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People's Republic of Bangladesh: South Asia Subregional Economic Cooperation Railway Connectivity Investment Program (Financed by the Technical Assistance Special Funds)

Final Report on Rolling Stock Maintenance

Prepared by:

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In association with:

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This consultant's report does not necessarily reflect the views of ADB or the Government concerned, and ADB and the Government cannot be held liable for its contents. (For project preparatory technical assistance: All the views expressed herein may not be incorporated into the proposed project's design.)

Asian Development Bank



Government of the People's Republic of Bangladesh
Ministry of Railways
Bangladesh Railway

Bangladesh SA/SEC Railway Connectivity Investment Programme Project

Rolling Stock Maintenance Final Report

Prepared for:

ADB/Bangladesh Railway

Prepared by:

CPCS Transcom Limited

In association with

e.Gen Consultants Ltd.

Date: 21 October, 2017

CPCS



ADB

Quality Assurance

**Bangladesh Railway Connectivity
Investment Programme Project
Rolling Stock Maintenance**

CPCS Ref: 15328

Draft Final Report: Rolling Stock Maintenance

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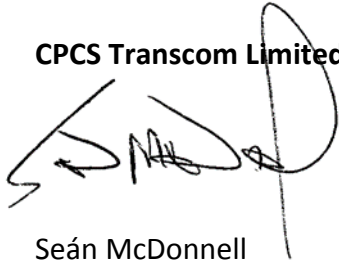
Dear Sakai-san:

Re: Final Report – TA 8596 BAN: SASEC Railway Connectivity Investment Program

Please find attached our Final Report: Rolling Stock Maintenance, part of the final deliverable under the captioned project. This report contains the Bangladesh Railway rolling stock maintenance status and our recommendations to improve maintenance performance in the Rolling Stock Maintenance aspect of the project.

Yours very truly,

CPCS Transcom Limited



Seán McDonnell
CPCS Team Leader

Acknowledgements

CPCS would like to acknowledge the kind assistance granted to them by the staff of the Bangladesh Railway. In addition we wish to thank all the stakeholders who gave so generously of their time and shared with us their insights into present shortcomings and future development of the railway rolling stock maintenance facility. Their contributions have been invaluable in defining a work program and task objectives that will go towards making the Rolling Stock Maintenance Plan a comprehensive and useful document to guide the development of the Bangladesh Railway. Any errors of fact or interpretation are ours

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Table of Contents

Acronyms/Abbreviations.....	iv
Executive Summary	vi
1 Introduction	1
1.1 Introduction.....	2
1.2 Methodology	3
1.3 Volume II Report Structure	5
2 Rolling Stock Maintenance Management.....	6
2.1 Introduction.....	7
2.2 RS Maintenance Objective	7
2.3 BR Rolling Stock Maintenance Facilities.....	9
3 BR Locomotive Maintenance	14
3.1 BR Locomotive Holding	15
3.2 Locomotive Age Profile	16
3.3 Locomotive Maintenance Schedules	17
3.4 Visits to Maintenance Workshops	19
4 Carriage & Wagon Maintenance	28
4.1 Passenger Coach Maintenance	29
4.2 Freight Wagon Maintenance.....	31
4.3 Visit to Maintenance Workshops	34
5 Due Diligence & Diagnostic Analysis	43
5.1 Introduction.....	44
5.2 Locomotive Maintenance.....	44
5.3 Locomotive Workshops – Performance	46
5.4 Carriage &Wagon Workshops – Performance	48
5.5 BR Rolling Stock Maintenance – Limitations, Constraints & Challenges	50
5.6 Over Aged Rolling Stock	51
5.7 Diesel Locomotive Workshops Infrastructure Constraints	52
5.8 Human Resource Constraints and Weakness	53
5.9 Procurement Constraints and Weakness.....	55
5.10 Rolling Stock Condemnation	55
6 Conclusions & Recommendations.....	56
6.1 Introduction.....	57
6.2 Rolling Stock Under Procurement	57
6.3 Administrative and Procedural Reforms	58

- 6.4 New Projects..... 59
- 6.5 Rolling Stock Maintenance Capacity Enhancement..... 62
- 6.6 Rolling Stock Procurement Plan 64
- 6.7 Outsourcing Options 67
- 6.8 Diesel Loco Shed Upgrade 67
- 6.9 C&W Maintenance Depot Upgrading..... 67
- 6.10 Other Recommendations 68

Acronyms/Abbreviations

ADB	Asian Development Bank
ADG	Additional Director-General
ASEAN	Association of South-East Asian Nations
BG	Broad Gauge
BR	Bangladesh Railways
BRASS	Bangladesh Railway Automated Support System
C&W	Carriage & Wagon
CAPEX	Capital Expenditures
CCS	Chief Controller of Stores
CLW	Central Locomotive Workshop
CME	Chief Mechanical Engineer
CPCS	CPCSTranscom Limited
CPLO	Chief Planning Officer, Bangladesh Railway
DEMU	Diesel Electric Multiple Unit
DG	Dual Gauge
DIR	Director
DSW	Divisional Superintendent Works
EOQ	Economic Order Quantity
GDP	Gross Domestic Product
GOH	General Overhaul
GPS	Global Positioning System
HRM	Human Resource Management
Hrs.	Hours
IC	Inter City
ICC	Inventory Control Cell
JDG	Joint Director General
km	Kilometre

LE	Lift Enamel
Loco	Locomotive
ME	Mail and Express
MG	Metre Gauge
MIS	Management Information System
NTK	Net Tonne-km
PDF	Portable Document Format
PDPP	Preliminary Development Project Proforma/Proposal
PHT	Pahartali
POH	Periodic Overhaul
PP&C	Production Planning & Control
PPP	Public-Private Partnership
PXC	Paksey
RCIP	Railway Connectivity Investment Program
RS	Rolling Stock
RSIP	Railway Sector Improvement Project
SAARC	South Asian Association for Regional Cooperation
TAR	Trans-Asian Railway

Executive Summary

The current Bangladesh Railways Masterplan was adopted in 2013. The actual plan preparation was made in 2006/2007 based on 2005 and earlier data. Under this Masterplan, Bangladesh Railways (BR) committed to an ambitious program of capital works designed to increase capacity in both freight and passenger transport. Some inroads have been made in that respect.

However, much remains to be done.

Bangladesh Railway has access to sources of capital to upgrade its operations. To efficiently exploit those resources, BR needs a revised Masterplan. It should allow for the long-term and sustainable development of the railway. It should plan out the most efficient route to gauge conversion. Finally, it should restore BR as an efficient, attractive alternative to road transport for both freight and passengers.

One of the project objectives is to assess the existing BR maintenance facilities and identify areas where additional capacity and additional inputs are required. This will include evaluation of existing major workshop infrastructure facilities, maintenance practices, machinery and plant condition and all other factors affecting performance of these workshops.

This due diligence and diagnostic analysis is thus the key input into the creation of the future plan for BR Rolling Stock maintenance facilities. It establishes the baseline upon which infrastructure upgrades, operational changes and institutional enhancements will be recommended for the BR facilities.

For the purpose of our draft final reporting, the due diligence and diagnostic assessment are intended to provide the context to addressing the following:

- Infrastructure Facilities
- Rolling Stock Maintenance Practices
- Human Resource
- Budget Allocation

The report, therefore, presents a holistic (within the mandate of the Consultant) overview of current rolling stock maintenance facilities and practices and identifies areas requiring special attention. The broad topics addressed in this report are:

- BR rolling stock holdings
- BR rolling stock maintenance philosophy
- Rolling stock availability to meet traffic demand

- Rolling stock maintenance facilities
- Maintenance facilities performance evaluation
- Identify reasons for poor performance

Discussions on above topics are intended to help define the current operational context of the BR rolling stock maintenance sector and thus present a credible basis for the recommendations on future improvements.

Bangladesh Railway rolling stock maintenance management is based on preventive maintenance model requiring locomotives, coaches and wagons to visit maintenance shed/workshop for inspection and repairs according to a pre-defined maintenance schedule.

Data Collection

We collected data to assess efficiency and effectiveness of the existing maintenance system from four key sources of information:

- Consultations and discussions
- Questionnaires
- Site visits
- Review of existing literature

Our team held several meetings with Bangladesh Railway to find out the effectiveness of the present maintenance system, shortfalls and constraints, if any, and BR future rolling stock procurement and maintenance strategies.

In addition to the meetings detailed above, the Consultants held number of meetings with workshop and shed in-charges to get their views about their unit performance, reasons for not meeting targets, areas requiring up-gradation etc.

We also prepared questionnaires to collect data regarding the current status of rolling stock and maintenance facilities performance during the last ten years. We then sent them to maintenance workshops, sheds and depots.

We visited following major rolling stock maintenance facilities in order to gather data and obtain firsthand information about maintenance practices, infrastructure facilities and problems faced in day to-day maintenance of rolling stock:

- Diesel Loco Running Shed, Dhaka – visited on January 18, 2016
- Coach Maintenance Depot, Dhaka – visited on January 25, 2016
- Diesel Workshop, Dhaka– visited on January 25, 2016
- Diesel Workshop, Parbatipur – visited on March 05, 2016
- Central Locomotive Workshop, Parbatipur – visited on March 06, 2016
- C & W Workshop, Saidpur – visited on March 07, 2016

- Diesel Workshop, Pahartali – visited on March 27, 2016
- Diesel Loco Running Shed, Pahartali – visited on March 27, 2016
- C & W Workshop, Pahartali – visited on March 28, 2016
- Railway Training Academy, Chittagong – visited on March 29, 2016

Collected data has been analysed to:

- Assess current on-line performance of rolling stock, their availability for traffic use and reasons for high ineffective percentages;
- Gather age-wise holding data on the books and identify the number of ineffective and serviceable units of each type of rolling stock;
- Assess current serviceable fleet inventory, the rolling stock condemnation and procurement plans;
- Review existing practices and procedures, staff and organisation, and current maintenance operations and overhaul schedules for each type of rolling stock; and
- Establish the future periodic inspections and preventive maintenance workload, including planned overhauls and major repairs.

The due diligence and diagnostic analysis was undertaken to assess BR rolling stock maintenance facilities performance and identify constraints and weaknesses for not achieving target schedule maintenance levels. Our analysis showed following major factors affecting rolling stock maintenance:

- Over age rolling stock –Very high percentage over age rolling stock (average Loco – 56%, coaches – 40% and wagons – 46%) is running on BR system. Their failure rate is high and they require frequent attention. Overage stock also has problem of obsolescence and non-availability of spares.
- Diesel locomotive infrastructure – All three Diesel Locomotive Workshops located at Dhaka, Parbatipur and Pahartali are converted loco running sheds. All three workshops have very low loco berthing capacity, poor support shop facilities, inadequate space to attend components and sub-assemblies etc.
- Human Resource –All rolling stock maintenance workshops have very serious problem of staff shortage. At present vacancies vary from 20% to 60% in different workshops and within next five years this will go up to 44% to 75%.
- Shop floor staff skill level is very poor as they are not given any practical or hands on training. Training Units attached to workshops are very poorly equipped and have no facility practical training.
- Materials, Components and Spare Parts Procurement –We noted during our visits to maintenance workshops that all of them had large number of materials, components and spare parts out of stock affecting maintenance performance.

- Rolling Stock Condemnation Policy – Condemn of rolling stock under current BR condemnation policy is very difficult with the result very large number of rolling stock continues to be on books even though these have been taken off the rails.
- Inadequate Revenue Budget Allocation – Many workshops have to lower their out turn level because of low revenue budget allocation. In fact Saidpur and Pahartali workshops have not done very important coach GOH schedule under revenue budget for the last fifteen or more years and many coaches are running overdue this schedule.

Based on above analysis and observations we have made the following new project recommendations:

Project	Estimated Cost	
	USD Millions	BDT crore
Additional machinery & plant for Central Locomotive Works, Parbatipur	100	770
Diesel Locomotive Workshop, Narayanganj – 150 locos	150	1155
DEMU Maintenance Workshop, near Dhaka – 75 Train sets	125	963
Carriage & Wagon Workshop, Rajbari	325	2503
Diesel Locomotive Workshop, Chittagong	150	1155
Traction Motor Rehabilitation Workshop, CLW, Parbatipur	50	385
Diesel Locomotive Workshop, Rajbari	150	1155
Carriage Maintenance Workshop, location to be decided later	325	2503
DEMU Maintenance Workshop , Ishurdi-75 Train sets	125	963
Carriage & Wagon Workshop – Chittagong	358	2755
Carriage Maintenance Workshop, location to be decided later	325	2503
DEMU Maintenance Workshop ,Chittagong -75 Train sets	125	963
Technical Training Schools up-gradation	5	39
Running staff rest room up-gradation	5.8	45
Mechanical, Electrical and Stores department codes and manual updating	4	31
Loco sheds upgrade and conversion to dual gauge	519	4000
C&W Depot upgrade and conversion to dual gauge	519	4000

With the commissioning of all recommended projects and providing all the necessary inputs BR rolling stock maintenance capacity will be:

- | | | | |
|------|-------------|---|-----------------------------|
| i. | Locomotives | : | 450 |
| ii. | Coaches | : | 5,625 vehicles |
| iii. | DEMU | : | 225 sets of 3 vehicles each |
| iv. | Wagon | : | 8,500 bogie wagons |

In addition following Administrative & Procedural Reforms have been recommended:

- Staff recruitment policy
- Procurement policy review
- Rolling stock condemnation policy
- Higher budget allocation

BR will require substantial procurement of rolling stock over the Plan period, both to replace overage and condemned stock as well as to cater to increased passenger and freight traffic. A summary of the procurement requirements over the Plan period is below. The analysis is based on the BR rolling stock complement as of April 2017; any RS procured after that date should be assumed to be included in the numbers below.

RS Procurement Summary Table		Phase 1 2017-20	Phase 2 2021-25	Phase 3 2026-30	Phase 4 2031-35	Phase 5 2036-40	Phase 6 2041-45	
Locomotives								
	Expansion							
		BG	31	0	48	63	75	64
		MG	37	0	0	0	0	0
	Replacement							
		BG	55	0	0	7	7	13
		MG	74	0	0	0	0	0
	Total		197	0	48	70	82	77
Coaches								
	Expansion							
		BG	216	103	831	775	858	965
		MG	65	171	0	0	0	0
	Replacement							
		BG	241	0	21	0	0	201
		MG	696	0	0	0	0	0
	Total		1218	274	852	775	858	1166
Wagons								
	Expansion							
		BG	1000	0	423	731	1165	1282
		MG	0	0	96	0	0	0
	Replacement							
		BG	140	482	33	0	0	0
		MG	580	0	507	0	0	0
	Total		1720	482	1059	731	1165	1282

1 Introduction

Key Messages

- In this introductory Chapter, we provide a description of the purpose and related structure of our Volume II Report, which forms part of Bangladesh RCIP Project Interim Report

1.1 Introduction

1.1.1 Purpose of the Report

The current Bangladesh Railways Master Plan was adopted in 2013. The actual plan preparation was made in 2006/2007 based on 2005 and earlier data. Bangladesh Railway has access to sources of capital to upgrade its operations. To efficiently exploit those resources, BR needs a revised Master Plan.

Under the current Master Plan, Bangladesh Railways (BR) is committed to an ambitious program of capital works and procurement designed to increase capacity in both freight and passenger transport. Some inroads have been made in that respect. However, much remains to be done.

One of the objectives of this project is to assess the existing BR rolling stock maintenance facilities and identify areas where additional capacity and additional inputs are required. This will include evaluation of existing major workshop infrastructure facilities, maintenance practices, machinery and plant condition and all other factors affecting performance of these workshops.

1.1.2 Project Objectives

This report presents the findings from the due diligence and diagnostic assessment of BR rolling stock maintenance facilities, its infrastructure and assets, operations and future prospects.

The due diligence and diagnostic analysis has been undertaken against the backdrop of the objectives of the 25-year master plan process.

This due diligence and diagnostic analysis is thus a key input into the creation of the future plan for BR rolling stock maintenance facilities. It establishes the baseline upon which infrastructure upgrades, operational changes and institutional enhancements will be recommended for the BR facilities.

The due diligence and diagnostic assessment are intended to provide the context to addressing the following:

BR requirements	Comments
Infrastructure Facilities	Provision and maintenance of RS assets to meet traffic requirements etc. Rehabilitation of old workshops, sheds and other facilities. Expansion of RS maintenance infrastructure, including locomotive workshops, C&W workshops, loco sheds and C&W depots.
Operational	Improve maintenance related support services such as manpower, material and machine & tools etc. Set modern standards for RS maintenance Ensure adequate and timely availability of rolling stock to meet all traffic demands.

BR requirements	Comments
Financial	Ensure that maintenance facilities are provided necessary funds for all maintenance activities
Human Resource	Ensure all necessary staff is provided at maintenance facilities. Provide facilities for training and skill development of inspectors, supervisors and artisans. Provide for safety and security of persons working in workshops, sheds and depots.

The report, therefore, presents a holistic (within the mandate of the Consultant) overview of current rolling stock maintenance facilities and practices and identifies areas requiring special attention. The broad topics addressed in this report are:

- BR rolling stock holdings
- BR rolling stock maintenance philosophy
- Rolling stock availability to meet traffic demand
- Rolling stock maintenance facilities
- Maintenance facilities performance evaluation
- Identify reasons for poor performance

Discussions on the above topics are intended to help define the current operational context of the BR rolling stock maintenance sector and thus present a credible basis for the recommendations on future improvements. The report concludes with specific recommendations for change in BR RS maintenance facilities and practice.

1.2 Methodology

1.2.1 Data Collection

Bangladesh Railway locomotive maintenance management is based on a preventive maintenance model requiring locomotives to visit maintenance sheds/workshops for inspection and repairs according to a pre-defined maintenance schedule.

We collected data to assess efficiency and effectiveness of the existing maintenance system from four key sources of information:

- Consultations and discussions
- Questionnaires
- Site visits
- Review of existing literature

1.2.2 Consultations and Discussions

Our team held several meetings with Bangladesh Railway to find out the effectiveness of the present maintenance system, shortfalls and constraints, if any, and BR future rolling stock procurement and maintenance strategies.

In addition to the meetings detailed above, the Consultants held number of meetings with workshop and shed in-charges to get their views about their unit performance, reasons for not meeting targets, areas requiring up-gradation etc. A list of these meetings can be found in Appendix 1.

1.2.3 Questionnaires

We prepared questionnaires to collect data regarding the current status of rolling stock and maintenance facilities performance during the last ten years. We then sent them to maintenance workshops, sheds and depots. Collected data will be analysed to:

- Assess current on-line performance of rolling stock, their availability for traffic use and reasons for high ineffective percentages;
- Gather age-wise holding data on the books and identify the number of ineffective and serviceable units of each type of rolling stock;
- Assess current serviceable fleet inventory, rolling stock condemnation and procurement plans;
- Review existing practices and procedures, staff and organisation, and current maintenance operations and overhaul schedules for each type of rolling stock; and
- Establish the future periodic inspections and preventive maintenance workload, including planned overhauls and major repairs.

Copies of questionnaires can be found in Appendices 2A to 2C.

1.2.4 Site Visits

We visited the following major rolling stock maintenance facilities in order to gather data and obtain firsthand information about maintenance practices, infrastructure facilities and problems faced in day to-day maintenance of rolling stock:

- Diesel Loco Running Shed, Dhaka – visited on January 18, 2016
- Coach Maintenance Depot, Dhaka – visited on January 25, 2016
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- C & W Workshop, Pahartali – visited on March 28, 2016
- Railway Training Academy, Chittagong – visited on March 29, 2016

1.2.5 Review of Existing Literature

Our team also collected available literature, statistics, reports and drawings pertaining to rolling stock holding, its availability for traffic, maintenance workshops performance etc. as part of the project effort.

1.3 Volume II Report Structure

This volume is structured into the following chapters:

- Chapter 1 - Introduction: presents the purpose of the Report and provides a general overview of the topics to be discussed in the report.
- Chapter 2 - BR Rolling Stock Maintenance Management: deals with –
 - Description of RS
 - Basic Principles of RS maintenance
 - Maintenance Inspection Cycle on BR
 - Facilities required for Overall Maintenance
- Chapter 3 - Locomotive Maintenance: contains observations made during visits to various BR locomotive maintenance facilities, their performance during the last ten years, constraints in achieving targets etc.
- Chapter 4 - Carriage and Wagon (C&W) Maintenance: deals with observations made during visits to various BR C&W maintenance facilities, their performance during the last ten years, constraints in achieving targets etc.
- Chapter 5 - Evaluation of BR Rolling Stock Maintenance Management: this has detail analysis of data collected during field visits is done and factors for low efficiency and performance are identified.
- Chapter 6 - Recommendations and Future Strategy

2

Rolling Stock Maintenance Management

Key Messages

- Bangladesh Railway currently has a total of 2,877 route km across two zones
- There is an ongoing program of conversion to Dual Gauge (Broad Gauge and Metre Gauge)
- There are many line capacity constraints, due to a variety of reasons
- There is a high percentage of non-operating rolling stock
- Passenger and freight carriage are not increasing, despite increasing overall demand for transport services

2.1 Introduction

Railway rolling stock refers to all the vehicles that move on a railway system. These can either be powered or unpowered vehicles or a combination of both. Some examples of rolling stock include locomotives, diesel multiple units, coaches and wagons. These are high-value capital assets and are the most maintenance-intensive and vulnerable part of the railway system. They have number of mechanical and electrical components combined into several systems containing a large number of moving parts. To achieve an acceptable railway service level, each system needs to be kept operational and regular maintenance is the essential factor to achieve this.

Although rolling stock maintenance is expensive, it will become more expensive to replace the failing equipment early in its life because maintenance has been neglected. Therefore, for a reliable railway operation the rolling stock must be kept in good working order.

2.2 RS Maintenance Objective

An efficient and successful railway system is required to maintain a high level of reliability, safety, punctuality, availability and maintainability within the railway network. Rolling stock has a huge effect on the performance level of the system because its failure in service adversely affects the train operation, freight movement, passenger safety and comfort. Therefore, to achieve the required service level, quality of the rolling stock performance needs to be improved continually and this can be achieved with proper maintenance.

Rolling stock maintenance can be categorized into two types: preventive and corrective maintenance.

2.2.1 Preventive Maintenance (Schedule Repairs):

Preventive, schedule or periodic maintenance is done on a regular pre-determined time schedule basis such as weekly, monthly, bi-monthly, quarterly, half-yearly or yearly periods. Its purpose is to prevent, minimize or predict the occurrence of future breakdown of any equipment. Factors that affect the efficiency of this type of maintenance are:

- Support and commitment from executive management to Preventive Maintenance programme
- Proper planning and scheduling of Preventive Maintenance programme
- Availability of adequate number of staff for rolling stock maintenance
- Trained staff with required technical qualifications and skills
- Right choice of equipment and machinery & plant suitable for rolling stock maintenance activities

Some of the important benefits of a properly operated preventive maintenance program are:

- Schedule repair production capacity is increased and the number of un-scheduled repairs are reduced

- Better conservation of assets and increased life expectancy of assets, thereby eliminating premature replacement of equipment and components
- Reduced overtime costs and more economical use of maintenance workers due to the ability to work on a scheduled basis instead of an emergency basis to repair breakdowns
- Timely, routine repairs circumvent fewer large-scale repairs
- Improved safety and quality conditions for everyone

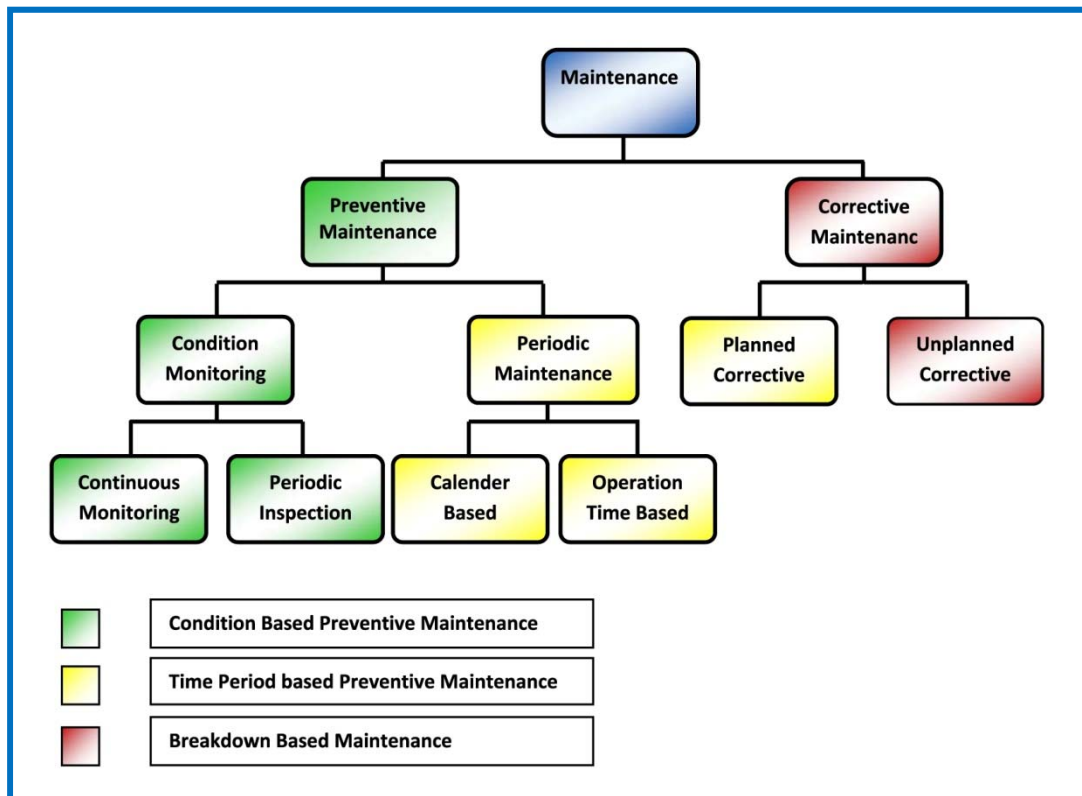
2.2.2 Corrective Maintenance (Unscheduled Repairs):

Corrective maintenance or Unscheduled Repairs are activities carried out to fix sudden breakdown of rolling stock due to an assembly or component failure during train operation or when a defect is detected during preventive maintenance schedule.

This type of maintenance is subdivided into three types:

- **Remedial maintenance** - a set of repair activities that are performed to eliminate the source of failure without interrupting the rolling stock availability for traffic operation. The way to carry out this type of corrective maintenance is by taking the rolling stock to running maintenance shed and replacing it with reconditioned item.
- **Deferred maintenance** - a set of corrective maintenance activities that are not immediately initiated after the occurrence of a failure but are delayed in such a way that the rolling stock availability is not affected.
- **Shutdown maintenance** - a set of corrective maintenance activities that are performed when the rolling stock is withdrawn from service and transferred to a workshop for attention.

Figure 2-1: BG/MG Locomotive Maintenance Schedule



Bangladesh Railway has adopted a Preventive Maintenance system for upkeep of rolling stock. But maintenance workshops, sheds and depots have not been able to achieve desired level of output due various constraints resulting in large number of locomotives, coaches and wagons running overdue maintenance schedules. This is one of the reasons BR is facing with the problem of large numbers of ineffective rolling stock and high rolling stock online failures requiring unscheduled repairs. These repairs further consume workshop capacities which are already at low levels.

2.3 BR Rolling Stock Maintenance Facilities

2.3.1 Locomotive Maintenance Facilities

BR locomotive maintenance is carried out in three phases:

- Heavy repairs (GOH) at the Central Locomotive Workshop located at Parbatipur. During this schedule all components are removed, inspected, overhauled, tested and replaced, if found necessary, before assembling them on the locomotive.
- Light repairs at diesel workshops located at Parbatipur, Dhaka and Pahartali. Light repair schedules are done by removing major components from the locomotive and overhauling them.

- Running repairs at ten loco sheds at different locations on the railway system. Locomotive schedule inspection such as trip inspection, forty five days inspection, three months inspection etc. are carried out in locomotive running sheds.

Diesel workshop and loco shed locations, type of schedules carried out, type of locomotives attended and work done details are given in Table 2-1.

Table 2-1: BG/MG Locomotive Maintenance Facilities

S.No.	Workshop/Shed Name	Rolling Stock Attended	Schedules Attended	Repairs Attended
LOCOMOTIVE MAINTENANCE WORKSHOPS				
1.	Central Locomotive Workshop, Parbatipur (CLW/PBT)	All BG & MG locomotives	GOH	General Overhaul, Heavy repairs, and unscheduled repairs
2.	Diesel Workshop, Dhaka	59 nos. MG locomotives	F & G	Light repairs Schedule inspection, maintenance and unscheduled repairs
3.	Diesel Workshop, Pahartali	121 nos. MG locomotives	F & G	
4.	Diesel Workshop, Parbatipur	97 nos. BG locomotives	F & G	

Table 2-2: BG/MG Locomotive Maintenance Facilities

S.No.	Workshop/Shed Name	Rolling Stock Attended	Schedules Attended	Repairs Attended
LOCOMOTIVE MAINTENANCE SHEDS				
1.	Khulna Loco Shed	BG	C, D & E	Running repairs, Trip inspection, schedule repairs and unscheduled repairs.
2.	Ishurdi Loco Shed	BG	C, D & E	
3.	Parbatipur Loco Shed	BG & MG	C, D & E	
4.	Lalmonirhat Loco Shed	MG	C, D & E	
5.	Dhaka Loco Shed	MG	C, D & E	
6.	Pahartali Loco Shed	MG	C, D & E	
7.	Chittagong Loco Shed	MG	C, D & E	
8.	Akhura Loco Shed	MG	Trip Inspection	
9.	Kayotkhali Loco Shed	MG	Trip Inspection	
10.	Sylhet Loco Shed	MG	Trip Inspection	

Source: Data supplied by BR Mechanical Department

2.3.2 Carriage & Wagon Maintenance Facilities

Passenger Carriages

Passenger carriage maintenance on BR is carried out in following phases:

- General Overhauls (GOH) are done at the Railway Workshop, Saidpur and Pahartali. During this schedule coach is practically rehabilitated and all components including internal fittings are removed, inspected, overhauled, tested and replaced, if found necessary, before assembling them back.
- Periodical Overhaul (POH) and Lift Enamel (LE) schedules are carried out in railway workshops located at Saidpur and Pahartali. Light repair schedules are done by removing major components and internal fittings and overhauling them.
- Running repairs are attended at twelve carriage & wagon depots located at different stations on the railway system. Minor repairs like brake blocks change, brake power adjustments, overhead tank attention, wheel change etc. are attended in C&W depots.

In addition to above schedules, every train is inspected and attended for minor faults in the wash sidings at terminal stations.

Freight Wagons

Freight wagon maintenance on BR is carried out in following schedules:

- Periodical Overhaul (POH) is carried out in railway workshops located at Saidpur and Pahartali. Body repair, brake gear inspection and repair, running gear inspection and repair, body painting etc. are attended in this schedule.
- Running repairs are attended to at twelve carriage & wagon depots located at different stations on the railway system. Minor repairs like brake block change, brake power adjustment, wheel change etc. are attended in C&W depots.
- In addition freight trains are also inspected and attended for minor faults at train examination stations.

C&W workshops and depots, type of schedules carried out, type of coaches and wagons attended and work done details are given in Table 2-3.

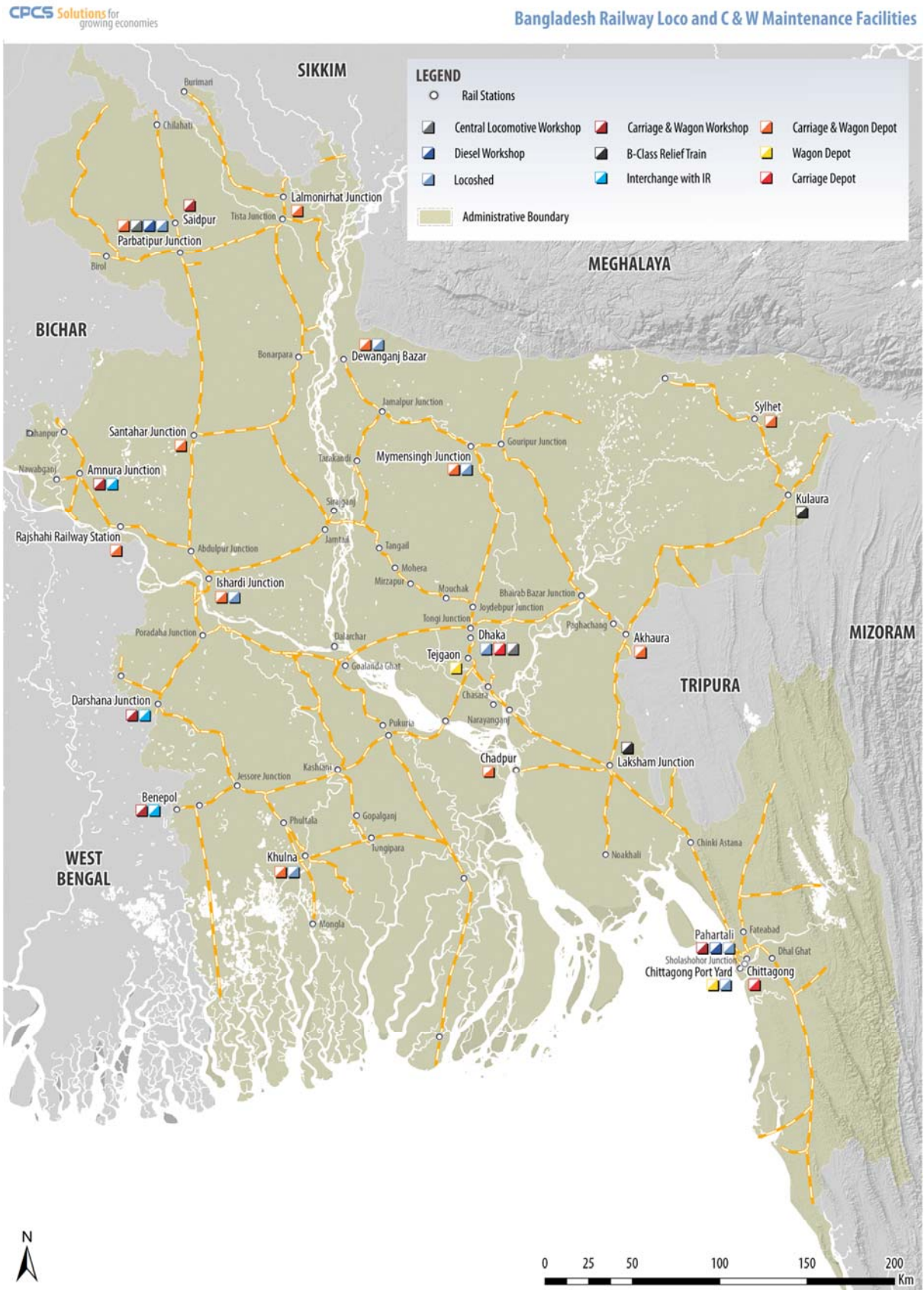
Table 2-3: BG/MG Passenger Carriage and Wagon Maintenance Facilities

S.No.	Workshop/Depot Name	Rolling Stock Attended	Schedules Attended	Repairs Attended
COACH& WAGON MAINTENANCEWORKSHOPS				
1.	Railway Workshop, Saidpur	BG/MG	GOH and POH	Rehabilitation and heavy repairs and
2.	Railway Workshop, Pahartali	MG	GOH and POH	Rehabilitation and heavy repairs and

S.No.	Workshop/Depot Name	Rolling Stock Attended	Schedules Attended	Repairs Attended
COACH& WAGON MAINTENANCE DEPOTS				
1.	Khulna C&W Depot	BG	Light Schedule	Running repairs, Trip inspection, schedule inspection, schedule repairs and unscheduled repairs.
2.	Ishurdi C&W Depot	BG	Light Schedule	
3.	Rajshahi C&W Depot	BG	Light Schedule	
4.	Parbatipur C&W Depot	BG & MG	Light Schedule	
5.	Lalmonirhat C&W Depot	MG	Light Schedule	
6.	Shantaher C&W Depot	MG	Light Schedule	
7.	Dhaka C&W Depot	MG	Light Schedule	
8.	Akhura C&W Depot	MG	Light Schedule	
9.	MymonshahiC&W Depot	MG	Light Schedule	
10.	Sylhet C&W Depot	MG	Light Schedule	
11.	Pahartali C&W Depot	MG	Light Schedule	
12.	Chittagong C&W Depot	MG	Light Schedule	
13.	Chittagong Port Wagon Depot	MG	Light Schedule	
14.	Bonapara Wagon Depot	MG	Light Schedule	

Source: Data supplied by BR Mechanical Department

Figure 2-2: Bangladesh Rolling Stock Maintenance Facilities



3

BR Locomotive Maintenance

Key Messages

- This chapter provides a broad overview of locomotive inspection and maintenance cycle, maintenance facilities and their performance.
- We then provide a description of various locomotive maintenance workshops, various schedules attended and their performance.
- We also discuss status of available staff, material, machinery and plant and funds.

3.1 BR Locomotive Holding

Bangladesh Railway diesel locomotive holding as at Apr 17, 2016 was 280 locomotives excluding 20 diesel electric multiple units. Out of these 70 locomotives (17 BG and 53 MG) were ineffective and not available for traffic service. Type-wise locomotive details are shown in Table 3-1 below.

Table 3-1: BR Locomotive Holding, Ineffective & Availability for Traffic as on 17.04.2016

S.No.	Type of Loco	Number on Books			Number Ineffective	Total Available	Ineffective %
		East Zone	West Zone	Total			
BG LOCOMOTIVES							
1.	BEA – 20	-	17	17	3	14	17.6
2.	BEM – 20	-	14	14	2	12	14.3
3.	BEH – 24	-	12	12	6	6	50.0
4.	BEB – 22	-	12	12	1	11	8.3
5.	BED – 26	-	13	13	2	11	15.4
6.	BED – 30	-	26	26	3	23	11.5
7.	BHZ – 5	-	0	0	-	-	0.0
Total		-	94	94	17	77	18.1
MG LOCOMOTIVES							
1.	MEG – 11	9	0	9	2	7	22.2
2.	MEG – 9	25	11	36	11	25	30.5
3.	MEM – 14	15	17	32	5	27	15.6
4.	MEG – 15	16	0	16	6	10	37.5
5.	MEL – 15	21	0	21	7	14	33.3
6.	MED – 14	10	0	10	6	4	60.0
7.	MEI – 15	38	1	39	8	31	20.5
8.	MHZ – 5	3	0	3	1	2	33.3
9.	MHZ – 8	0	3	3	0	3	0.0
10.	MEH-14	17	0	17	7	10	41.3
Total		154	32	186	53	133	28.5
Grand Total		154	126	280	70	210	25.0

Source: Data supplied by BR Mechanical Department

3.2 Locomotive Age Profile

As the life of a locomotive increases, reliability, performance and fuel efficiency goes down but maintenance cost and running cost increases. Most railways, therefore, consider 40 years as the economic life of a locomotive. But BR Mechanical code lays down economic life of diesel locomotive as 20 years, which is considered very low.

A BG locomotive on BR works at an average 9.34 hrs per day covering 176 km and MG loco 11.4 hours covering 173 km. On neighbouring Indian Railways a locomotive earns at an average 560 km per day, almost three times that on BR, but specified economic life of a diesel locomotive is 35 years. We recommend diesel locomotive economic life to be raised to 30 years when Mechanical Code is updated.

BR has 94 BG locos on their books and out of these 55 locos (58.5%) are beyond the economic life of 20 years and 13 more locos will be older than 20 years within the next 5-8 years.

Similarly out of 186 MG locos 116 (62.3%) are older than 20 years and beyond the maximum economic life of a locomotive. Another 61 locos are in 11-20 years age range and will be exceeding economic life within the next 6-8 years.

Table 3-2: BR Locomotive Age Profile as On 17.04.2016

S.No.	Type of Loco	Number on Books	Age Profile (Years)					
			0-10	11-20	21-30	31-40	40-50	> 50
BG LOCOMOTIVES								
1.	BEA – 20	17	-	-	-	-	17	-
2.	BEM – 20	14	-	-	-	-	14	-
3.	BEH – 24	12	-	-	-	12	-	-
4.	BEB – 22	12	-	-	-	12	-	-
5.	BED – 26	13	-	13	-	-	-	-
6.	BED – 30	26	26	-	-	-	-	-
Total BG		94	26	13	0	24	31	0
MG LOCOMOTIVES								
1.	MEG – 11	9	-	-	-	-	-	9
2.	MEG – 9	36	-	-	-	-	-	36
3.	MEM – 14	32	-	-	-	11	21	-
4.	MEG – 15	16	-	-	16	-	-	-
5.	MEL – 15	21	-	-	21	-	-	-
6.	MED – 14	10	-	10	-	-	-	-
7.	MEI – 15	39	20	19	-	-	-	-
8.	MHZ – 5	3	-	-	-	3	-	-
9.	MHZ – 8	3	-	-	-	3	-	-

S.No.	Type of Loco	Number on Books	Age Profile (Years)					
			0-10	11-20	21-30	31-40	40-50	> 50
10	MEH-14	17	-	-	-	17	-	-
Total MG		186	20	29	37	34	21	45
Total BR		280	46	42	37	58	52	45

Source: Data supplied by BR Mechanical Department

3.3 Locomotive Maintenance Schedules

3.3.1 Locomotive Maintenance Schedules

Locomotive availability in proper working condition is one of the most important and critical factor for efficient and on-time train operation. Therefore, each locomotive must go through specified periodic inspection, repair and testing to ensure long defect free availability. If these schedules are not executed on time and locomotives are allowed to run with overdue schedules, chances of defects and component failures in service increase leading to train operation disruption. This will lead to lower number of locomotives on line because failed locos will have to wait for repairs.

Locomotive maintenance schedules specified by BR are shown in Table 3-3 below.

Table 3-3: BG/MG Locomotive Maintenance Schedule

S.No.	Schedule Details	Schedule Frequency	Schedule Time	Schedule Carried Out At
Heavy Repair Schedules				
1.	General Overhaul (GOH)	6 years	45 days	Central Locomotive Workshop (CLW)
2.	"G" Schedule	3 years	21 days	Diesel Workshop
3.	"F" Schedule	18 months	10 days	Diesel Workshop
Light Repair Schedules				
1.	"E" Schedule	6 months	16 hrs	Loco Shed
2.	"D" Schedule	3 months	8 hrs	Loco Shed
3.	"C" Schedule	45 Days	6 hrs	Loco Shed
4.	Trip Inspection	After every trip	45 minutes	Loco Shed

Source: BR Mechanical Department

Schedule and Inspection Description

BR locomotive maintenance is based on schedule inspections over a period of six years, after which the locomotive is due for General Overhaul. The inspection frequency and brief content description of each schedule is as under:

- “C” Schedule – performed every 45 days. It consists of general inspection, fuel and oil system filtration change and inspection of consumables such as motor carbon brushes, lube oil, alarm and protection devices, safe working of engine, traction and braking system and general cleaning of locomotive.
- “D” Schedule – performed every three months. In addition to items attended in “C” schedule attention is given to wheel inspection, truck and car body lubrication and engine air intake system.
- “E” Schedule – performed every six months. In addition to items of “D” schedule more detailed inspection of fuel, air in-take, engine components and protective device tuning are carried out.
- “F” Schedule – performed every 1½ years. In addition to items attended in “E” schedule detailed exhaust system inspection, protective devices and cooling system calibration, traction control calibration and load tests are done.
- “G” schedule – performed every three years. In addition to all items attended in earlier schedules, detailed testing, calibration, repair and maintenance of all major and critical components and sub-assemblies are done.
- “General Overhaul (GOH)” – This schedule is done every six years and as the name suggests all major components are removed, tested and wherever necessary replaced. Effort is to bring locomotive performance as close to a new loco as possible.

A typical six year maintenance cycle of a locomotive includes:

- GOH : 1 instance
- “G” Schedule : 1 instance
- “F” Schedule : 2 instances
- “E” Schedule : 8 instances
- “D” Schedule : 12 instances
- “C” Schedule : 24 instances

From the time it undergoes a General Overhaul, a locomotive will typically follow a maintenance schedule programme similar to that shown in Table 3-4 below over the six-year cycle.

Table 3-4: BG/MG Locomotive 6-Year Maintenance Matrix

Month	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	Sch.	Sch.	Sch.	Sch.	Sch.	Sch.
Jan.						

Feb.	C	C	C	C	C	C
Mar.	D	D	D	D	D	D
Apr.						
May.	C	C	C	C	C	C
Jun.	E	F	E	E	F	E
Jul.						
Aug.	C	C	C	C	C	C
Sep.	D	D	D	D	D	D
Oct.						
Nov.	C	C	C	C	C	C
Dec.	E	E	G	E	E	GOH

To ensure the entire BR holding of 280 locomotives remains in good mechanical and running condition and is available at all times to meet traffic department requirements, maintenance workshops should aim to achieve following heavy schedule outturn:

- General Overhaul (GOH) – Every 6 years : 47 locos/year
- “G” Schedule – Every 3 years : 47 locos/year
- “F” Schedule – Every 1½ years : 94 locos/year

3.4 Visits to Maintenance Workshops

We visited the following locomotive maintenance facilities to gather data and obtain firsthand information about maintenance practices, infrastructure facilities and problems faced in day to-day maintenance of rolling stock:

- Central Locomotive Workshop, Parbatipur – Visited on March 06, 2016
- Diesel Locomotive Workshop, Dhaka – Visited on January 25, 2016
- Diesel Locomotive Workshop, Parbatipur – Visited on March 05, 2016
- Diesel Locomotive Workshop, Pahartali – Visited on March 27, 2016
- Loco Running Shed, Dhaka – visited on January 18, 2016

A detailed questionnaire had been prepared and sent to all workshops prior to the visit to collect information regarding current status of rolling stock and maintenance facilities performance during the last ten years. Collected data was analysed to:

- Assess current on line performance of rolling stock, their availability for traffic use and reasons for high ineffective percentages;
- Gather age-wise holding data on the books, identify the number of ineffective and serviceable units of each type of rolling stock;

- Assess current serviceable fleet inventory, the rolling stock condemnation and procurement plans;
- Review of existing practices and procedures, staff and organisation, and current maintenance operations and overhaul schedules for each type of rolling stock; and
- Establish the future periodic inspections and preventive maintenance workload, including planned overhauls and major repairs.

3.4.1 Visit to Central Locomotive Workshop, Parbatipur

General

Figure 3-1: Entrance Gate Central Locomotive Workshop, Parbatipur



During our visit to Central Locomotive Workshop (CLW), Parbatipur, we met Mr. Noor Mohammed WM/P since Mr. Burhan Uddin, Chief Executive of the workshop was out of station. He explained details of workshop facilities, maintenance schedules carried out, last ten years output, constraints in achieving target output, etc.

The workshop was set up in 1992 to carry out General Overhaul (GOH) schedule of all Bangladesh Railway BG and MG locomotives. Its design capacity is maintenance and repair of 400 locomotives: i.e. approximately $400/6 = 66$ locos/year GOH and unscheduled repair.

There are 25 tracks, all dual gauge, in the main repair bay to hold locomotives under maintenance. Lifting of locos superstructure to release bogies is done with the help of synchronized lifting jacks.

The response to our workshop questionnaire can be found in Appendix 3.

Performance

Workshop output during the last ten years (2005-06 to 2014-15) has been:

Table 3-5: CLW, Parbatipur Output for the Last Ten Year

S.No.	Year	GOH	Special Repair	Total
1.	2005 - 2006	17	07	24
2.	2006 - 2007	18	11	29
3.	2007 - 2008	22	07	29
4.	2008 - 2009	19	09	28
5.	2009 - 2010	18	18	36
6.	2010 - 2011	25	12	37
7.	2011 - 2012	27	19	46
8.	2012 - 2013	16	22	38
9.	2013 - 2014	17	20	37
10	2014 - 2015	17	15	32
Total		196	140	336
Average Per Year		19.6	14.0	33.6

Source: BR Mechanical Department

The above data shows that average GOH output during the last ten years has been 19.6 locos/year and maximum GOH output in any one year during the last ten years was 27 in 2012–13.

Figure 3-2: Locomotive Undergoing GOH at CLW, Parbatipur



Current BR diesel loco holding is 280 locos and to carry out GOH once in six years in accordance with specified maintenance schedule for all locos, CLW should attend $280/6 =$ approx. 47 locos/year. This means that with current average output of 19.6 locos/year, approximately 26 to 27 (47 – 19.6) locos are added every year as overdue GOH locos running on BR system.

Staff Position

From its inception in 1992, CLW has never had full workshop staff strength and has been carrying 25–30% vacancies. BR also has some administrative problems in fresh staff recruitment even against vacancies created by normal attrition like retirement, resignation, transfer etc. As a result, vacancies are increasing year after year and have reached a level of 44.4% in 2016.

Table 3-6: Staff Position at CLW, Parbatipur

S.No.	Year	Sanctioned Strength	Staff On Roll	Vacancies	% Vacancies
1.	2005	525	390	135	25.7
2.	2006	537	400	137	25.5
3.	2007	537	386	151	28.1
4.	2008	545	363	182	33.4
5.	2009	545	363	182	33.4
6.	2012	544	340	204	37.5
7.	2013	544	340	204	37.5
8.	2014	544	337	207	38.0
9.	2015	545	317	228	41.8
10	2016	545	303	242	44.4

Source: CLW, Parbatipur Management

Material Management

Approximately 25,000 items are required for diesel loco maintenance. Out of these 15,000 items are stocked at the store depot attached to CLW; the rest are stocked elsewhere.

Traction motor repair has been outsourced to a private party who is carrying out repairs within the shop premise.

At the time of our visits, 25 critical diesel loco spares had been out of stock for more than three months.

Earlier, a unit exchange system (Known as R&R) was practised for replacement of damaged and defective spares, components and sub-assemblies. This system is no longer practiced because of spares and a large number of repairable items are accumulating in the stores. 1,466 compressor cylinders and 98 traction motors (repaired and repairable) were available in stores with very little shop requirement.

Machinery & Plant

CLW workshop has approximately 350 machinery and plants. Out of these, 33 machines, some very critical for production, maintenance and testing, were out of order. Many

machines such as a Dynamic Balancing Machine, a Test Stand for Woodward Speed Regulator, a Spectrophotometer, a Hardness Tester etc. have been under breakdown for more than five years. These are all testing and inspection equipment and their non-availability seriously affects testing and quality control of repaired components.

3.4.2 Diesel Workshop, Dhaka

We visited the Diesel Workshop, Dhaka on January 25, 2016 and made following observations:

The workshop was established in 1976 by converting five lines of diesel loco running shed into a workshop.

- Loco workshop has five lines – two lines are with pit and platform.
- One bay covering two lines has one 20/5 ton electric overhead crane but the other bay is without any overhead crane facility.
- The workshop maintains 59 MG diesel locomotives. All 59 locos have vacuum brake system for trailing stock.
- Age profile of these locomotives is:

Table 3-7: Diesel Workshop, Dhaka Locomotive Age Profile

	0 – 20 Years	21 – 30 Years	31 – 40 Years	Above 40 Years	% Above Economic Life
No. of Locos	10	Nil	28	21	35.6

Source: Diesel Workshop, Dhaka

- Workshop attends to three year “G” schedule, 18 months “F” schedule and special repairs. With 59 loco holding, workshop should be doing 10 loco “G” schedule and 20 loco “F” schedule per year. Workshop outturn for the last ten years has been:

Table 3-8: Diesel Workshop, Dkaka Outturn

S.No.	Year	Schedule “G”	Schedule “F”	Special Repairs	Total
1.	2005-06	8	20	60	88
2.	2006-07	12	11	62	85
3.	2007-08	15	10	80	105
4.	2008-09	8	15	104	127
5.	2009-10	6	17	89	112
6.	2010-11	14	11	114	139

S.No.	Year	Schedule "G"	Schedule "F"	Special Repairs	Total
7.	2011-12	16	10	111	137
8.	2012-13	6	19	183	208
9.	2013-14	10	16	178	204
10.	2014-15	11	14	157	182
Total		106	143	1130	1,379
Average/Year		10.6	14.3	113.0	137.9

Source: BR Mechanical Department

- "G" schedule performance meets the target but "F" schedule is at 75% of the target. Similarly standard time for completing a "G" schedule is 21 days and for an "F" schedule 10 days but workshop is completing a "G" schedule in 30 days and an "F" schedule in 15 days.
- In addition to regular schedules workshop is also attending to special repairs of locomotives. At an average of 113 locos have been attended for special repairs during the last ten years. This means that every loco based at the workshop comes twice a year for special repairs – a very poor reflection on the quality of work done in the workshop.
- 30-40% locomotives based at the shed are running overdue schedule and loco availability for traffic is only 60-65%.
- One under-floor wheel lathe for locomotive wheel turning was installed in 2012 but the machine is highly underutilised.
- The workshop sanctioned staff strength is 171 but only 145 staff is on roll.
- This workshop was created by converting two bays of the loco shed. Therefore, it has very poor infrastructure facility, very little space to attend components and sub-assemblies, poor support shop facilities etc.
- The workshop response to our questionnaire is placed at Appendix 4.

3.4.3 Diesel Workshop, Parbatipur

We visited the Diesel Workshop, Parbatipur on March 05, 2016 and held discussions with the Works Manager regarding workshop performance, quality issues, constraints, staff matters etc. Our team made following observations:

- This workshop was established by converting Parbatipur steam loco shed to diesel workshop.
- Loco workshop has five lines – two lines are with pit and platform.

- The workshop maintains 97 diesel locomotives. All locomotives have dual brake system (Vacuum and Air brake).
- Age profile of these locomotives is:

Table 3-9: Diesel Workshop, Parbatipur Locomotive Age Profile

	0 – 20 Years	21 – 30 Years	31 – 40 Years	Above 40 Years	% Above Economic Life
No. of Locos	39	Nil	24	34	58.7

Source: Diesel Workshop, Parbatipur

- Workshop attends to three year “G” schedule, 18 months “F” schedule and special repairs. With 97 loco holding workshop should be attending 16 loco “G” schedule and 32 loco “F” schedule per year. Workshop out turn for the last ten years has been:

Table 3-10: Diesel Workshop, Parbatipur Outturn

S.No.	Year	Schedule “G”	Schedule “F”	Special Repairs	Total
1.	2005-06	14	21	28	63
2.	2006-07	17	16	38	81
3.	2007-08	15	15	37	67
4.	2008-09	13	19	78	110
5.	2009-10	8	23	61	92
6.	2010-11	19	13	59	91
7.	2011-12	16	18	71	105
8.	2012-13	11	19	85	115
9.	2013-14	16	16	63	95
10.	2014-15	16	18	67	101
Total		145	178	587	920
Average/Year		14.5	17.8	58.7	92.0

Source: BR Mechanical Department

- Against a “G” schedule target of 16 locos/year the average output for the last ten years has been 14.5 locos/year (90% of target) and against “F” schedule target of 32 locos/year the average output has been only 17.8 locos/year (55.6% of the target).
- Similarly standard time for completing “G” schedule is 21 days and for “F” schedule 10 days but workshop is completing “G” schedule in 30 days and “F” schedule in 15 days.
- In addition to regular schedules workshop is also attending to special repairs of locomotives. During the last ten years at an average of 58.7 locos have been attended for special repairs.

- 30-40% locomotives based at the shed are running overdue schedule and loco availability for traffic is only 60-65%.
- One under floor wheel lathe for locomotive wheel turning was installed in 2012 but the machine is highly underutilised.
- One of the main reasons for workshop not able to meet its target is low staff availability. Workshop is working with 50% staff vacancy. The sanctioned workshop staff strength is 298 but only 153 staff are on roll.
- This workshop was created by converting two bays of the loco shed. Therefore, has very poor infrastructure facility, very little space to attend components and sub-assemblies, poor support shop facilities etc.

3.4.4 Diesel Workshop, Pahartali

- Our team visited the Diesel Workshop, Pahartali on March 27, 2016. Mr. Abdul Matin Chowdhury, Joint Director General (Mechanical) was kind enough to visit Pahartali at the same time and accompany our team during workshop visit. Discussions were held with JDG (Mechanical) and Mr. Monir Hossain Chowdhury, Works Manager (Diesel), Pahartali regarding workshop performance, quality issues, constraints, staff matters etc. Workshop response to our questionnaire is placed at Appendix 5.
- Our team made following observations:
 - This workshop was originally set up as running shed for 50 GM locomotives but has now been converted to locomotive maintenance workshop for 121 MG locos and 20 sets DEMU units.
 - Loco workshop has four covered bays and two lines in one bay are with pit and platform.
 - Age profile of locomotives based at Pahartali workshop is:

Table 3-11: Diesel Workshop, Pahartali Locomotive Age Profile

	0 – 20 Years	21 – 30 Years	31 – 40 Years	Above 40 Years	% Above Economic Life
No. of Locos	39	37	0	45	67.78

Source: Diesel Workshop, Parbatipur

- The workshop attends to three year “G” schedule, 18 months “F” schedule and special repairs. Workshop output with 121 loco holding should be 20 loco “G” schedule and 40 loco “F” schedule per year. Workshop output for the last ten years has been:

Table 3-12: Diesel Workshop, Pahartali Output

S.No.	Year	Schedule “G”	Schedule “F”	Special Repairs	Total
1.	2005-06	13	24	225	262
2.	2006-07	28	14	251	293

3.	2007-08	16	24	273	313
4.	2008-09	19	15	263	297
5.	2009-10	26	10	296	332
6.	2010-11	18	13	310	341
7.	2011-12	10	21	281	312
8.	2012-13	21	11	216	248
9.	2013-14	19	13	193	225
10.	2014-15	22	16	191	229
Total		192	161	2499	2852
Average/Year		19.2	16.1	250	285.2

Source: BR Mechanical Department

- The workshop is almost meeting “G” schedule target of 20.0/year but “F” schedule is at 16.1 loco/year against a target of 40 locos/year i.e. just about 40% of the target.
- Similarly standard time for completing “G” schedule is 21 days and for “F” schedule 10 days but workshop is completing “G” schedule in 44 days and “F” schedule in 27.5 days.
- In addition to regular schedules, workshop is also attending to special repairs of locomotives. During the last ten years at an average of 250 locos have been attended for special repairs. This means that every loco based at the workshops comes twice a year for special repairs – a very poor reflection on the quality of work done in the workshop.
- Staff strength of 311 was sanctioned for maintaining 50 GM locomotives. Currently 121 locos and 20 DEMU sets are maintained but staff sanction has not been revised. Even against the sanction of 311 only 188 staff is on roll.
- Workshop has 71 important and critical machines. Their age profile is:

Table 3-13: Diesel Workshop, Pahartali Machine Age Profile

	0 – 20 Years	21 – 30 Years	Above 30 Years
No. of Machines	05	04	62

- There is an urgent need to replace overage machines.
- This workshop has very poor infrastructure facilities. Out of four bays only one bay has a crane. Basic workshop utility facilities such as compressed air, water pipe line, fire hydrants and fire-fighting systems are not available.
- The workshop is very congested and over-crowded with no proper sub-shop and component maintenance facilities.

4

Carriage & Wagon Maintenance

Key Messages

- This chapter provides a broad overview of C & W inspection and maintenance cycle, maintenance facilities and their performance.
- We then provide a description of various C & W maintenance workshops, various schedules attended and their performance.
- Status of available staff, material, machinery and plant and funds is also discussed.

4.1 Passenger Coach Maintenance

4.1.1 Coach Holding

Bangladesh Railway coaching stockholding as at June 30th, 2016 was 1,249 (BG – 347 and MG – 902) vehicles out of which 1,218 (BG – 335 and MG – 883) were for carrying passengers and 31 (BG - 12 and MG – 19) were for tourist, motor vans etc. Out of 1,218 passenger coaches 271 (BG – 63 and MG – 208) were ineffective and not available for traffic service. Type-wise passenger coach details are shown in Table 4-1 below:

Table 4-1: BR Passenger Coach Holding, Ineffective & Availability for Traffic as On 30.06.2016

S.No.	Type of Coaches	Number on Books	Number Ineffective	Total Available for Service	Ineffective %
1.	BG Passenger Coaches	335	63	272	18.81
2.	MG Passenger Coaches	883	208	673	23.79
	Total	1,218	271	945	22.42

Source: BR Information Book 2014-15

4.1.2 Passenger Coach Age Profile

Age profile of current passenger coach holding is shown below in Table 4-2.

Table 4-2: BR Coach Age Profile as On 30.06.2014

S.No.	Type of Coaches	Number on Books	Age Profile (Years)					% Above Economic Life
			0-10	11-20	21-30	31-35	> 35	
BG COACHES								
1.	Inter City Coaches	200	50	0	21	92	37	18.5
2.	Mail & Express Coaches	112	0	0	0	58	54	48.2
Age Profile of Total BG Coaches		312	50	0	21	150	91	29.1
BG Coach Age Profile Percentage			16.0	0	6.7	48.1	29.2	
MG COACHES (East Zone)								
1.	Inter City Coaches	429	76	68	159	26	100	23.3
2.	Mail & Express Coaches	501	4	1	62	61	373	74.45
Total		930	80	69	221	87	473	50.86
MG COACHES (West Zone)								
1.	Inter City Coaches	76	0	0	32	14	30	39.5
2.	Mail & Express Coaches	159	0	0	64	15	80	50.3
Total		235	0	0	96	29	110	46.8
Age Profile of Total MG Coaches		1165	80	69	317	116	583	
MG Coach Age Profile Percentage			6.9	5.9	27.2	10.0	50.0	
TOTAL COACHES		1477	130	69	338	266	674	45.7
Total Coach Age Profile Percentage			8.8	4.7	22.9	17.9	45.7	

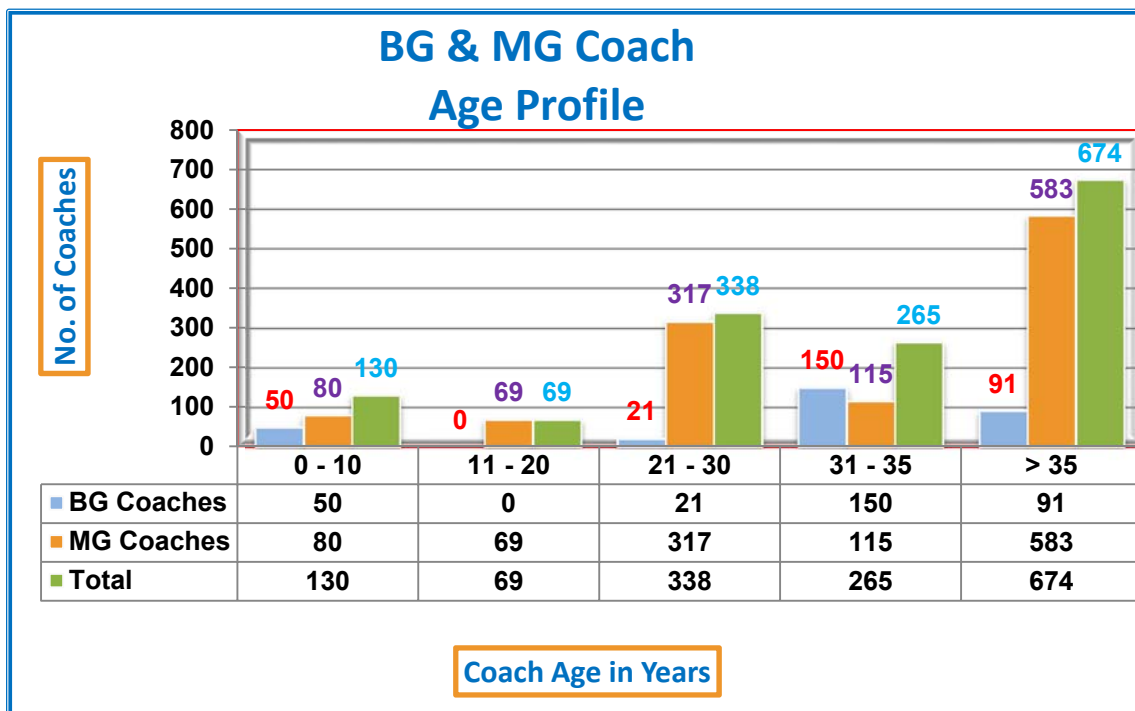
Source: Data supplied by BR Mechanical Department

Passenger trains are a public utility service and passengers want safe, reliable, comfortable, accessible and punctual trains providing proper facilities for journeys they make. As coaches

become older, not only their reliability, performance and interior deteriorate but maintenance cost and running cost also increase. Most railways, therefore, consider 35 years as the economic life of a coach.

Out of 1,474 BR passenger coaches 674 (45.6%) are beyond their economic life of 35 years and 265 more coaches will get added to this category within the next 1-5 years. If overage coaches are not replaced in near future BR will be running 939 (63.6%) overage coaches on its system.

Figure 4-1: BR Coach Age Profile as On 30.06.2014



4.1.3 Coach Maintenance Schedules

The objective of passenger coach maintenance is to ensure that the asset continues to function and meet the required quality standards throughout the anticipated life or even beyond the original design life. Coach availability in safe, reliable, clean and satisfactorily working condition fitted with all passenger amenities is one of the most important and critical factors to generate public confidence and satisfaction.

There are three main types of coach maintenance schedules and a fourth instance where repairs are unscheduled:

- Routine trip inspection carried out in washing siding;
- Minor repair schedules carried out at C&W Depot;
- Periodic maintenance carried out in Workshop; and
- Emergency unscheduled repair.

If these schedules are not executed on time and coaches are allowed to run with overdue schedules, chances of defects and component failures in service increase leading to public complaints and train operation disruption.

Coach maintenance schedules specified by BR are shown below in Table 4-3.

Table 4-3: BG/MG Coach Maintenance Schedule

S.No.	Schedule Details	Type Of Coach	Schedule Frequency	Schedule Time	Schedule Carried Out At
1.	General Overhaul (GOH)	All Coaches	12 years	45 days	Carriage & Wagon Workshop, Saidpur & Pahartali
2.	POH	Inter City Coach	4 years	27 days	1. C&W Workshop, Saidpur 2. C&W Workshop, Pahartali
		Mail & Express Coach	6 years		
3.	Light Enamel (LE)	Inter City Coach	1 year	15 days	1. C&W Workshop, Saidpur 2. C&W Workshop, Pahartali
		Mail & Express Coach	1½ years		

Source: BR Mechanical Department

The BR coach holding is 1,477. To ensure that the entire BR holding remains in good mechanical and running condition and is available to meet traffic department requirements, maintenance workshops should aim to achieve the following heavy schedule outturn:

Inter City Coaches

- GOH Schedule - Every 12 years(705/12) : 59 coaches/year
- POH Schedule - Every 4 years(705/4-59) : 117coaches/year
- LE Schedule - Every 1 years (705/1-117-59) : 529 coaches/year

Mail & Express Coaches

- GOH Schedule - Every 12 years(772/12) : 64 coaches/year
- POH Schedule - Every 6 years (772/6-64) : 65 coaches/year
- LE Schedule - Every 1½ years (772*2/3-129) : 386 coaches/year

4.2 Freight Wagon Maintenance

4.2.1 Wagon Holding

Bangladesh Railway freight wagon holding as on June 30, 2016 was 8,677 units (BG – 1,830 and MG – 6,847). Type-wise details of total wagons are shown below in Table 4-:

Table 4-4: Type-wise BR Wagon Details as On 30.06.2016

S.No.	Type of Wagon	No. Unit on Books	No. 4-Wh Wagon
1.	BG Wagons	1,830	2,751
2.	MG Wagon	6,847	9,303
	Total	9,179	5,815

Source: Data Supplied By BR

4.2.2 Wagon Age Profile

Freight wagons carry various commodities like food grains, cement, petroleum products, consumable goods etc. from the source of generation to the point of consumption. Therefore, wagons must provide reliable, safe and fast service to its customers. As a wagon becomes old, not only its reliability, condition and performance deteriorate but maintenance cost and running cost also increase. Most railways, therefore, consider 40 years as the economic life of a wagon.

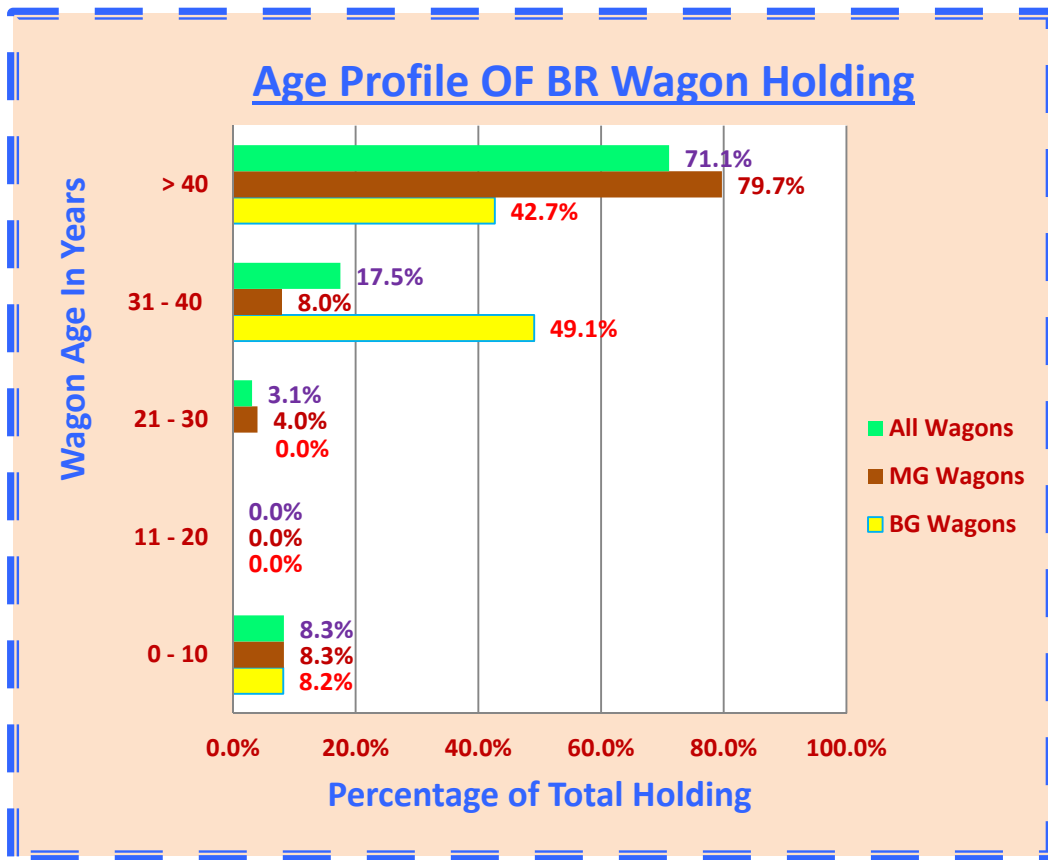
Age profile of current wagon holding is shown below in Table 4-5.

Table 4-5: BR Wagon Age Profile as at June 30.06.2016

S.No.	Type of Wagon	No.on Books	Age Profile (Years)					% Above Economic Life
			0-10	11-20	21-30	31-40	>40	
1.	BG Wagons	2,079	171	0	0	1,020	888	42.7
	BG Wagon Age Profile Percentage		8.2	0	0	49.1	42.7	
2.	MG Wagons	6,850	474	100	278	550	5,448	79.5
	MG Wagon Age Profile Percentage		6.9	1.5	4.0	8.0	79.5	
	Age Profile of All Wagons	8,929	645	100	278	1,570	6,336	71.0
	Age Profile Percentage of All Wagons		7.2	1.1	3.1	17.6	71.0	

Source: Data supplied by BR Mechanical Department

Figure 4-2: BR Wagon Age Profile as at June 30th, 2014



BR freight wagons holding is 8,969 and out of these 6,376 (71.1%) are beyond their economic life of 40 years and 1,570 more wagons will get added to this category within the next 5-10 years. ***In the last ten years BR has added only 220 MG bogie flat wagons, 181 MG bogie tank wagons and 165 BG tank wagons to its holding. If overage wagons are not replaced urgently, BR will have approximately 7,946 (88.6%) overage wagons on its system.***

The wagon maintenance objective is to ensure that the asset continues to function and meet the required quality standards throughout its anticipated life or even beyond the original design life. Wagon availability in safe, reliable and satisfactory working condition is one of the most important and critical factors to generate public confidence and satisfaction.

There are two types of wagon maintenance schedules, along with unscheduled repairs:

- Routine trip inspection carried out in yard and all minor defects attended in C & W depot
- Periodic POH carried out in Workshop
- Unscheduled special repairs.

If these schedules are not executed on time and wagons are allowed to run with overdue schedules, chances of defects and component failures in service increase, leading to public complaints and train operation disruption.

Wagon maintenance schedules specified by BR are shown below in Table 4-.

Table 4-6: BG/MG Wagon Maintenance Schedule

S.No.	Schedule Details	Type Of Coach	Schedule Frequency	Schedule Time	Schedule Carried Out At
1.	Periodic Overhaul (POH)	BG and MG wagons	3½ years	45 days	Carriage &Wagon Workshop, Saidpur
2.	Periodic Overhaul (POH)	MG Wagons	3½ years	45 days	C&W Workshop, Pahartali

Source: BR Mechanical Department

BR freight wagons holding is 8,969 and to ensure that entire BR holding remains in good mechanical and running condition and is available at all times to meet traffic department requirements, maintenance workshops should aim to achieve following POH outturn:

- Wagon POH Schedule - Every 3½ years (8,969÷3½) : 2,563 wagon/year

4.3 Visit to Maintenance Workshops

We visited the following carriage and wagon maintenance facilities to gather data and obtain firsthand information about maintenance practices, infrastructure facilities and problems faced in day to-day maintenance of rolling stock:

- Railway Workshop, Saidpur – Visited on March 07, 2016
- C & W Workshop, Pahartali – Visited on March 28, 2016

A detailed questionnaire was prepared and sent to these workshops prior to the visit to collect information regarding the current status of rolling stock and maintenance facilities performance during the last ten years. Collected data was analysed to:

- Assess current on line performance of rolling stock, their availability for traffic use and reasons for high ineffective percentages;
- Gather age-wise holding data on the books, identify the number of ineffective and serviceable units of each type of rolling stock;
- Assess current serviceable fleet inventory, the rolling stock condemnation and procurement plans;
- Review of existing practices and procedures, staff and organisation, and current maintenance operations and overhaul schedules for each type of rolling stock; and
- Establish the future periodic inspections and preventive maintenance workload, including planned overhauls and major repairs.

4.3.1 Visit to Railway Workshop, Saidpur

General

Figure 4-3: Entrance Gate Railway Workshop, Saidpur



We visited Railway Workshop, Saidpur on March 07, 2016 to collect firsthand information about the workshop. We met Mr. Nur Ahmed Hossain, Divisional Superintendent (Workshop) and discussed workshop performance, its facilities, maintenance schedules carried out, last ten years' outturn, constraints, if any, in achieving target outturn etc. He submitted responses to our questionnaire; these responses can be seen in Appendix 6.

We made following observations during our visit to the workshop:

- This workshop started functioning in 1870 as a small MG steam locomotive running repair shed. In 1903 it was upgraded as a workshop for maintenance of MG carriage, MG wagon and steam locomotives.
- BG rolling stock maintenance facilities were created in 1926.
- Carriage construction was started in an improvised shop in the year 1966 but all activities of this shop were stopped in 1993.
- Most of the shops roof and other structures have been recently renovated.
- Long, wide, vacant and high roof bays of old steam loco overhaul shop are available and can be utilised to expand coach repair or re-building activity.
- 324 BG and 232 MG coaches are allotted to workshop to carryout GOH, POH and LE schedules.
- All BG coaches have solid wheels.

Performance

Workshop outturn during the last six years (2009-10 to 2014-15) has been:

Table 4-7: Railway Workshop, Saidpur Coaching Outturn for the Last Ten Year

S.No.	Year	Coaches Allotted			Workshop Outturn			
		IC Coaches	Others	Total	POH	LE	Special Repair	Total
BG Coaches								
1.	2009 - 10	194	130	324	11	97	4	112
2.	2010 - 11	194	130	324	32	83	5	120
3.	2011 - 12	199	125	324	84	115	13	212
4.	2012 - 13	201	123	324	54	125	13	192
5.	2013 - 14	200	124	324	15	154	8	177
6.	2014 - 15	200	124	324	14	191	16	221
6-Year Total		1188	756	1944	210	765	59	1034
MG Coaches								
1.	2009 - 10	66	158	224	17	48	4	69
2.	2010 - 11	70	159	229	12	71	3	86
3.	2011 - 12	74	160	234	26	62	2	90
4.	2012 - 13	75	160	235	23	83	4	110
5.	2013 - 14	76	159	235	20	58	13	91
6.	2014 - 15	76	159	235	19	65	5	89
6-Year Total		437	955	1392	117	387	31	535
6-Yr. Total BG + MG		1625	1711	3336	327	1152	90	1569
Average/Year		271	285	556	54.4	192	15	261.4

Source: BR Mechanical Department

The Saidpur workshop is maintaining 556 coaches (IC – 271 & ME - 285). The workshop outturn to ensure that no coach runs with any schedule overdue should be:

Inter City Coaches

- GOH Schedule - Every 12 years (271/12) : 23 coaches/year
- POH Schedule - Every 4 years (271/4-23) : 45 coaches/year
- LE Schedule - Every 1 years (271/1-23-45) : 203 coaches/year

Mail & Express Coaches

- GOH Schedule - Every 12 years (285/12) : 24 coaches/year
- POH Schedule - Every 6 years (285/6-24) : 24 coaches/year
- LE Schedule - Every 1½ years (285*2/3-48) : 142 coaches/year

- Saidpur Workshop has not done coach GOH schedule under revenue budget for many years due to budget shortage, staff shortage and other constraints. This schedule is now done as a project. Currently a project for 100 coaches GOH is in process. Out of these, Saidpur Workshop will attend 50 coaches and a private contractor the other 50.
- The workshop does not have any provision of separate staff for GOH. The regular staff attends GOH work for 1 – 2 hrs every day on overtime after normal working hours.
- A coach is practically rebuilt under GOH though the workshop does not have facilities like fixtures, qualified welders, manipulators to ensure down hand welding etc. The coach under-frame is the most critical part of the coach body because it has to withstand buffing, traction and braking forces. The photograph below shows that half of the side member of the under frame has been cut off and a new one is being welded without following prescribed procedures and quality controls.
- All normal coaches are converted to mid-on generation under rebuilt programme.

Figure 4-4: Coach Rebuilding under GOH at Railway Workshop, Saidpur



Wagon Maintenance

- Saidpur workshop maintains 2079 wagons.
- Wagon POH periodicity is 3½ years. Workshop should POH 594 wagons every year to ensure no wagon runs overdue schedule on BR system.
- Workshop wagon POH outturn during the last ten years has been:

Table 4-8: Wagon POH Outturn, Railway Workshop, Saidpur

S.No.	Year	Wagon BG	Wagon MG	Special Repairs	Total	Working Days	Outturn/Day
1.	2005-06	201	944	0	1145	286	4.58
2.	2006-07	234	888	0	1122	286	4.28
3.	2007-08	312	468	0	780	288	3.15

S.No.	Year	Wagon BG	Wagon MG	Special Repairs	Total	Working Days	Outturn/ Day
4.	2008-09	411	357	0	768	285	2.8
5.	2009-10	305	166	16	487	286	2.08
6.	2010-11	192	284	11	487	286	2.16
7.	2011-12	174	124	43	341	285	1.53
8.	2012-13	77	109	217	403	285	1.33
9.	2013-14	146	64	5	215	285	1.28
10.	2014-15	118	141	5	264	287	1.42
Total		2170	3545	297	6012		
Average/Year		217	354.5	29.7	601.2		

Source: Railway Workshop, Saidpur Management

It is seen from the above table that the POH outturn of the workshop has been coming down over the years and current level is almost half of what it should be.

Staff Position

The Saidpur workshop has been carrying 50 – 60% vacancies for many years. Recruitment is not done even against vacancies created by normal attrition like retirement, resignation, transfer etc. Staff shortage is very seriously affecting the quality and quantity of workshop outturn. Last ten years staff status is given below in Table 4-.

Table 4-9: Staff Position at Railway Workshop, Saidpur

S.No.	Year	Sanctioned Strength	Staff On Roll	Vacancies	% Vacancies
1.	2006	2847	2115	732	25.7
2.	2007	2847	2003	844	29.6
3.	2008	2847	1843	1004	35.3
4.	2009	2847	1652	1195	42.0
5.	2010	2847	1469	1378	48.4
6.	2011	2847	1291	1556	54.6
7.	2012	2847	1381	1466	51.5
8.	2013	2847	1368	1479	51.9
9.	2014	2847	1309	1538	54.0
10.	2015	2845	1328	1517	53.3

Source: Railway Workshop, Saidpur Management

Machinery & Plant

Saidpur workshop has 742 machineries and plants. Out of these 383 machines, some very critical for production, maintenance and testing, are more than 50 years old, 205 machines are between 20 – 50 years and only 154 are under 25 years of age. Machine shop and Tool Room have very old belt driven machines. These machines are very energy inefficient, have poor accuracy and repeatability and product quality is based on operator skill.

Figure 4-5: Belt Driven Machines in Railway Workshop, Saidpur



4.3.2 Visit to C & W Workshop, Pahartali

General

We visited the C & W Workshop, Pahartali on March 28, 2016 to collect firsthand information about the workshop. We met with Mr. Md. Mizanur Rahman, Divisional Superintendent (Workshop) and discussed workshop performance, its facilities, maintenance schedules carried out, last ten years outturn, constraints, if any, in achieving target outturn etc. He submitted responses to our questionnaire – these can be seen in Appendix 7.

This workshop was established in 1947 and undertakes schedule maintenance of MG coaches and wagons.

930 (IC – 429 + Others – 501) MG coaches are based at this workshop for GOH, POH and LE schedules.

Performance

Workshop outturn during the last six years (2009-10 to 2014-15) has been:

Table 4-10: C & W Workshop, Pahartali Coaching Outturn for the Last six Years

S.No.	Year	Coaches Allotted			Workshop Outturn				
		IC Coaches	Others	Total	GOH	POH	LE	Special Repair	Total
MG Coaches									
1.	2009 - 10	429	501	930	1	102	117	62	282
2.	2010 - 11	429	501	930	2	91	148	66	307
3.	2011 - 12	429	501	930	3	103	148	47	301
4.	2012 - 13	429	501	930	0	76	167	31	274
5.	2013 - 14	429	501	930	1	100	128	41	270
6.	2014 - 15	429	501	930	0	85	149	44	278
6-Year Total		2574	3006	5580	7	557	857	291	1712
Average/Year		429	501	930	1.2	92.8	144.5	48.5	285.3

Source: C & W Workshop, Pahartali

Pahartali workshop is maintaining 930 coaches (IC – 429& ME - 501).The workshop should attend the following number of schedules per year to ensure no overdue schedule coach runs on BR system:

- GOH Schedule (IC Coach - Every 12 years (429/12)) : 36 coaches/year
- GOH Schedule (ME Coach - Every 12 years (501/12)) : 42 coaches/year

Inter City Coaches

- POH Schedule - Every 4 years (429/4-36) : 71 coaches/year
- LE Schedule - Every 1 years (421/1-36-71) : 314 coaches/year

Mail & Express Coaches

- POH Schedule - Every 6 years (501/6-42) : 42 coaches/year
- LE Schedule - Every 1½ years (501*2/3-84) : 250 coaches/year

To ensure all coach schedules are attended on time and no coach runs with any overdue schedule, the workshop must complete 2.6schedules/day. But the shop does not have facilities and capacity to achieve this level. Last six years average out turn of the shop has been1.0/day.

GOH schedule is not attended by the workshop and has been outsourced because adequate revenue budget is not allotted. Cost of each GOH is approximately TK 3.8 million etc.

A workshop rehabilitation project is underway. It includes:

- Supply of 65 new machines
- Attention to 26 sub-shop infrastructure – track, roof and machinery & plant
- Replacement of electrical sub-station and accessories

Wagon Maintenance

Pahartali workshop maintains 6887 wagons.

Wagon POH periodicity is 3½ years. Workshop should, therefore, attend $6887/3\frac{1}{2} = 1968$ wagons every year for POH schedule or $1968/288 = 6.8$ wagon/day.

Workshop wagon POH outturn during the last nine years has been:

Table 4-11: Wagon POH Outturn, C & W Workshop, Pahartali

S.No.	Year	Wagon POH	Special Repairs	Total	Working Days	Outturn/ Day
1.	2006-07	363	287	650	283	2.3
2.	2007-08	377	281	658	287	2.3
3.	2008-09	379	279	658	286	2.3
4.	2009-10	411	138	549	286	1.9
5.	2010-11	309	168	477	286	1.7
6.	2011-12	345	66	411	287	1.4
7.	2012-13	250	101	351	286	1.2
8.	2013-14	188	312	500	286	1.7
9.	2014-15	274	140	414	286	1.4
Total		2896	1772	4668		16.2
Average/Year		321.8	196.9	518.7		1.8

Source: C & W Workshop, Pahartali

It is seen from the above table that POH outturn of the workshop has been coming down over the years and current level is almost 26% of what it should be.

Staff Position

The Pahartali workshop has been carrying 35-38% vacancies for the last many years. Recruitment is not done even against vacancies created by normal attrition like retirement, resignation, transfer etc. Staff shortage one of the main reasons for not achieving workshop target outturn.

The last nine years' staff status is given below in Table 4-.

Table 4-12: Staff Position at Railway Workshop, Saidpur

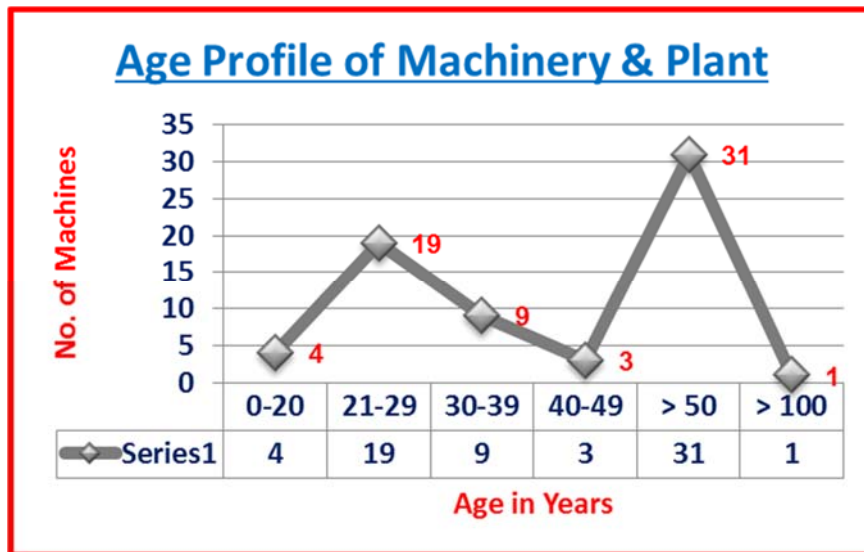
S.No.	Year	Sanctioned Strength	Staff On Roll	Vacancies	% Vacancies
1.	2006	1776	1290	486	27.4
2.	2007	1776	1196	580	32.6
3.	2008	1776	1148	628	35.4
4.	2009	1776	959	817	46.0
5.	2010	1776	942	834	47.0
6.	2011	1780	1109	671	37.7
7.	2012	1780	1059	721	40.5
8.	2013	1780	1059	721	40.5
9.	2014	1780	1149	631	35.5

Source: C & W Workshop, Pahartali Management

Machinery & Plant

Saidpur workshop has 67 major machineries and plants. Age profile of these machines is:

Figure 4-6: Staff Position at Railway Workshop, Saidpur



5

Due Diligence & Diagnostic Analysis

Key Messages

- In this Chapter, we analyse to what extent present rolling stock maintenance management is efficient and effective for smooth traffic operation.
- We also look into availability of all maintenance input resources like infrastructure, manpower, material, machinery and plant etc.
- As part of our analysis, we identify constraints, problems and weakness in the present RS maintenance management.
- We then assess the development potential of maintenance facilities, improved performance and greater rolling stock reliability.

5.1 Introduction

Railway systems are considered as environmentally friendly compared to other transportation modes and their demand has been increasing over the years. The system service quality very largely depends on rolling stock reliability, availability, maintainability and safety. Although rolling stock maintenance is expensive, it will become more expensive to replace the failing equipment early in its life because maintenance has been neglected. Therefore, an efficient maintenance schedule management is an essential factor to achieve a reliable rolling stock system.

BR has, as a policy, decided to follow a PM (Preventive Maintenance) system. But success of this maintenance option lies in strictly adhering to periodicity and scope of inspection and repair prescribed in each schedule. Any failure to attend schedules as they fall due and allow overdue schedule rolling stock to continue in service may result in failure on line disrupting train services. Such a situation requires corrective maintenance and failed rolling stock may have to be moved to a workshop for attention. A special or corrective repair in a workshop creates a vicious circle situation because it eats into workshop schedule maintenance capacity creating high overdue schedule, causing high on line failures resulting in high un-schedule repairs in workshop and so on.

Therefore, each maintenance workshop management should strive to create all necessary facilities and inputs to ensure full implementation of maintenance schedule programme of rolling stock allotted to it.

5.2 Locomotive Maintenance

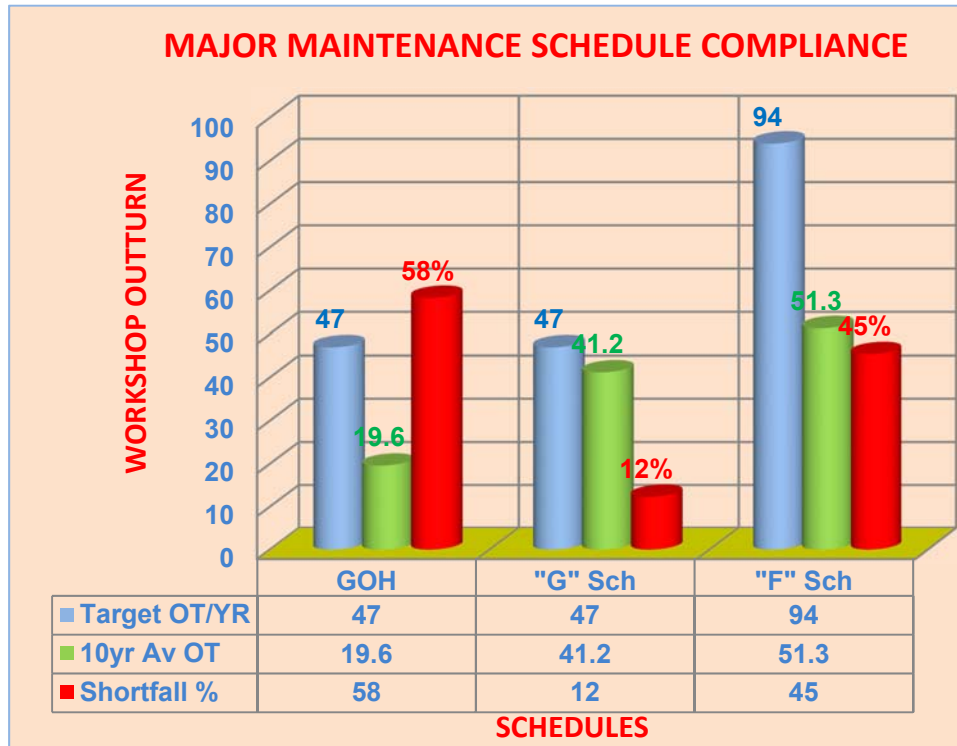
5.2.1 Locomotive Maintenance

To ensure entire BR holding of 280 locomotives remains in good mechanical and running condition and is available at all times to meet traffic department requirements, maintenance workshops should aim to achieve following heavy schedule outturn:

- General Overhaul (GOH) – Every 6 years : 47 locos/year
- “G” Schedule – Every 3 years : 47 locos/year
- “F” Schedule – Every 1½ years : 94 locos/year

But during the last ten years average compliance of locomotive major maintenance schedules has been far below the desired level. The average out turn has been:

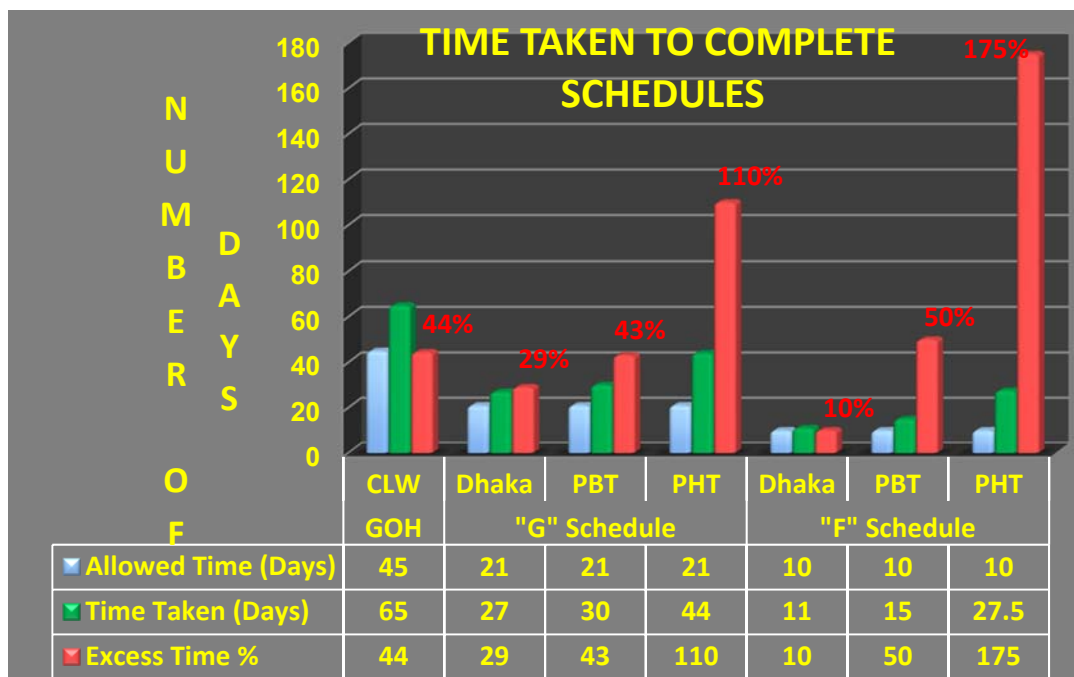
Figure 5-1: Major Locomotive Maintenance Schedule Compliance



Source: BR Mechanical Department

BR locomotive maintenance workshops have not only fallen short of their output targets but have taken far more time to complete schedules than what is specified. The average schedule completion time taken by various workshops is indicated below:

Figure 5-2: Diesel Maintenance Schedule Time Allowed Vs Time Taken By Workshops



All workshops have exceeded the standard time allowed for completing schedules. Even CLW, which is comparatively a new workshop, has taken almost 50% extra time. The worst performer is Pahartali workshop which has taken 110% and 175% extra time to complete “G Schedule” and “F Schedule” respectively. Not completing schedules on time has two negative effects:

- i. Locomotives are not available for traffic use for extra time taken to complete the schedule.
- ii. Delayed schedule completion causes a locomotive to occupy workshop bay for a longer period, eating into workshop bay holding capacity.

5.3 Locomotive Workshops – Performance

5.3.1 Central Locomotive Workshop, Parbatipur

Main features of this workshop are:

- Workshop has adequate capacity to handle GOH schedule of 400 locomotives.
- Traction motor repair activity has been out-sourced but repair quality needs improvement.
- CLW was following unit exchange system to keep schedule repair time within the specified value. But this practice has now been given up.
- CLW can attend higher number of locomotives and improve its performance if some new machines are added and some old ones are replaced. Machine details are:

A. New Machines

i.	Universal Milling and Boring Machine	:	1 no.
ii.	Engine Block Boring Machine	:	1 no.
iii.	Cam Profile Testing Machine	:	1 no.
iv.	Diesel Engine Test Plant	:	1 no.
v.	Traction Motor Test Console	:	1 no.

B. Machines To Be Replaced

i.	Locomotive Load Box Test Plant	:	1 no.
ii.	Wheel Turning Lathe (Dual Gauge)	:	1 no.
iii.	Traction Motor Armature Balancing Machine	:	1 no.
iv.	Turbo Charger Rotor Balancing Machine	:	1 no.
v.	Magnetic Particle Testing Machine	:	1 no.
vi.	Spectro Photometer	:	1 no.
vii.	Vertical Honing Machine	:	1 no.
viii.	Vertical Lathe	:	1 no.

5.3.2 Diesel Locomotive Workshop, Dhaka

- The workshop has very limited infrastructure facility, inadequate loco holding bay capacity and very little space to attend components and sub-assemblies.
- It practically does not have any support shop facility, tools and gauges, inspection equipment etc.
- Workshop average out turn for the last ten years has been – “G” schedule 10.6locos/year and “F” schedule 14.3 locos/year.
- In addition to regular schedules, workshop is also attending to locomotive break down/special repairs. At an average of 113 locos have been attended for special repairs during the last ten years. This means that every loco based at the workshop comes twice a year for special repairs – a very negative reflection on the quality of work done in the workshop.
- 30-40% locomotives based at the shed are running overdue schedule and loco availability for traffic is only 60-65%.

5.3.3 Diesel Locomotive Workshop, Parbatipur

- Against “G” schedule target of 16 locos/year the average output for the last ten years has been 14.5 locos/year (90% of target)and against “F” schedule target of 32 locos/year the average output has been only 17.8 locos/year (55.6% of the target).
- Similarly standard time for completing “G” schedule is 21 days and for “F” schedule 10 days but workshop is completing “G” schedule in 30 days and “F” schedule in 15 days.
- In addition to regular schedules workshop is also attending to special repairs of locomotives. During the last ten years at an average of 58.7 locos have been attended for special repairs.
- 30-40% locomotives based at the shed are running overdue schedule and loco availability for traffic is only 60-65%.

5.3.4 Diesel Locomotive Workshop, Pahartali

- The workshop is very congested and over-crowded with no proper sub-shop and component repair facilities.
- No infrastructure facilities, testing facilities, special tooling or sub-assembly repair facilities were added when loco running shed was upgraded to diesel workshop.
- The workshop is meeting “G” schedule target of 20.0/year but “F” schedule output is 16.1 loco/year against a target of 40 locos/year i.e. just about 40% of the target.
- Similarly standard time for completing “G” schedule is 21 days and for “F” schedule 10 days but workshop is completing “G” schedule in 44 days and “F” schedule in 27.5 days.
- In addition to regular schedules, workshop is also attending to special repairs of locomotives. During the last ten years at an average of 250 locos have been attended for special repairs. This means that every loco based at the workshops comes twice a

year for special repairs – a very poor reflection on the quality of work done in the workshop.

- Workshop has 71 machines and out of these 66 machines are more than 20 years old.

Table 5-1: Diesel Workshop, Pahartali Machine Age Profile

	0 – 20 Years	21 – 30 Years	Above 30 Years
No. of Machines	05	04	62

- There is an urgent need to replace overage machines.

5.4 Carriage & Wagon Workshops – Performance

5.4.1 Carriage & Wagon Workshop, Saidpur

- Long, wide and high roof bays of old steam loco overhaul shops are available and can be utilised to expand coach repair or re-building activity.
- Saidpur workshop is maintaining 556 coaches (IC – 271 & ME - 285). The workshop outturn to ensure no coach runs overdue schedule should be:

Inter City Coaches

- GOH Schedule - Every 12 years (271/12) : 23 coaches/year
- POH Schedule - Every 4 years (271/4-23) : 45 coaches/year
- LE Schedule - Every 1 years (271/1-23-45) : 203 coaches/year

Mail & Express Coaches

- GOH Schedule - Every 12 years (285/12) : 24 coaches/year
- POH Schedule - Every 6 years (285/6-24) : 24 coaches/year
- LE Schedule - Every 1½ years (285*2/3-48) : 142 coaches/year
- Saidpur Workshop has not done any GOH schedule for many years because of staff shortage and other constraints. This schedule is done as a project. Currently one project for 100 coaches GOH is in process. Out of these, Saidpur Workshop is attending 50 coaches and a private contractor other 50.
- Saidpur workshop maintains 2079 wagons.
- Wagon POH periodicity is 3½ years. Workshop should POH 594 wagons every year to ensure no wagon runs overdue schedule on BR system.

Performance

We tried our best to get Saidpur Workshop installed capacity for coaching and wagon maintenance schedules but could not find any record. Therefore, we worked out annual

average outturn of the workshop during the last 40 years (1975-76 to 2014-15) and also best average annual out turn for ten years (1980-81 to 1989-90). Workshop outturn figures are:

Table 5-2: Railway Workshop, Saidpur Outturn

S.No.	Schedule	MG/Year	BG/Year	Total/Year
A.	Yearly Average Out Turn for 40 Years (1975-76 to 2014-15)			
1.	Coach LE	92.1	95.6	187.7
2.	Coach POH	45.2	44.0	89.2
3.	Wagon POH	901.0	365.6	1,266.6
B.	Best Yearly Average Out Turn for 10 Years (1980-81 to 1989-90)			
1.	Coach LE	110	95	205
2.	Coach POH	67	58	125
3.	Wagon POH	1258	599	1,857

Source: BR Mechanical Department

From the best yearly average outturn figures, one can reasonably calculate that Saidpur Workshop has infrastructure facilities to maintain 625 passenger coaches (300 – Inter City + 325 Mail & Express) and 3,500 bogie wagons.

5.4.2 Carriage & Wagon Workshop, Pahartali

This workshop is maintaining 930 coaches (IC – 429 & ME - 501).

GOH schedule is not attended by the workshop under revenue budget. This work has been outsourced because adequate revenue budget is not allotted. Cost of each GOH is approximately TK 3.8 million.

Pahartali workshop also maintains 6887 wagons. Wagon POH periodicity is 3½ years. Workshop should, therefore, attend $6887/3\frac{1}{2} = 1968$ wagons every year for POH schedule.

A workshop rehabilitation project is underway. It includes:

- Supply of 65 new machines
- Attention to 26 sub-shop infrastructure – track, roof and machinery & plant
- Replacement of electrical sub-station and accessories

Bangladesh Railway carriage and wagon workshops performance during the last ten years has been:

Table 5-3: BR Coach and Wagon Workshop Annual Maintenance Performance

S.No.	Schedule	Yearly Target	Actual Achieved	Target Achieved %
A. Last Ten Years Average Annual Maintenance Performance				
Saidpur C&W Workshop				
1.	Coach POH	69	64	93
2.	Coach Lift Enamel (L.E.)	345	101	63
3.	Wagon POH	594	286	48
Pahartali C&W Workshop				
1.	Coach POH	113	101	89
2.	Coach Lift Enamel (L.E.)	572	144	25
3.	Wagon POH	1968	350	18

Source: BR Mechanical Department

5.5 BR Rolling Stock Maintenance – Limitations, Constraints & Challenges

5.5.1 General

Railway rolling stock is a capital intensive asset and, therefore, maximum number should be available for maximum period of service. Rolling stock is the most maintenance intensive part of the railway system and therefore, the most vulnerable if maintenance is neglected. An efficient maintenance plan is an essential factor to achieve a reliable, safe and high availability rolling stock system.

Bangladesh Railway rolling stock availability according to Information Book June 2015 was:

Table 5-4: BR Rolling Stock Availability As At June 2015

S.No.	Type of Rolling Stock	Number on Books	Number Ineffective	Total Available	Ineffective %
1.	Locomotive	BG	96	76	21.9
		MG	186	131	29.5
2.	Coaches	BG	324	244	24.7
		MG	1183	837	29.2
3.	Wagon	BG	2862	2173	24.1
		MG	8725	6656	23.7

Source: BR Information Book – June 2015

Optimal utilisation of rolling stocks is an important aspect of train operation. Better rolling stock utilization means less unit overhead cost. Efficient railway systems maintain locomotive ineffective percentages below 10% and coach and wagon ineffective percentages between 5-10%. Above data shows that BR rolling stock availability is very low

compared to well-run railway systems and reflects very adversely on rolling stock maintenance system.

We have tried to identify major issues adversely affecting rolling stock maintenance and these are:

5.6 Over Aged Rolling Stock

BR Mechanical Code specifies 20 years as economic life for locomotives. This is considered very low because locomotive utilization on BR is just about 175 km per day. Neighbouring Indian Railways has locomotive utilisation of approximately 573 km per day (More than three times that on BR) but locomotive economic life is 35 years. We recommend that BR locomotive economic life should be raised to at least 30 years when the Mechanical code is revised.

- i. Locomotives : 30 years
- ii. Passenger coaches : 35 years
- iii. Wagons : 45 Years

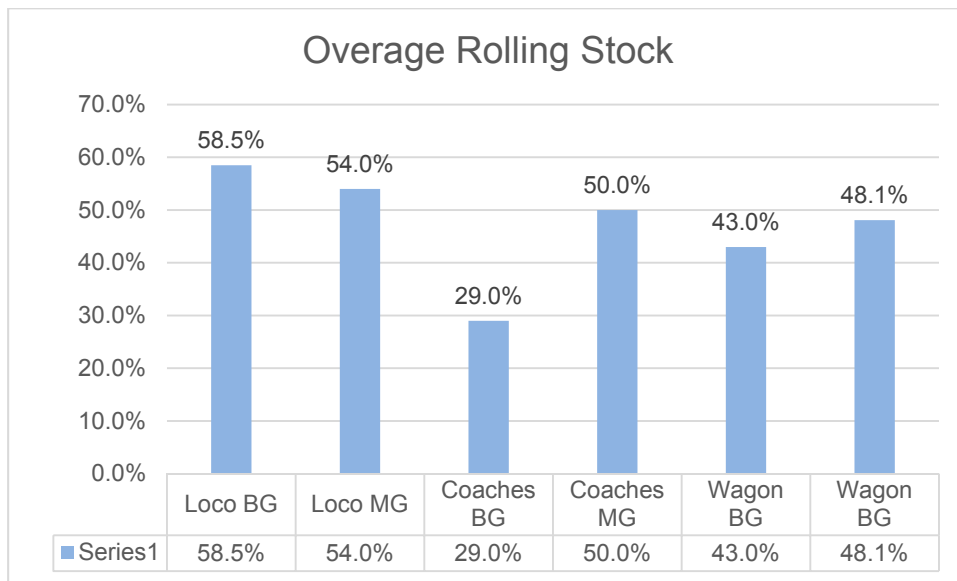
BR overage rolling stock numbers based on these economic lives are:

Table 5-5: BR Overage Rolling Stock As At June 2016

S.No.	Type of Rolling Stock	Economic Life Yrs.	Number on Books	No. Overage	Overage %
1.	Locomotive	BG	94	55	58.5
		MG	186	100	54
2.	Coaches	BG	312	91	29
		MG	1165	583	50
3.	Wagon	BG	2079	888	43
		MG	6850	3299	48.1

Source: BR Mechanical Department

Figure 5-3: BR Overage Rolling Stock As At June 2016



Operating overage rolling stock has number of negative factors affecting operation and finances of the system. These are:

Technical –Overage vehicle operation becomes unsafe and unreliable. Online breakdowns are frequent disrupting traffic flow.

Economic - Operating and maintenance costs of overage vehicle is much higher as compared to modern rolling stock. Current condition of the vehicle may be such that it requires a high amount of investment in order to extend its life for a longer period of time.

Maintenance – Maintenance costs associated with older vehicles are higher than new vehicles. Availability of spares and the obsolescence of parts also affect maintenance quality.

BR should, therefore, plan to phase out and replace overage rolling stock with new ones.

5.7 Diesel Locomotive Workshops Infrastructure Constraints

There are three Diesel Locomotive Workshops located at Dhaka, Parbatipur and Pahartali. None of these workshops was properly planned, designed and constructed. The Dhaka workshop came into existence by taking away two bays of Dhaka running loco shed and renaming them as a Workshop. Parbatipur workshop was set up by converting part of steam loco shed into a workshop and General Motor locomotive running shed at Pahartali was renamed as Pahartali Diesel Workshop. At the time of conversion to workshops very little or no infrastructure facilities were added to the old establishment. With the result all three workshops:

- Have inadequate bay space and berthing capacity;

- Have no space to attend and repair components like pumps, compressors, motors etc.;
- Have very inadequate back up and support shop facilities;
- Have very low availability of special tools and equipment; and
- Have inadequate inspection and testing facilities

These inadequacies clearly reflect in the performance of these workshops. None of these shops are able to achieve their target outturn with the result that a very high percentage of rolling stock is running over due schedules. The worst performer is Pahartali workshop which is attending more breakdown and special repairs than scheduled maintenance.

BR urgently needs three new well planned Diesel Locomotive Workshops equipped with all modern repair and testing facilities.

5.8 Human Resource Constraints and Weakness

5.8.1 Staff Vacancies

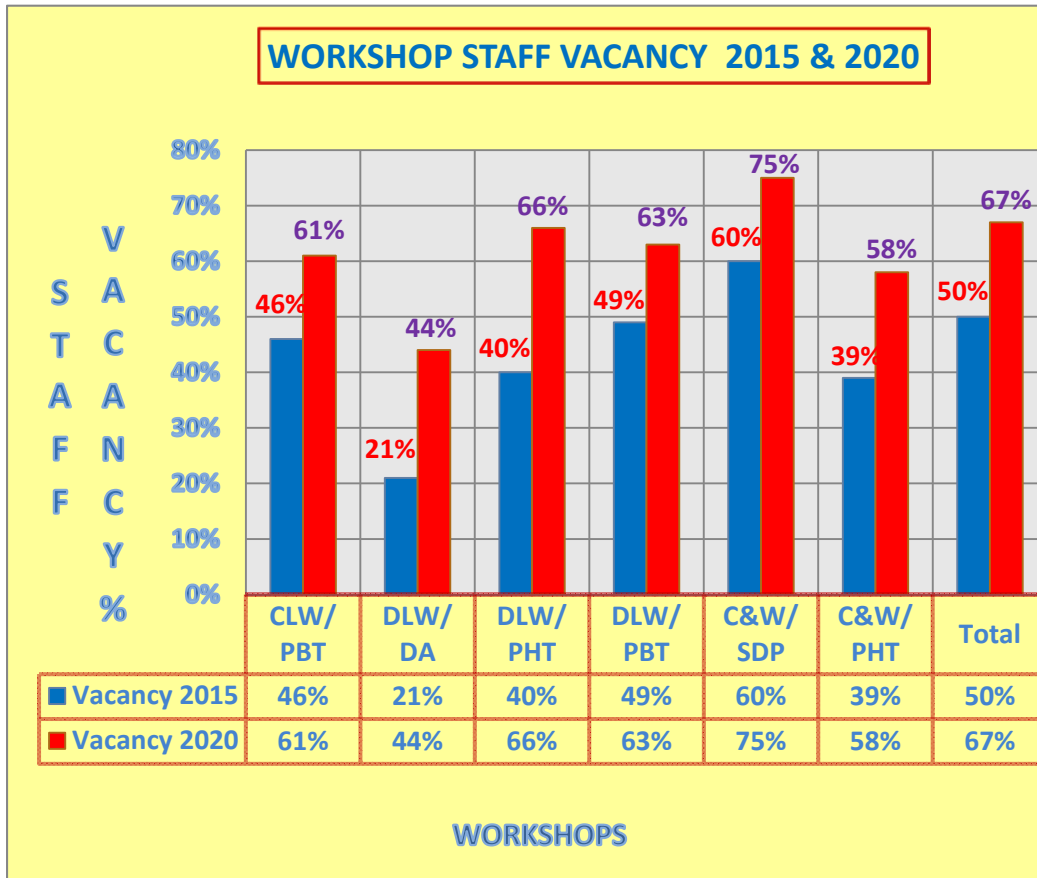
In 1993 BR made a Voluntary Retirement offer to staff. Many persons found it attractive and left the service. That was the starting point of staff shortage. Since then, new recruitments have not taken place even against natural attrition i.e. retirements, transfers, resignations etc.

We have collected next five years staff retirement data from all the rolling stock maintenance workshops and present staff vacancies as at June 2015 and expected vacancies by June 2020 are:

Table 5-6: BR Maintenance Workshop Staff Vacancies As At June 2015 and June 2020

Workshop▶	CLW Parbatipur	DLW Dhaka	DLW Parbatipur	DLW Pahartali	C&W W/S Saidpur	C&W W/S Pahartali
Staff Vacancy % As At June 2015	46	21	49	40	60	39
Expected Staff Vacancy % As At June 2020	61	44	66	63	75	58

Figure5-4: BR Maintenance Workshop Staff Vacancies As At June 2015 and June 2020



Source: BR Mechanical Department

Staff vacancy has reached a critical stage and recruitment-training cycle takes one to two years. Therefore, we recommend that recruitment process to fill all vacancies must be initiated immediately otherwise the entire rolling stock maintenance system may totally collapse in few years.

5.8.2 Staff Skill Development

There are five technical Training Units attached to various maintenance workshops. These are:

- i. Workshop Training Unit, Pahartali
- ii. Workshop Training Unit, Dhaka
- iii. Workshop Training Unit, Parbatipur
- iv. Workshop Training Unit, Ishurdi and
- v. Workshop Training School, Saidpur

All newly recruited supervisors and artisan staff like diesel loco fitters, diesel loco electricians, carriage & wagon fitters and others artisans like welders, machinists, fitters should undergo theoretical and practical lessons at these units. But these units have very poor training facilities particularly in terms of working models, cut models, charts, posters etc.

5.9 Procurement Constraints and Weakness

Bangladesh Railway stores department is responsible to procure, stock and supply raw materials, spare parts, sub-assemblies, components etc. to rolling stock maintenance workshops, depots and sheds. BR has fifteen different types of locomotives, therefore, stores department has to procure and stock almost 25,000 locomotive items and 8,000 C&W items. Out of 33,000 items 80% are procured from foreign sources and 20% from indigenous suppliers.

But BR inventory management is not very efficient and many important and critical items are out of stock for more than one year though similar items have been procured by project organisation for rolling stock repair.

5.10 Rolling Stock Condemnation

During our visits and discussions with workshop management we noted that condemnation of rolling stock and machinery and plant under present condemnation policy is very slow. This forces management to continue rolling stock and machine on their books even after these have been taken off from service. A review of wagon age profile shows that 109 wagons of more than 100 years age continue to be on the books.

6

Conclusions & Recommendations

Key Messages

- In previous Chapters, we analysed to what extent present rolling stock maintenance management is efficient and effective for smooth traffic operation.
- We also looked into availability of all maintenance input resources and have tried to identify constraints, problems and weakness in the present RS maintenance management.
- In this Chapter, we have assessed and recommended the development potential of maintenance facilities, improved performance and greater rolling stock reliability.

6.1 Introduction

Bangladesh Railway rolling stock maintenance performance has not been very satisfactory. All maintenance workshops output in terms of maintenance schedules has been far below their target. This has resulted in very large number of overdue schedule vehicles running on the system causing high on- line failures requiring special repairs.

In this Chapter we have identify areas where additional inputs and additional capacity are required.

6.2 Rolling Stock Under Procurement

BR has processed procurement of following rolling stock and in some cases full or part supply has already been received:

Table 6-1: BR Rolling Stock Under Procurement As At June 2016

S.No.	Project Name	Project Status
1.	Procurement of 70 MG Diesel Electric Locomotives	Tender under process
2.	Procurement of 100 MG and 50 BG coaches	Part supply has been received
3.	Procurement of 120 BG passenger coaches	Part supply has been received
4.	Rehabilitation of 50 MG and 50 BG coaches	Project under process
5.	Procurement of 11 MG locomotive	Locomotives received
6.	Procurement of 16 BG locomotive	Locomotive Received
7.	Procurement of 10 MG locos, 4 cranes (2 BG & 2 MG) and one loco simulator	Tender under process
8.	Procurement of 200 MG and 50 BG coaches and 2 Automatic Train Washing plants	Tender under process
9.	Procurement of 200 MG coaches	Under process
10.	Procurement of 20 MG locomotives under EDCF Korean loan	Under process
11.	Procurement of 150 MG coaches under EDCF Korean loan	Under process
12.	Construction of a new carriage workshop within the existing Saidpur Railway Workshop against LoC India	Under process

Source: BR Mechanical Department

6.3 Administrative and Procedural Reforms

We have noted during our visits to maintenance workshops and discussions with management that many current Administrative Orders/Procedures are adversely affecting their performance. These are:

6.3.1 Staff Recruitment Policy

All workshops are carrying large vacancies (40-60%) seriously affecting workshop performance. These vacancies will go up to 75% and entire maintenance system will collapse if immediate action to fill up vacancies is not taken.

6.3.2 Procurement Policy Review

All maintenance workshops are facing serious problems of non-availability of critical parts, components and sub-assemblies. There are cases where critical assemblies are not available for the last two years for regular maintenance but are available for rehabilitation of coaches under project. If one arm of BR can procure parts the other should also be able to do it. There is, therefore, a need to review BR procurement policy.

6.3.3 Rolling Stock Condemnation Policy

We noted during our discussions that under the present policy rolling stock condemnation is not easy. Therefore, a very large number of rolling stock continues on books even when these have been taken off the rails. Over 100 wagons aged 100 years or more are still on BR wagon holding. This not only inflates the ineffective percentage but also gives a wrong picture of total holding. BR must review its rolling stock condemnation policy and make it simpler.

6.3.4 Budget Allocation

Adequate fund allocation is the base requirement to get proper quality and quantity output from maintenance facilities. All workshops suffer from low maintenance budget allocation and have to, therefore, restrict procurement of spares, materials, tools, equipment etc. This is one of the major factors for poor and low performance of various workshops.

Annual budget for maintenance workshops should be based on following scale:

- | | | | |
|------|-------------------------|---|------------------------|
| i. | Locomotive | : | \$100,000 per loco |
| ii. | Air condition coach | : | \$ 15,000/AC coach |
| iii. | Non air condition coach | : | \$ 12,500/Non-AC coach |
| iv. | Wagon | : | \$ 3,750/Wagon |

6.4 New Projects

6.4.1 New RS maintenance Projects 2018 – 2025

Table 6-2: New Projects Recommended for BR Rolling Stock Maintenance 2018-25

Project No.	Phase	Project Name	Project Cost (BDT)
59	2018-20	Modernization of Parbatipur Central Locomotive Workshop	770 crore
60	2018-20	Construction of new locomotive workshop at Naryanganj: i. 150 loco maintenance capacity ii. Workshop will be capable of attending BG and MG locomotives iii. All schedules (Sch F & Sch G) will be attended at the workshop iv. Approach and all tracks inside the workshop will be dual gauge v. Staff strength will be approximately 1050	Total Capital Cost of New Workshop - 1155 crore i. 1 st year CAPEX – 10% ii. 2 nd year CAPEX – 30% iii. 3 rd year CAPEX – 50% iv. 4 th year CAPEX – 10% (Above cost does not include land cost)
61	2018-20	Construction of Repair & Maintenance Workshop for DEMU at Narayanganj: i. 75 DEMU sets maintenance capacity ii. Workshop will be capable of attending BG and MG DEMU train sets iii. Workshop will attend both power cars and coaches iv. Approach and all tracks inside the workshop will dual gauge v. Staff strength will be approximately 850	Total Capital Cost of New Workshop - 963 crore i. 1 st year CAPEX – 10% ii. 2 nd year CAPEX – 40% iii. 3 rd year CAPEX – 50% (Above cost does not include land cost)
62	2021-25	New Carriage & Wagon Workshop at Rajbari: i. Workshop will have capacity to maintain 1,000 coaches and 2,000 bogie wagons ii. Approach and all tracks inside the workshop will dual gauge iii. Staff strength will be approximately 1,900	Total Capital Cost of New Workshop - 2503 crore i. 1 st year CAPEX – 5% ii. 2 nd year CAPEX – 20% iii. 3 rd year CAPEX – 60% iv. 4 th year CAPEX – 15% (Above cost does not include land cost)
63	2021-25	New Diesel Locomotive Workshop at Chittagong: i. 125 loco maintenance capacity expandable to 150 locos	Total Capital Cost of New Workshop - 1155 crore i. 1 st year CAPEX – 10% ii. 2 nd year CAPEX – 30%

		<ul style="list-style-type: none"> ii. Workshop will be capable of attending BG and MG locomotives iii. All schedules (Sch F & Sch G) will be attended at the workshop iv. Approach and all tracks inside the workshop will dual gauge <p>Staff strength will be approximately 1,05</p>	<ul style="list-style-type: none"> iii. 3rd year CAPEX – 50% iv. 4th year CAPEX – 10% <p>(Above cost does not include land cost)</p>
70	2018-20	Upgradation and reconstruction of Dhaka Diesel Loco Shed including equipment upgrade and DG conversion	Total Capital Cost: BDT 500 crore
71	2018-20	Reconstruction of Diesel Loco sheds (09 total) including Equipment upgrade and DG Conversion	Total Capital Cost: BDT 3,500 crore
72	2018-20	Reconstruction of Washing Pits & Coach and Wagon Depots (14 total) including equipment upgrades and DG conversion	Total Capital Cost: BDT 4,000 crore
73	2018-20	Enhancement of Technical Training Facilities at 5 existing Workshop Training Units	Total Capital Cost: BDT 80 crore
211	2021-25	Capacity enhancement and construction of additional new units of Saidpur Carriage & Wagon Workshop	Total Capital Cost: BDT 800 crore
212	2018-20	Capacity enhancement and construction of additional new units of Saidpur Carriage & Wagon Workshop	Total Capital Cost: BDT 754 crore

6.4.2 New RS maintenance Projects 2026 – 2035

Table 6-3: New Projects Recommended for BR Rolling Stock Maintenance 2026-35

Project No.	Phase	Project Name	Project Cost
64	2031-35	BR will have approximately 450 locomotives by 2025. This means there will be 450x6= 2700 traction motors on the system. Average life of a traction motor is 18 years, i.e. approximately 140 motors will be attended every year in	<p>Total Capital Cost of New Workshop: 385 crore</p> <ul style="list-style-type: none"> i. 1st year CAPEX – 20% ii. 2nd year CAPEX – 40% iii. 3rd year CAPEX – 40% <p>(Above cost does not include land cost)</p>

		<p>addition to breakdown repairs. It is recommended that a new Traction Motor repair and rewinding workshop should be set up at CLW, Parbatipur.</p> <ul style="list-style-type: none"> i. Workshop capacity will be to attend 200 traction motors (BG and MG) per year for regular maintenance and about 100 motors for special repairs ii. Workshop will be capable of traction motor rewinding, commutator repair and stator repair iii. Staff strength will be approximately 550 	
65	2026-30	<p>New Diesel Locomotive Workshop at Rajbari:</p> <ul style="list-style-type: none"> i. 150 loco maintenance capacity ii. Workshop will attend only BG locomotives iii. All schedules (Sch F & Sch G) will be attended at the workshop iv. Staff strength will be approximately 1,050 	<p>Total Capital Cost of New Workshop: 1155 crore</p> <ul style="list-style-type: none"> i. 1st year CAPEX – 10% ii. 2nd year CAPEX – 30% iii. 3rd year CAPEX – 50% iv. 4th year CAPEX – 10% <p>(Above cost does not include land cost)</p>
66	2026-30	<p>New BG Carriage and Wagon Maintenance Workshop at suitable location of Mymensingh:</p> <ul style="list-style-type: none"> i. Workshop will have capacity to maintain 1,500 BG -coaches ii. Approach and all tracks inside the workshop will dual gauge iii. Staff strength will be approximately 1500 	<p>Total Capital Cost of New Workshop: 2310 crore</p> <ul style="list-style-type: none"> i. 1st year CAPEX – 5% ii. 2nd year CAPEX – 20% iii. 3rd year CAPEX – 60% iv. 4th year CAPEX – 15% <p>(The above cost does not include land cost)</p>
67	2026-30	<p>New Diesel Electric Multiple Unit maintenance Workshop at Ishurdi:</p> <ul style="list-style-type: none"> i. 75 DEMU sets maintenance capacity ii. Workshop will be capable of attending BG and MG DEMU train sets iii. Workshop will attend both power cars and coaches iv. Approach and all tracks inside the workshop will dual gauge 	<p>Total Capital Cost of New Workshop: 963 crore</p> <ul style="list-style-type: none"> i. 1st year CAPEX – 10% ii. 2nd year CAPEX – 40% iii. 3rd year CAPEX – 50% <p>(The above cost does not include land cost)</p>

		v. Staff strength will be approximately 850	
213	2031-35	Construction of new Carriage & Wagon Depot and Loco Shed to meet additional traffic demand	Total Capital Cost: BDT 400 crore

6.4.3 New RS maintenance Projects 2036 – 45

Table 6-4: New Projects Recommended for BR Rolling Stock Maintenance 2036 – 45

Project No.	Phase	Project Name	Project Cost
68	2036-40	Reconstruction of existing Carriage & Wagon Workshop at Chittagong: i. Workshop will have capacity to maintain 1,000 BG -coaches and 3,000 bogie wagons ii. Approach and all tracks inside the workshop will dual gauge iii. Staff strength will be approximately 1900	Total Capital Cost of New Workshop -BDT 2755 crore i. 1 st year CAPEX – 5% ii. 2 nd year CAPEX – 20% iii. 3 rd year CAPEX – 60% iv. 4 th year CAPEX – 15% (The above cost does not include land cost)
69	2036-40	New Diesel Electric Multiple Unit maintenance Workshop at Chittagong: i. 75 DEMU sets maintenance capacity ii. Workshop will be capable of attending BG and MG DEMU train sets iii. Workshop will attend both power cars and coaches iv. Approach and all tracks inside the workshop will dual gauge. v. Staff strength will be approximately 850	Total Capital Cost of New Workshop: BDT 963 crore i. 1 st year CAPEX – 10% ii. 2 nd year CAPEX – 30% iii. 3 rd year CAPEX – 50% iv. 4 th year CAPEX – 10% (The above cost does not include land cost)

6.5 Rolling Stock Maintenance Capacity Enhancement

All new projects identified above will create better and enhanced locomotive, coach and wagon maintenance facilities. But this goal will be achieved only when adequate and timely provision of other major inputs like men, machines, material and money is made.

Project-wise maintenance facility enhancement details are shown below in Tables 6-5 to 6-8:

Table 6-5: Enhanced Locomotive Maintenance Facility

Project No.	Project Completion Date	Project	Locomotives		
			BG	MG	Total Capacity
	Present Status	Diesel Locomotive Workshop, Parbatipur	97	0	97
		Diesel Locomotive Workshop, Dhaka	0	59	59
		Diesel Locomotive Workshop, Pahartali	0	121	121
		TOTAL	97	180	277
60	2022	New 150 loco capacity Dual Gauge Diesel Locomotive Workshop, Dhaka to replace old one.	150		277+150 - 59 = 368
63	2029	New 150 loco capacity Dual Gauge Diesel Locomotive Workshop, Chittagong to replace Pahartali workshop.	150		368+150 - 121= 397
65	2031	New 150 loco capacity BG Diesel Locomotive Workshop, Rajbari to replace Parbatipur workshop.	150	0	397+150 - 97 = 450

Table 6-6: Enhanced Coach Maintenance Facility

Project No.	Project Completion Date	Project	Coaches		
			BG	MG	Total Capacity
	Present Status	C&W Workshop, Saidpur	625		625
		C&W Workshop, Pahartali	0	600	600
		TOTAL			1,225
62	2024	New Dual Gauge C&W Workshop, Rajbari. Capacity 1,000 coaches.	1,000		2,225
66	2033	New Carriage Workshop at location to be decided later. Capacity 1,500 coaches.	1,500		3,725
68	2040	Reconstruction of existing Carriage & Wagon Workshop at Chittagong. Capacity 1,000 BG coaches. Existing MG Workshop at Pahartali will be demolished because unigauge is expected to be completed by 2036.	1,000		3,725+1,000-600 = 4,125
70	2044	Upgradation and reconstruction of Dhaka Diesel Loco Shed including equipment upgrade and DG conversion	1,500		5,625

Table 6-7: Enhanced DEMU Maintenance Facility

Project No.	Project Completion Date	Project	DEMU		
			BG	MG	Total Capacity
	Present Status	DEMU Maintenance Facility	0	0	0
61	2023	Dual Gauge DEMU Maintenance Facility, Narayangunj/nearby Dhaka	75 sets		75 sets
67	2035	BG DEMU Maintenance Facility, Ishurdi	75 sets		150 sets
69	2042	BG DEMU Maintenance Facility, Chittagong	75 sets	0	225 sets

Table 6-8: Enhanced Wagon Maintenance Facility

Project No.	Project Completion Date	Project	Wagon		
			BG	MG	Total Capacity
	Present Status	C&W Workshop Workshop, Saidpur	3,500 Bogie Wagons (BW)		6,000 Bogie Wagons
		C&W Workshop, Pahartali	0	2,500 BW	
62	2024	New Dual Gauge C&W Workshop, Rajbari. Capacity 2,000 Bogie Wagons.	2,000		8,000
68	2036	Reconstruction of existing Carriage & Wagon Workshop at Chittagong. Capacity 3,000 BG wagons. Existing MG Workshop at Pahartali will be demolished because unigauge is expected to be completed by 2036.	3,000		8,000 + 3,000 - 2,500 = 8,500 bogie wagons

6.6 Rolling Stock Procurement Plan

The proposed rolling stock procurement plan is to meet projected additional passenger and freight traffic as well as to replace overage and condemned stock. This plan should be revisited annually for updating to current conditions of the time.

Table 6-9: Rolling Stock Procurement Plan

ROLLING STOCK PROCUREMENT PLAN
1. The proposed rolling stock procurement plan is to meet projected additional passenger and freight traffic

		2016	2017-20	2021-25	2026-30	2031-35	2036-40	2041-45
Rolling Stock Requirement								
Coaches								
Intercity Trains	MG	344	419	532	341	403	385	377
	BG	193	232	294	710	933	1322	1795
ME Trains	MG	173	207	262	149	118	93	117
	BG	116	140	180	412	594	816	1037
Commuter Train	MG	111	129	145	166	40	11	13
	BG	63	73	110	161	367	517	649
Total Required	MG	628	755	939	656	561	489	507
	BG	372	445	584	1283	1894	2655	3481
Ineffective %age	MG	33%	33%	28%	25%	20%	15%	15%
	BG	25%	25%	15%	15%	15%	15%	15%
Total Required including ineffective and luggage vans	MG		1227	1398	964	786	655	676
	BG		644	747	1578	2353	3212	4176
Total Holding including ineffective	MG	1162	1162	1227	1175	1160	1091	1081
	BG	428	428	644	747	1578	2353	3212
Coaches turning Overage	MG		696	223	15	69	10	143
	BG		241	0	21	0	0	201
Additional Coaches to Procure due to Traffic Growth	MG		65	171	0	0	0	0
	BG		216	103	831	775	858	965
Total Procurement including Replacement	MG		761	171	0	0	0	0
	BG		457	103	852	775	858	1166
Replacement procurement	MG		696	0	0	0	0	0
	BG		241	0	21	0	0	201
Wagons - Bogie Vehicles								
Total Required	MG	946	1310	1140	1405	1460	1406	1153
	BG	748	1153	1372	1802	2536	3526	4616
Ineffective %age	MG	40%	40%	35%	30%	25%	20%	15%
	BG	40%	40%	25%	20%	15%	15%	15%
Total Required for Traffic including ineffective	MG	1577	2184	1754	2008	1947	1758	1357
	BG	1247	1922	1830	2253	2984	4149	5431
Total Holding including ineffective	MG	2581	2581	1912	1912	2008	2008	1730
	BG	922	922	1922	1830	2253	2984	4149

Wagons turning Overage	MG		1249	0	507	0	278	0
	BG		140	574	33	0	0	0
Additional Wagons to Procure due to traffic Growth	MG		0	0	96	0	0	0
	BG		1000	0	423	731	1165	1282
Total Procurement including Replacement	MG		580	0	603	0	0	0
	BG		1140	482	456	731	1165	1282
Replacement procurement	MG		580	0	507	0	0	0
	BG		140	482	33	0	0	0
Locomotives								
Intercity Trains	MG	34	39	38	20	22	20	19
	BG	30	33	31	50	57	72	93
ME Trains	MG	30	39	37	19	12	7	7
	BG	24	30	27	46	57	62	63
Commuter Trains	MG	28	32	25	24	5	2	2
	BG	17	18	21	24	45	68	74
Freight Trains	MG	30	42	29	30	32	31	26
	BG	13	19	18	27	41	62	88
Total Required	MG	122	152	129	93	71	60	54
	BG	84	100	97	147	200	264	318
Ineffective %age	MG	31%	31%	25%	20%	15%	15%	15%
	BG	20%	20%	15%	15%	15%	15%	15%
Total Required including ineffective	MG	177	221	172	117	84	71	64
	BG	105	125	115	173	236	311	375
Total Holding including ineffective	MG	184	184	197	179	161	147	133
	BG	94	94	125	125	173	236	311
Locos turning Overage	MG		98	18	18	14	14	10
	BG		55	0	0	7	7	13
Additional Locos to Procure due to traffic Growth	MG		37	0	0	0	0	0
	BG		31	0	48	63	75	64
Total Procurement including Replacement	MG		111	0	0	0	0	0
	BG		86	0	48	70	82	77
Replacement procurement	MG		74	0	0	0	0	0
	BG		55	0	0	7	7	13

6.7 Outsourcing Options

6.7.1 Rolling Stock Leasing

Lease financing is a method of owning an asset by manufacturer or a financier (Lessor) and then provide the asset for use by another party (Lessee) for a certain period of time against periodic rental payment.

BR can obtain rolling stock on lease from the manufacturer and pay lease fee at regular intervals once the rolling stock gets into service. Lease can be:

- i. Wet Lease – The lessor not only provides rolling stock for use on BR but also maintains to ensure a minimum agreed level of outage.
- ii. Dry Lease – Under this option the lessor only makes rolling stock available for use on BR and does not provide any maintenance facility.

6.8 Diesel Loco Shed Upgrade

Diesel locomotives light repair schedules (C, D and E schedules) and Trip inspections are carried out at loco sheds. BR has ten diesel loco sheds (Location details at Para 2.3.1):

- | | | | |
|------|------------------------|---|---|
| i. | BG loco sheds | : | 3 |
| ii. | MG loco sheds | : | 4 |
| iii. | MG loco sheds | : | 3 |
| | (Only trip inspection) | | |

These sheds have inadequate infrastructure and support shop facilities and very old machinery & plant. BG loco sheds need upgrading and MG sheds to be converted to dual gauge sheds. New dual gauge sheds will have to be constructed wherever MG shed conversion is not possible.

Cost - Loco Shed Upgrade: USD 519 million (BDT 4000 crore)

6.9 C&W Maintenance Depot Upgrading

Every passenger train has a base station where it is attended in washing siding for internal and external cleaning, water filing, minor repairs like brake block change etc. If any coach is detected with defect that cannot be attended in washing siding then it is marked to Carriage and Wagon Depot (C&W Depot) located at the same station.

BR has following washing sidings and C&W Depots (Location details are available at Para 2.3.2):

- | | | | |
|-----|--------------------------------|---|----|
| i. | BG Washing siding & C&W Depots | : | 4 |
| ii. | MG Washing siding & C&W Depots | : | 10 |

All washing sidings and C&W depots have inadequate infrastructure facilities, old machinery & plant, inadequate component and sub-assembly repair facility. These have to be upgraded.

We recommend four BG facilities should be renovated and upgraded to meet current coach technology requirement, air conditioning system and mid-on/end-on generation system.

We also recommend ten MG facilities should be replaced by new dual gauge washing siding and C&W depots with all the modern facilities to attend hi-tech coaches.

Cost – Washing Siding & C&W Depot Upgrade: 14 depots – USD 519 million (BDT 4000 crore)

6.10 Other Recommendations

6.10.1 Technical Training schools

There are five technical Training Units attached to various maintenance workshops. These are:

- i. Workshop Training Unit, Pahartali
- ii. Workshop Training Unit, Dhaka
- iii. Workshop Training Unit, Parbatipuri
- iv. Workshop Training Unit, Ishurdi and
- v. Workshop Training School, Saidpur

All newly recruited supervisors and artisan staff like diesel loco fitters, diesel loco electricians, carriage & wagon fitters and others artisans like welders, machinists, fitters should undergo theoretical and practical lessons at these units. But these units have very poor training facilities particularly in terms of working models, cut models, charts, posters etc.

The training unit should have large class rooms with adequate space for models, cut away sections, wired panels, control stands, brake systems etc. Class rooms should be well equipped with large charts, drawings and components so that the trainee is given maximum possible exposure to the equipment. Trainees must be constantly encouraged and urged to handle them. Trainees should be accommodated in well-furnished hostel.

One class room should be fully equipped and self-contained for a particular system to teach major aspects of that system. For example, one class room may be developed for power pack, another for transmission, a third for controls, a fourth for brake equipment, etc.

One Model Room containing the following items should be available in each Centre:

- i. Real size working models
- ii. Cut away models to show constructional details of that component.
- iii. Circuit diagrams, sectioning diagrams, etc. illuminated and arranged to show the sequence of operations.
- iv. Special tools and instruments used in diesel loco maintenance.
- v. Samples of damaged equipment with tablets explaining the nature and cause of failure and preventive checks.
- vi. Display Boards with slogans and illustrations, emphasizing safe methods of working

- vii. Display Boards illustrating 'Do's and 'Don'ts'

Cost of developing five training Units is estimated at BDT 80 crore (see Project No. 73).

6.10.2 Running Staff Rest Room Upgrading

A comfortable Rest Room facility for running staff is very essential to ensure undisturbed rest during their lay over at outstation. Present running staff rest room facilities are very old and with inadequate capacity.

BR should make provision for upgraded new clean and quiet resting places for running staff along with necessary messing, boarding and recreational facilities round the clock. New running rooms location should be decided taking into consideration noise pollution and air pollution. Proximity to booking lobby should also be considered to the extent possible.

Accommodation in all Running Rooms should be adequate to ensure not even a single case of a loco pilot/ assistant loco pilot/ guard waiting for a bed after arriving in the running room.

Running rooms may be classified on the basis of number of users per day:

- i. Category "A" – 51 or more users,
- ii. Category "B" – between 21-50 users and
- iii. Category "C" – up to 20 users.

Running rooms will be required at sixteen different places. Total running room facility should be to accommodate approximately six hundred fifty crew members of Mechanical, Electrical and Traffic departments.

Total cost of sixteen Running Rooms upgrade will be approximately BDT 45 crore (see Project No. 74).

All running rooms should be provided with following basic amenities:

- i. Proper hygiene, adequate toilet facilities and clear drinking water.
- ii. Running room maintenance including room service should be out sourced to a private contractor.
- iii. Proper ventilation and lighting
- iv. Desert cooler for summer and room heaters for winter wherever required
- iv. Reading room with magazine and newspaper
- v. Proper mess facilities for running staff. Preferably mess operation should be outsourced to a private party.
- vi. A norm of two or fewer beds per room for core running staff like loco pilots, assistant pilots and guards. Cubicles with four to six beds should be provided for other staff.
- vii. Where ever necessary boundary walls/fencing should be provided.
- viii. Standby power supply arrangement may be provided.
- ix. Mosquito nets/mosquito repellent etc. should be provided.

- x. Regular pest control should ensured
- xi. Railway and general public phone connections should be provided.
- xii. Lockers should be provided to keep personal belongings and valuables.
- xiii. First aid box and firefighting equipment should be provided.
- xiv. Good quality linens, crockery, cutlery etc. should be provided.
- xv. Proper well- lit pathways should be provided from crew lobbies to running rooms.

6.10.3 Manuals and Codes Updating

All codes and manuals of mechanical and stores department are of steam locomotive and wooden body coach era and have become totally irrelevant to the current rolling stock and workshop practices. These need to be upgraded urgently.

Electrical department does not have a code and a new code is to be written.

Mechanical and Stores departments have following five manuals:

- | | | | |
|------|------------------------------------|---|------------------------|
| i. | Code for Mechanical Department | : | Last edition 1964 |
| ii. | Locomotive and Running Shed Manual | : | Last edition 1964 |
| iii. | Carriage and Wagon Manual | : | Last edition 1964 |
| iv. | Mechanical Workshop Manual | : | Last edition 1962 |
| v. | Code for Stores Department | : | Last edition 1964 |
| vi. | Code for Electrical Department | : | New code to be written |

Cost of updating/writing all six manuals will be approximately USD 4.0 million, or BDT 31 crore (see Project No 75).

Appendix 1: List of Meetings

Meetings and discussions attended with the different related agencies:

Date of Meeting	Organization	Attendees
18-Jan	Diesel Loco Maintenance Shed, Dhaka, Bangladesh Railway	Mr. Taslim Ahmed Khan, WM (Diesel), Dhaka, Mr. Md. Abul Hossain, Foreman, Diesel Shed, Dhaka, Anurag Gupta, Ashoka Baijal
24-Jan	Bangladesh Railway	Mr. Abdul Matin Chowdhury JDG (Mech), Ashoka Baijal & Matin Talukder
25-Jan	Coach Maintenance Depot, Dhaka, Bangladesh Railway	Mr. Taslim Ahmed Khan, DME (C&W), Dhaka, Mr. Mojibur Rahman, HTXR, Carriage Depot, Dhaka, Matin Talukder, Ashoka Baijal
25-Jan	Diesel Loco Workshop, Dhaka, Bangladesh Railway	Mr. Taslim Ahmed Khan, WM (Diesel), Dhaka, Mr. Janardhan Bonik, General Foreman, Diesel Workshop, Dhaka, Matin Talukder, Ashoka Baijal
05-Mar	Loco Workshop, Parbatipur, Bangladesh Railway	Mr. Noor Mohamad, Works Manager, Parbatipur, Matin Talukder, Ashoka Baijal
06-Mar	Central Locomotive Workshop (CLW), Parbatipur, Bangladesh Railways	Mr. Burhan Uddin, Chief Executive, CLW, Parbatipur, Mr. Mustafa Zake Hassan, WM/R, CLW, Mr. Rashid Zul Islam WM/M, CLW, Matin Talukder, Ashoka Baijal
06-Mar	Central Locomotive Workshop (CLW), Parbatipur, Bangladesh Railways	Mr. Polash Kumar Shah, ACOS, CLW, Parbatipur, Matin Talukder, Ashoka Baijal
07-Mar	Railway Workshop, Saidpur, Bangladesh Railway	Mr. Nur Ahmed Hossain, Divisional Superintendent (Workshop), Bangla Desh Railway, Matin Talukder, Ashoka Baijal
10-Mar	Bangladesh Railway	Mr. Mohammad Hassan Mansur, Director (Standards and Procedure/Loco), Bangladesh Railway, Matin Talukder, Ashoka Baijal
10-Mar	Bangladesh Railway	Mr. Khalilur Rahaman, ADG (RS), Mr. Abdul Matin Chowdhury JDG (Mech), Bangladesh Railway, Matin Talukder & Ashoka Baijal
27-Mar	Diesel Locomotive Workshop, Pahartali, Bangladesh Railway	Mr. Monir Hossain Chowdhry, Works Manager/Diesel, Diesel Locomotive Workshop, Pahartali, Bangladesh Railway, Matin Talukder, Ashoka Baijal
28-Mar	Carriage & Wagon Workshop, Pahartali, Bangladesh Railway	Mr. Md. Mizanur Rahman, Divisional Superintendent (Workshop), Pahartali, Bangladesh Railway, Matin Talukder & Ashoka Baijal
29-Mar	Railway Training Academy, Chittagong, Bangladesh Railway	Mr. Ruhul Kader Azad, Rector, Railway Training Academy, Mr. Ahmed Mahboob Chowdhry, Chief Training Officer, Railway Training Academy, Bangladesh Railway, Matin Talukder & Ashoka Baijal
31-Mar	Bangladesh Railway	Mr. Md. Shamsuzzaman, ADG (RS), Mr. Abdul Matin Chowdhury JDG (Mech), Bangladesh Railway, Matin Talukder & Ashoka Baijal

