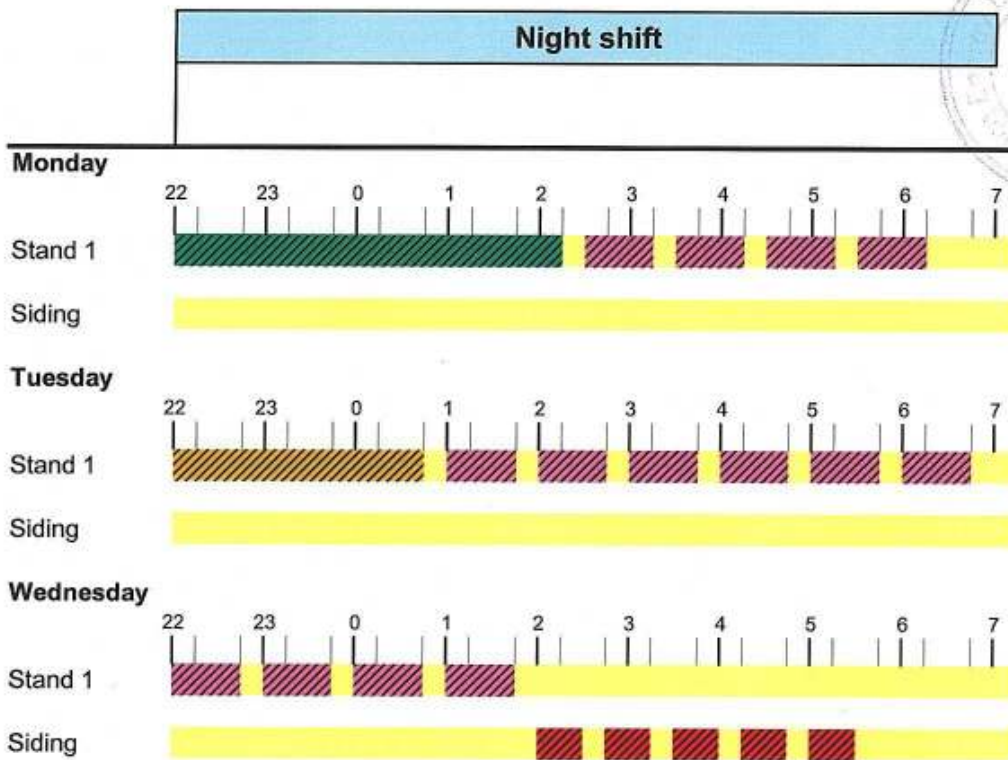
**Annexure 8**

**Track occupation cleaning week type A**

Stand still time per term



Track occupation (week type A)



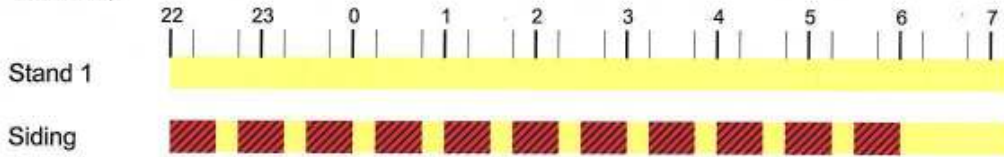
Mumbai Metro One

**Annexure 8**

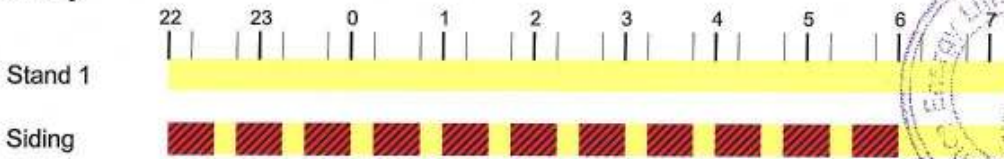
**Track occupation cleaning week type A**

**Stand still time per term**

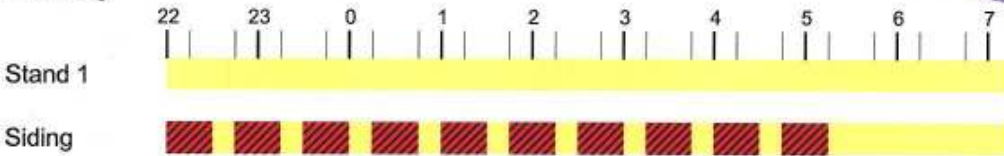
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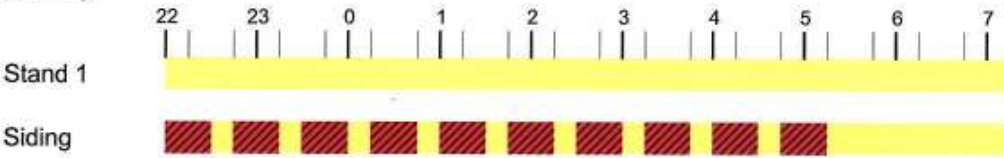
**Friday**



**Saturday**



**Sunday**



**Annexure 9**

**Projected Annual Income Statements**

**Projected Cash Flow Statement**

**Projected Balance Sheet**







Financial Statements

Annexure - Business Plan

Income Statement

Particulars	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	
Revenue	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300	3400	3500	3600	3700	3800	3900	4000	4100	4200	4300	4400	4500	4600	4700	4800	4900	5000
Expenses	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550	1600	1650	1700	1750	1800	1850	1900	1950	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800
Profit	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550	1600	1650	1700	1750	1800	1850	1900	1950	2000	2050	2100	2150	2200



**Annexure 10**  
**Ridership forecasts**



Years	Annual ridership
2011	203,832,750
2012	211,874,694
2013	220,233,921
2014	228,922,950
2015	237,954,794
2016	243,011,439
2017	248,175,541
2018	253,449,383
2019	258,835,295
2020	264,335,661
2021	269,952,912
2022	276,446,651
2023	283,096,597
2024	289,906,508
2025	296,880,231
2026	304,021,709
2027	311,334,975
2028	318,824,162
2029	326,493,502
2030	334,347,329
2031	342,390,081
2032	350,626,301
2033	359,060,644
2034	367,697,876
2035	376,542,877
2036	385,600,646
2037	394,876,300
2038	404,375,080
2039	414,102,355
2040	424,063,619
2041	434,264,503



## Section 3

**FORMAT 25**

**FUNDING PLAN**

Name of the Bidder – **Mumbai Metro One**

**Supporting documents/ letter for equity commitment of REL and Connex SA attached.**

- Equity (by consortium partners) – 74%
  - Equity of Partner - Reliance Energy Limited & its affiliates – 69%
  - Equity of Partner - Connex SA – 5%
- Equity (by MMRDA) – 26%
- Debt component - **Rs 1750 Crores**
- Capital contribution if any - considered

Supported by

Letter of Interest/Comfort from – **Standard & Chartered Bank for the debt requirement**





**Reliance Energy**

A Dhirubhai Ambani Enterprise

**Reliance Energy Limited**

Reliance Energy Centre  
Santa Cruz (E)  
Mumbai 400 055

Tel: +91 (022) 3009 9999  
Fax: +91 (022) 2616 0437  
www.rel.co.in


**Format 5**

**Letter of Commitment**

**From:** Reliance Energy Limited  
Reliance Energy Centre, Santa Cruz (East)  
Mumbai – 400 055, INDIA

**To:** Chief, Transport & Communications Division  
Mumbai Metropolitan Regional Development Authority  
Bandra-Kurla Complex  
Bandra (East)  
Mumbai – 400 051

1. Reliance Energy Limited ("Equity Provider"), with its registered office at Reliance Energy Centre, Santa Cruz (East), Mumbai, India along with the other member of the Bidding Consortium comprising Connex SA, Parc des Fontaines, 169 avenue Georges Clemenceau, 92735 Nanterre cedex, France, in response to a Request for Proposals ("RFP") issued by MMRDA have submitted a Proposal dated 16 May 2005, (the "Proposal") to implement the development and operation of Mass Rapid Transit System for Versova-Andheri-Ghatkopar Corridor Project as envisaged in the RFP document issued by MMRDA for the MRT project.
2. Reliance Energy Limited ("Equity Provider"), with its registered office at Reliance Energy Centre, Santa Cruz (East), Mumbai, India, has agreed to commit 26% of the total equity of the SPV formed for the implementation of MTRS Project for a period of 15 years from the COD.
3. Reliance Energy Limited ("Equity Provider"), with its registered office at Reliance Energy Centre, Santa Cruz (East), Mumbai, India, along with the other members of the Bidding Consortium comprising of Reliance Energy Limited and Connex SA, together has agreed to commit the entire equity requirement of 74% in the SPV in case the bidder is unable to obtain equity investment from financial investors (who are not a part of the Consortium) in the SPV.
4. The signatory to this Letter of Commitment is a duly authorized representative of Reliance Energy Limited and duly empowered to represent and commit Reliance Energy Limited for the proposed Mass Rapid Transit System Project. A copy of the Power of Attorney is attached herewith.

(i)	SIGNATURE	
(ii)	NAME	J P Chalasani
(iii)	TITLE	Director (Business Development)
(iv)	DATE	16 May 2005

Encl: Power of Attorney (Relaince Energy Limited)

Note: Terms used in this Letter of Commitment have the same meaning as in the RFP and its relevant Formats.

**Format 5**

**Letter of Commitment**


**From: Connex SA, Parc des Fontaines, 169, avenue Georges Clemenceau, 92735 Nanterre Cedex, France**

**To:**

Chief, Transport & Communications Division  
 Mumbai Metropolitan Regional Development Authority  
 Bandra-Kurla Complex  
 Bandra (East)  
 Mumbai - 400 051

1. Connex SA ("Equity Provider"), with its registered office at Parc des Fontaines, 169, avenue Georges Clemenceau, 92735 Nanterre cedex, France, along with the other members of the Bidding Consortium comprising, [Reliance Energy Limited, Reliance Energy Centre, Santa Cruz (East), Mumbai - 400 055, INDIA], in response to a Request for Proposals ("RFP") issued by MMRDA have submitted a Proposal dated 16 May 2005 (the "Proposal") to implement the Development and operation of Mass Rapid Transit System for Versova-Andheri-Ghatkopar Corridor Project as envisaged in the RFP document issued by MMRDA for the MRT project.
2. Connex SA, ("Equity Provider"), with its registered office at Parc des Fontaines, 169 avenue Georges Clemenceau, 92735 Nanterre cedex, France, has agreed to commit 5% of the total equity of the SPV formed for the implementation of MTRS Project for a period of 2 years from the COD.
3. Connex SA ("Equity Provider"), with its registered office at Parc des Fontaines, 169, avenue Georges Clemenceau, 92735, Nanterre cedex, France, along with the other members of the Bidding Consortium comprising of Reliance Energy Limited, Reliance Energy Centre, Santa Cruz (East), Mumbai - 400 055, INDIA, together has agreed to commit the entire equity requirement of 74% in the SPV in case the bidder is unable to obtain equity investment from financial investors (who are not a part of the Consortium) in the SPV (Reliance Energy Limited being liable for 69% and Connex SA for 5% of such entire equity requirement).
4. The signatory to this Letter of Commitment is a duly authorized representative of Connex SA and duly empowered to represent and commit Connex SA for the proposed Mass Rapid Transit System Project. A copy of the Power of Attorney is attached herewith.

**Connex SA**

(i) SIGNATURE .....	
(ii) NAME .....	Stéphane RICHARD
(iii) TITLE .....	General Manager
(iv) DATE .....	May 9, 2005

**Note :** Terms used in this Letter of Commitment have the same meaning as in the RFP and its relevant Formats.



December 1, 2005

Reliance Energy Limited  
Reliance Energy Center,  
Santacruz (East)  
Mumbai - 400 055

Dear Sir,

**Sub: Mass Rapid Transit System for Versova-Andheri-Ghatkopar Corridor in Mumbai**

1. We refer to your business proposal and the correspondences on the above subject.
2. We understand that the project is for survey, investigation, design, engineering, financing, procurement, construction, operation and maintenance of the Mass Rapid Transit System ("**Project**") for Versova-Andheri-Ghatkopar corridor on a Build, Own, Operate and Transfer (BOOT) basis through Public Private Partnership (PPP).
3. We further understand that the capital cost of the Project is proposed be funded through debt and equity based on a debt-to-equity ratio of 70:30. The debt component will amount to a maximum of Rs.1,750 crores with the balance costs being funded through equity contribution.
4. Based on the evaluation of the information available at this stage, we are pleased to inform you that should the consortium led by Reliance Energy Limited be selected as the Preferred Bidder, we will arrange debt upto Rs.1,750 crores towards part financing of the capital expenditure subject to comprehensive technical and legal due-diligence and internal credit approvals.

We look forward to having the opportunity to work with you on this transaction.

Yours sincerely,



Abhay Rangnekar  
Managing Director  
Project and Export Finance Group

**Standard Chartered Bank**  
**Project & Export Finance**  
90, M. G Road  
Mumbai 400 001  
[www.standardchartered.com](http://www.standardchartered.com)

tel: +91 22 2268 3151  
fax: +91 22 2268 3158



## Section 4





## Section 5



**Reliance Energy**

A Dhirubhai Ambani Enterprise

**Reliance Energy Limited**

Reliance Energy Centre

Santa Cruz (E)

Mumbai 400 055

Tel: +91 (022) 3009 9999

Fax: +91 (022) 2616 0437

www.rel.co.in

**FORMAT 27**

**ADDITIONAL INFORMATION**

**NAME OF BIDDER: Reliance Energy Limited & Connex SA (Mumbai Metro One)**

**NO ADDITIONAL INFORMATION**

Signature

Name: S Mohan Gurunath

Bidder: Reliance Energy Limited & Connex SA (Mumbai Metro One)

## Section 6

**MUMBAI METRO ONE**

This annexure received from MMRDA seeking confirmation from the consortium is being responded to by inclusion of the statements from the Consortium under each Paragraph / Point listed by MMRDA :

**1. Alignment**

That emergency cross-over will be provided in accordance with the submitted track schematic.

That the turn round facilities will be provided in accordance with the submitted track schematic and will include provision for stabling a crippled train.

- **Confirmed**

**2. Building Services**

That ventilation, air conditioning, fire fighting, fire alarm, electrical, lighting, water, plumbing, drainage and SCADA/BMS for the Stations, Depot, workshops, yard, substations, Administration Building and OCC will, as a minimum, be provided, in accordance with the information previously supplied.

- **Confirmed**

**3. Communications**

That a PA system will also be provided for the Depot.

- **Confirmed**

That the OCC will have the same flexibility as the Stations control; i.e. the ability to address selected stations, platforms, concourses etc.

- **Confirmed**

That the trunk radio system proposed will be compatible to open, vendor-neutral standards such as Tetra.

- **Confirmed**

That the telephone and digital transmission system proposed are compatible to open, vendor-neutral standards.

- **Confirmed**

**4. Depot Facilities**

That emergency generators and UPS system will be provided within the Depot.

- **Confirmed**

That the design of the Depot will allow for expansion of some facilities, e.g. the stabling area.

- **Confirmed that the design of the Depot will allow for expansion of some facilities and the same will be finalised in consultation with MMRDA.**

That a Hazardous Material Store and a Paint Shop will be provided.

- **Confirmed.**

That roads and car parks will be provided in accordance with the submitted drawing.

- **Confirmed**

That PA, CCTV, telephone and a clock system will be provided within the Depot.

- **Confirmed**



That a limited speed test track with signalling will be provided within the Depot if possible

- **Confirmed**

That the proposed yard lighting, will be sufficient to allow the effective working of the Depot and that a minimum of 80 Lux will be provided.

- **Confirmed**

That the Rolling Stock will be moved into workshops that do not have an overhead electric supply by a combination of a battery/diesel vehicle and winches.

- **Confirmed**

#### 5. Electrical Power

That a lightning protection system will be provided for the Overhead Catenary System and Traction Sub Stations.

- **Confirmed**

That the maintenance equipment to be supplied will include an OHL recording car and a tower wagon.

- **Confirmed**

That three phase power will be supplied to the MRTS from two separate sources at 33kV or above.

- **Confirmed**

That power will be supplied and distributed for general services, including Stations, the Depot and the Administration Building by means of a ring main from the supply points.

- **Confirmed**

That your design will recognise the need to deal with stray currents and earthing issues and take into account that the alignment is adjacent to and passes through 1500 v DC traction areas, which may still be in place when the system opens.

- **Confirmed**

That the Switchgear & CB's can be operated at 3 levels; OCC, Sub Station and component.

- **Confirmed**

That the Transformer capacities are to be rated for six cars at two minute headway.

- **Confirmed**

That Trip Stations are not required with the proposed system.

- **Confirmed**

That the OHE will be deactivated whilst trains are passing through the wash plant.

- **Confirmed**

#### 6. Rolling Stock

That a minimum gangway width of 1400 mm will be provided.

- **Confirmed**

That the required level of interior lighting will be provided.

- **Confirmed**

That under worst conditions the wheel load will not exceed the specified 9.35 tonnes.





- **Confirmed**

That provision will be made for wheelchairs within the saloon.

- **Confirmed**

That acceptable brake blending will be possible.

- **Confirmed**

That the design of the bogies will take into account the need to operate over a minimum radius of 100m.

- **Confirmed**

That brake resistors will not be provided on the roof of the motor car.

- **Confirmed**

That the lighting provided in the vehicles will conform to the Specification.

- **Confirmed**

That the parking brake will be capable of holding a fully loaded train on the steepest gradient with a factor of safety of at least one point five.

- **Confirmed**

That the "pushback" feature for the door allows limited pushback for releasing a trapped arm etc

- **Confirmed**

That electric door operation will be considered during detailed design.

- **Confirmed**

That made for wheelchairs the saloon.

- **Confirmed**

That integrated ventilation will be provided for traction motors.

- **Confirmed**

That a wheel diameter of 80mm will be used.

- **It is our understanding that this pertains to wheel wear. Confirmed that wheel wear of 80 mm has been considered**

## 7. **SCADA**

That the SCADA for ECS will include monitoring and alarm for ECS for critical rooms such as signalling, relay, CER, and UPS.

- **Confirmed**

That the design and provision of the SCADA system will allow for future expansion.

- **Confirmed**

That SCADA will interface with signalling to provide the overhead line equipment energisation status at the OCC.

- **Confirmed**

That Stations will be controlled by SCADA, the Administration Building and Depot will be controlled by BMSs and that it will be possible to monitor both of these at the OCC.

- **Confirmed**



That the SCADA scope for supervision and control will include traction power supply, auxiliary power supply, fire alarm, fire fighting, ECS, plumbing, drainage, escalators, lifts, UPS, generators, lighting, access security and AFC

- **Confirmed**

#### 8. Signalling

That consideration will be given to supplying ATO as part of the initial system.

- **Noted**

That the design of the signalling system will be such that, (if not supplied initially) it will be upgradeable to ATO with no significant affect on operations.

- **Confirmed**

That ATP, ATS, CBI and Point Machines will have self diagnostic features.

- **Confirmed**

That "wrong way" running will be possible with the proposed system.

- **Confirmed. We envisage that such requirements can arise only in extreme emergency.**

That the design of the Signalling system will be compatible with the Rolling Stock.

- **Confirmed**

That the proposed Traction System will be compatible with the Rolling Stock and the signalling system to be supplied.

- **Confirmed**

#### 9. Station Buildings

That the design of the Station roof will conform to the submitted drawing.

- **Confirmed**

That Ghatkopar station will be located in accordance with the drawings.

- **Confirmed**

That the designs will take cognisance of the impact of the MUIP.

- **Confirmed**

#### 10. Ticketing

That spares will be provided on the basis of one additional set per array or 10%.

- **Confirmed**

That token will be considered for single journeys.

- **Confirmed**

#### 11. Viaducts

Structure

That the proposal to use U beams throughout the viaduct and boxes in the stations will be reviewed.

- **Confirmed**



**COMMON TO ALL BIDDERS**

Financial Proposal Stage Bid Bulletin No. 1

The Consortium has acknowledged the points brought out by MMRDA and included its response to each paragraph :

**1. Noise Levels**

Clause 6.5 of Volume II of the RFP shall be revised as follows:

The average noise level along the length of the interior of each car measured at a height of 1.5 metres above the floor at the car centre line shall not exceed the following levels with all equipment operating and the vehicle running on the MRTS alignment with new level tangent track conditions and with all windows and doors closed: a) At 80 km/h - 74 dB (A) (b) With car stationary 69 dB (A) The average noise levels shall exclude measurements taken in the inter-car connecting gangway.

- **Noted. The revised requirements of MMRDA will be reflected in the Technical Performance Specifications which will form part of the C.A.**

**2. Ambient Noise**

Clause 6.5 of Volume II of the RFP is further amended to include following:

Ambient noise generated by a passing train shall comply with the relevant ambient noise standards as specified by Central Pollution Control Board (CPCB) Bidders shall provide and adopt noise mitigation and abatement measures at critical sections along the alignment to comply with the said regulation.

- **Locations of Noise Sensitive Receivers (NSR) will be identified in consultation with MMRDA.**
- **Existing ambient noise levels along MRTS alignment will be measured to generate baseline data.**
- **Noise levels less than 75 dBA will be achieved at 25 m from rail, by using 1 to 1.5 m high noise barriers.**
- **Full enclosure will be used in selected areas to achieve the norms specified by CPCB.**

**3. Rake Transfer Facilities**

Clause 8.1 of Volume II of the RFP is hereby amended to include the following:

Provisions to allow for train transfers to/from the depot and the envisaged north-south line is to be included. **Appendix 1** is provided as a conceptual guide for the bidders.

- **Noted. Arrangement shall be made within the Car Depot limits for receiving similar trains as plying in the V-A-G Corridor from North South line**

**4. Depot Layout**

Clause 8.1 of Volume II of the RFP is further amended to include the following:

The depot layout should be such that a 30-meter wide 'greenbelt' be provided around the depot. This is to comply with a recent notification issued by the Government of Maharashtra attached as **Appendix 2** for reference.

- **Noted**



**5. Airport Branch**

The Airport Branch is being deferred. All references to the Airport Branch in the RFP are hereby omitted. However, the Airport Road Station Layout should provide for future extension to the airport for services from Versova end only.

- **Noted**

**6. Transportation of Rolling Stock**

Bidders are hereby directed to Clause 6.6.7 of Volume II of the RFP. Due to the narrow and limited structural capacity of the roads likely to be traversed in transporting the coaches, bidders are reminded to plan carefully for transportation and delivery of the rolling stock.

- **Noted.**

**7. WEH Station**

Bidders are reminded that the current vertical height of WEH station shown on the RFP drawings appears excessive and escalators may be required for downward movement of passengers. However, the vertical alignment can be optimised to best suit the operator's requirements.

- **Noted**

**8. Track Layout: Crossovers**

Clause 4.1 of Volume II of the RFP, a portion of which reads as: "The types of turnouts used shall be kept to a minimum. Diamond crossovers are not to be used." shall be amended to read as: "The types of turnouts used shall be kept to a minimum. As a general rule, diamond crossovers are not to be used."

- **Noted . The desired amendment suggested by MMRDA will be reflected in the Technical Performance Specifications which will form part of the C.A.**

**9. Andheri Station**

The Andheri Station layout must be compatible with, and make provision for the planned MUIP Flyover at the same location. The conceptual layout which incorporates entrusted Works to be performed by the Concessionaire, and for which compensation will be made, will be provided during the proposed meeting to discuss civil works.

- **Noted**

**10. Track Alignment and Provision of Asalapha Station**

The alignment of the MRTS and the MUIP between Asalapha Station and Ghatkopar station have been changed to incorporate compatible MUIP and MRTS layouts.

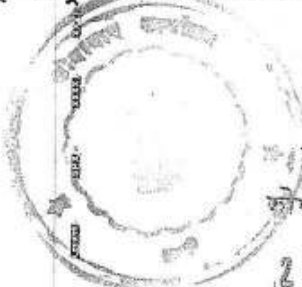
- **Noted. For clarity, it is submitted here that the elevated alignment of the way structure at Asalapha would continue to be in the same vertical alignment as planned in Technical submission.**



## Section 7



महाराष्ट्र MAHARASHTRA



मुद्रक प्रमुख लिपिक  
 कोषागार कार्यालय, ताणे  
 24 OCT 2005

वेदहं स्टॉप केंद्र  
 स्थितिचे ठिकाण:- २३ नं. पी. एन. ए.  
 प्लॉट नं. १४, सेक्टर-४, कोणक्याणे  
 नवी मुंबई-४०० १०५  
 परवाना क्र. ४४ २००१ ३००  
 अनुक्रमांक = 20784  
 2754894  
 २००५-१०-१४-२२७

E 318586  
 28 OCT 2005

Reliance Energy Ltd.  
 वेदहं स्टॉप केंद्र



**SPECIAL POWER OF ATTORNEY**

KNOW ALL MEN BY THESE PRESENTS, RELIANCE ENERGY LIMITED, a Company incorporated under the Indian Companies Act, 1913 and having its Registered Office at Reliance Energy Centre, Santa Cruz (East), Mumbai 400 055, (hereinafter referred to as the "Company") do hereby nominate, appoint and constitute Shri S Mohan Gurnath, Head Business Development (Infrastructure) of the said Company as its true and lawful attorney or agent with full powers and authority to do and execute all acts, deeds and things in respect of the prequalification bids, indicative bids, final bids, bidding documents and tender documents related to infrastructure projects on behalf of, in the name of, for the Company that is to say :



*(Handwritten signature)*



महाराष्ट्र MAHARASHTRA



मुद्रांक प्रत्येक लिपिक  
कोषागार कार्यालय, ता. २४

24 OCT 2005

वेदहो स्टॉप केंद्र  
विक्रिचे ठिकाण - १२३, ११ प्लाजा  
स्ट्रीट नं १४, मंगलूर, कोणकोणे  
मती मुबई-४०००००  
पत्ता नं. ४४, २०००, मुंबई  
मजकूर नं. २०७८५  
गव. Reliance Energy Ltd.  
त. २७५४८९४

२४/१०/०५  
२४/१०/०५

E 318587

28 OCT 2005

- 1 (a) To submit bid(s) and applications including Request for Qualification, Request for Proposal, declarations, undertakings, agreements constituting the prequalification bids, indicative bids, final bids, bidding documents and tender documents on behalf of the Company in response to any tender(s) and/or other documents floated by any entity related to infrastructure projects and to enter into necessary agreements to provide any service(s) of the Company in pursuance of the bids submitted for and on behalf of the Company.
- (b) To make, vary or amend any bid(s), application(s) or other documents submitted for and on behalf of the Company related to infrastructure projects and to agree to all or any terms and conditions or changes thereto, as may be stipulated by the entity inviting business proposals, represent and deal with all concerned authorities of any such entity, on behalf of the Company, as may be required and sign, execute all applications, bids, tender documents, forms, declarations, agreement, statements, affidavits and such other documents in connection with the above.

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2. To represent the Company and complete all formalities required to be fulfilled in connection with submission of the above bid documents.
3. To receive notices in respect of the above bid process and the Tender at the Registered office of the Company.
4. And generally to act as the Attorney of the Company for and on behalf of the Company to execute and do all lawful acts, instruments, matters and things required for successful completion of the above bid process.

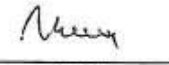
And the Company does hereby agree to ratify and confirm all and whatsoever the aforesaid Attorney shall lawfully do or purport to do by virtue of these presents.

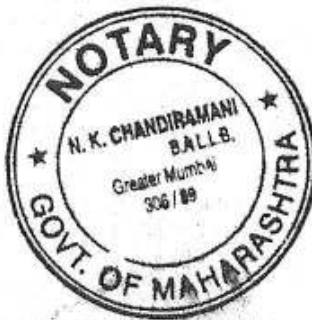
This Power of Attorney shall be effective, binding and operative till 31<sup>st</sup> March, 2007, if not revoked earlier or as long as the said Attorney is in the service of the Company, whichever is earlier.

IN WITNESS WHEREOF Reliance Energy Limited have caused its Common Seal to be hereunto affixed at Mumbai this 29<sup>th</sup> day of December, 2005.

The Common Seal of Reliance Energy Limited )  
 was hereunto affixed in the presence of Shri )  
 Satish Seth, Executive Vice Chairman of the )  
 Company and Shri Ramesh Shenoy, Company )  
 Secretary of the Company, who have signed )  
 these presents in token thereof. )

  
 \_\_\_\_\_  
**Satish Seth**  
 Executive Vice Chairman

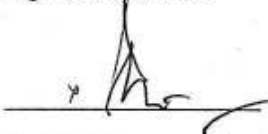
  
 \_\_\_\_\_  
**Ramesh Shenoy**  
 Company secretary



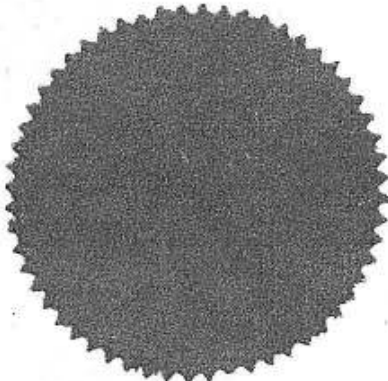
Specimen signature of:  
**S Mohan Gurunath**



Signature Attested:



**Satish Seth**  
 Executive Vice Chairman  
 Reliance Energy Limited



**BEFORE ME**  
*A. Chand*  
29.12.05  
**N. K. CHANDIRAMANI**  
 B. A. LL. B.  
 NOTARY GREATER MUMBAI  
 GOVT. OF MAHARASHTRA  
29.12.2005



## Section 8

## FORMAT 31 – B

### CHECK LIST FOR USE OF BIDDERS FINANCIAL PROPOSAL

SI No	Document	Mark	No of Pages	Remark
1	Is Letter of Transmittal – (Financial Proposal) given in Format 1 – B provided?	√	2	Section 1
2	Is Financial Proposal – Business Plan as given in Format 7A provided?	√	158	Section 2
3	Is Funding Programme as given in Format 25 provided?	√	4	Section 3
4	Is Cash Flow Statement as given in Format 26 provided?	√	2	Section 4
5	Is Additional Information as given in Format 27 provided?	√	1	Section 5
6	Is Form of Bank Guarantee for Bid Security as given in Format 28 provided?	√	2 each	
7	Is Financial Proposal in Format 29 provided?	√	2	Two Separate Envelop
8	Appendix 1 & 2	√	6	
9	Concession Agreement (Nov 2005) and clarifications	√		

Signature



Name : S Mohan Gurunath  
Bidder : Reliance Energy Limited & Connex SA (Mumbai Metro One)