付属資料８．JCC Report　全９回分

Reports and Presentations for each JCC are as followings.

・Appendix-8-1
Inception Report (1st JCC), August 2013

・Appendix-8-2
Progress Report for 2nd JCC, February 2014

・Appendix-8-3
Project Progress Report (3rd JCC), May 2014

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Project Progress Report (4th JCC), September 2014

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Project Progress Report (8th JCC), October 2015

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Draft Final Report (9th JCC), January 2016
* Draft final report is omitted because its contents are same as this report.

Myanma Railways (MR)
Japan International Cooperation Agency (JICA)

# PROJECT ON IMPROVEMENT OF SERVICE AND SAFETY OF RAILWAY IN MYANMAR

# INCEPTION REPORT

August 2013

JAPAN INTERNATIONAL CONSULTANTS FOR TRANSPORTATION CO., LTD
ORIENTAL CONSULTANTS CO., LTD
SUMITOMO CORPORATION

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## 1. Project Summary

### 1.1 Project background

The Republic of the Union of Myanmar has a totally non-electrified meter-gauge railway network spreading as long as 5,934 km. Most of the network is single-tracked, with double-tracked sections limited to (1) the Yangon–Mandalay section (approximately 620 km in length) crossing the central plain and (2) urban railway lines centering on the Yangon circular section. The yearly number of passengers is 53.8 million (or approximately 147,000 per day) as of fiscal 2012. The Myanma Railways (hereinafter referred to as MR) under the Ministry of Rail Transportation centralizes all aspects of its management, from construction, operation, and maintenance.

In recent years, MR and Ministry of Rail Transportation have come to recognize the importance of maintenance/repair of existing lines. In the past, however, MR invested more than a half of the budget in the construction of new railway lines, with only a small portion appropriated for the renewal of existing facilities and equipment. As a result, MR is now has crucial subjects how to recover the deteriorated safety level and passenger services. In concrete terms, facilities and equipment have extremely superannuated and machines, tools and materials are running short. Maintenance, and management have not been implemented appropriately in the past. As a matter of fact, 118 accidents including derailment and collision having occurred in fiscal 2011 in the Yangon–Mandalay section. There are a number of problems in the section, such as delays of train operation, lowered train speed and worsened ride comfort.

According to the data of MR, the status of the safety of train operation is as follows. From 2011 through 2012, 118 accidents occurred in the 620.4 km-long Yangon–Mandalay section, of which those attributed to tracks, rolling stock and others accounted for 50, 29 and 21%, respectively. This means that most of the accidents were caused by deteriorated tracks.

The status of services is as follows.
There are a number of factors that govern the service level, such as train speed, punctuality, comfort (ride comfort, cleanliness in the passenger room) and fare and charge. The scheduled speed between Yangon and Mandalay is as low as 39 km/h, with train speed limited at various points. The on-time operation rate of express passenger trains in the same section is as low as 41% during the past three years, with trains delayed 59% by improper track conditions and 22% by malfunction of rolling stock. This means that train delay is caused mostly by deteriorated tracks. Furthermore, trains vibrate excessively and passenger rooms are not clean. MR is required to eliminate these drawbacks and improve passenger services.

### 1.2 Circumstances led to the project

With the above facts in the background, the government of Myanmar requested the government of Japan to implement a project of technical cooperation, namely "The Project on Improvement of Service and Safety of Railway." Based on this request, JICA delegated a detailed project planning study team in October 2012 and surveyed the present status of the railways around Yangon and in the suburbs of Naypyidaw and also had the consultations with MR.

According to the Record of Discussion (hereinafter referred to as R/D) signed on March 25, 2013, between President of MR and General Manager, JICA office in Myanmar, agreement was reached upon the detailed contents of the Project and cooperation of JICA to be extended thereto.

### 1.3 Purpose of the Project

Administration and maintenance ability is improved for the enhancement of service and safety of Myanma Railways.

## 2. Basic Plan of Project Implementation

### 2.1 Overall goal and Project purpose

Overall goal and Project purpose of this Project and expected outputs are as follows.

| Overall goal and Project purpose | |
|---|---|
| 1 | Service and safety level of Myanma Railways is improved (Overall goal) |
| 2 | Administration and maintenance ability is improved for the enhancement of service and safety of Myanma Railways (Project purpose) |

⇩

| Expected outputs | |
|---|---|
| Output1 | Based on accident analysis, issues are clarified for the enhancement of service and safety in the administration and maintenance process, and the improvement plan is drawn. |
| Output2 | Technical Transfer of Track Maintenance Technology to improve the level of Service and Safety through implementation of the Pilot Project |

### 2.2 Implementation plan

Implementation plans which accomplish the project purpose are as follows.

| Implementation plan for Output1 |
|---|
| To survey current situations of track, rolling stock, signal and telecommunication, and operation, and to establish system for collecting information in these various areas above. |
| To promote familiarization on the investigation and analysis method of accident cause based on the comprehensive factors of track, rolling stock, signal and telecommunication, and operation. |
| To conduct the investigation and analysis mentioned above with due consideration on hardware (facilities, equipments), and.software (operational and maintenance standards, human errors etc.) |
| To provide recommendation based on the above analysis on necessary technical standards relating to operational and maintenance aspects to improve service and safety level |
| To draw up the improvement plan of railway facilities through discussion with the "Working Group of service and safety improvement" |

| Implementation plan for Output2 |
|---|
| To draw up technology transfer plan of track maintenance through OJT in the Pilot Section. |
| According to the technology transfer plan above, to procure the necessary equipments and materials. |
| To conduct track maintenance (inspection, planning, work) jointly with MR staff, making use of the equipments and the materials. |
| To summarize points to be improved obtained during track maintenance operation mentioned above, and to feed back to the successive measures. |
| To revise the track maintenance manual based on the feedback above. |
| To conduct seminars, training for technical improvement of the track maintenance |

### 2.3 Project Section

The section between Yangon and Bago in the Yangon suburban area. Pilot section of about 20km shall be selected between Yangon and Bago.

## 3. Flow Chart of Project Implementation

The flow chart of the Project implementation is shown in figure3-1.

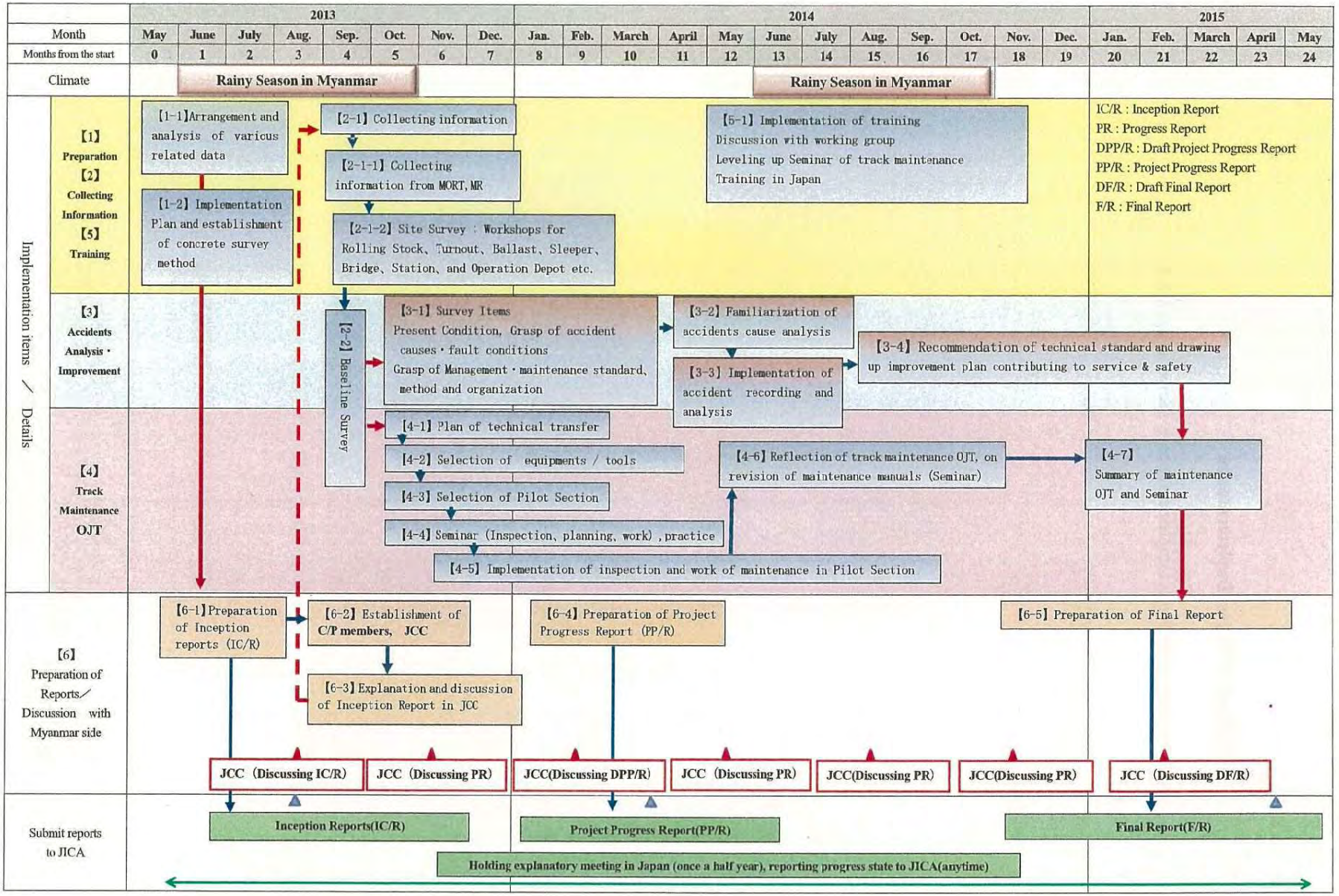



Figure 3-1 Project Implementation

## 4. Detailed Methods for the Project Implementation

### 4.1 Recommendation of technical standards relating to administrative and maintenance aspect and drawing up railway facilities improvement plan to improve service and safety level.

Safety can be compared to "air" not only in railways but also in other traffic and transport services, as they cannot exist without safety, though it is not visible or tangible. On the other hand, the improvement of customer services is an indispensable element for existence for traffic and transport services that are being exposed to the waves of modal shift and competition with other transport facilities.

Bearing in mind such a concept, JICA Team surveys in this project the present status of safety and customer services of MR and introduces technical standards related to its maintenance and management. We also extract items for improvement and have discussions with Working Groups (W/G), and based on the results of which we aim at determining the items of improvement for the short-, medium- and long-term phases.

#### 4.1.1 Preparation of a working plan

JICA Team surveys the present status of MR and guides its staff on the technique to analyze causes of accidents and abnormalities. JICA Team requests MR to make its staff participate in the database creating and data analyzing work to understand the meaning of these procedures, thereby expecting that MR staff can continue the sustainable work by themselves after completion of the project.

Japanese experts compile text books to introduce how Japan and other countries tackle with prevention of accidents, and cases and mechanisms of typical accidents.

JICA Team holds a workshop together with MR staff attended to summarize and share the outcome of the above efforts.

See Table 4-1 for the working plan.

#### 4.1.2 Survey of the present status and establishment of organization to collect information

To ensure smooth implementation and high efficiency of project activities from now on, JICA Team grasps the present status and collect relevant information on the basic/general item, methods of accident prevention and action at the occurrence of accidents through the newly appointed counterpart (C/P).

(1) Collection of basic information

We collect (1) the information on the present status of the facilities/equipment in the fields of tracks, rolling stock, signal and telecommunication and train operation, (2) information directly related to the safety and services such as maintenance-related standards, regulations and occurrence of accidents and malfunction and (3) information indirectly related to safety and services, such as revenue/expenditure , organizations, employee structures and other basic factors. We survey, among others, plans and records of investment in respective fields, estimation of maintenance cost, its request, notification status and purposes of expense.

(2) How to tackle with prevention of accidents

We survey methods of prevention of accidents and failures (accident analysis meetings, methods to disseminate the outcome of the meetings over field organizations) and grasp the number of accidents and malfunctions, methods of budget allocation to relevant fields of budget, and notification and purposes of expenditure.

(3) Actions at the occurrence of accidents

We survey the present status of reporting of accidents and relevant actions at the site of accident, the directing and commanding actions at the Head Office, methods of reporting to competent ministries and agencies and the methods of releasing information on accidents to mass media.

**4.1.3 Guidance and familiarization of the technique to analysis the present status and causes of accidents and poor services.**

Safety of railways assumes learning from the heavy toll of human lives of properties caused by the past accidents and makes it a prerequisite to disseminate among employees an oath never to repeat the same accidents. Regarding passenger services on the other hand, employees shall understand that the closer to customers they are, the heavier responsibilities they are supposed to have.

Aiming at "visualized management," we create a database on accidents and malfunctions in MR from 2010 through 2012 together with the C/P using Excel and other software for calculation. Based on the database, we analyze the trend of the occurrence of accidents/malfunctions and discuss counter measures against. We also guide the C/P on the method to create a simplified database on accidents and introduce cases of compiling monthly and yearly reports.

**4.1.3-A Safety**

We adopt cases of collision, derailment, train separation and level crossing accidents recently experienced by MR, and compile a text book to introduce methods to verify/analyze causes of selected accidents accident and accident preventing measures.

In selecting cases of accident for the above purpose, we consult with the C/P and consider the important items and those in which MR is interested.

By utilizing the text book, we familiarize the MR staff methods to analyze causes of accidents and to establish measures for accident prevention.

(1) Compilation of the text book

1) Introduction of the efforts of Japan and European countries towards to analysis of accidents and improvement of safety level.

MR currently relies not on national railway technical standards, but on railway technical standards adopted by International Union of Railways (UIC) and the European Railway Industry (UNIFE). Therefore, we introduce the accident preventing measures adopted not only in Japan but also in European countries.

As a successful case in Japan, we cite the measures to prevent level crossing accidents to make MR understand that, in order to decrease the total number of accidents, it is

effective to respond to the most frequently occurring incidents on a preferential basis, and to allocate a budget for hardware measures.

Simultaneously, we introduce the importance of human factors that allows prompt application without requiring particular budgetary arrangements, but requires five- to 10-year for generating successful results.

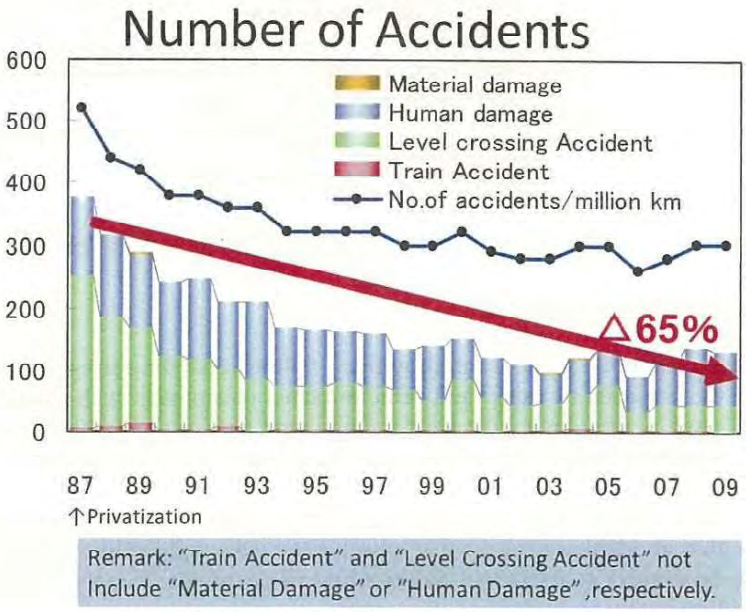



Fig. 4-1: Railway accident after Privatization of Japanese National Railroad

2) Introduction of the causes of and countermeasures against typical accidents in the past in Japan

a) Collision accident

We introduce the accidents caused by hardware failures and human errors, while referring to the (1) Mikawashima accident that accelerated the introduction of Automatic Train Stop device (ATS) and institution of a research institute on labor psychology and physiology, (2) "collision accident on the Shigaraki Railway in which a human error of a person affected the survival of the operator's management, (3) Tsurumi accident and (4) Derailment replication test of train derailment implemented on the Karikachi Test line.

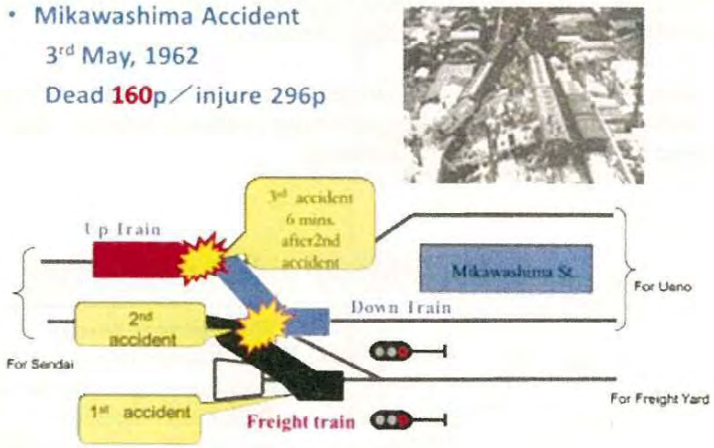



Fig. 4-2: Accident at Mikawashima Station on Joban line, Tokyo

b) Derailment accident

We adopt accidents caused by track failures including irregularities of alignment and those caused by track- and vehicle-related phenomena such as wheel climbing the rail head by introducing the Hibiya derailment accident to make MR understand that even a train running at low speed can claim a heavy toll of human lives.

As a case of train derailment accident on high-speed railways, we introduce (1) the ICE accident at Eschede that unfortunately claimed the lives of 101 passengers and (2) derailment accident on Joetsu Shinkansen at the Niigata Chuetsu earthquake that fortunately victimized no passengers.

ICE Eschede Accident in 1998

Joetsu-Shinkansen Accident in 2004

Fig.4-3: High speed rail derailment accident

c) Accident caused by natural disaster

In consideration of the natural environment surrounding MR, such as cyclones and long rains in the rainy season, we adopt accidents relating to earth-flows and river water increases and introduce cases of accidents in the past such as the loss of Fujigawa river bridge girders on Tokaido line, and train derailment and overturn in a strong wind on Uetsu line.

d) Train fire accident

It is important for MR that relies on diesel engines for powering to implement measures against fire, given the increases in the transport volume and high-speed train operation speed in the future. We introduce the fire accident preventive measures taken for high-speed diesel express trains Hatsukari that were introduced in Japan to cope with the expanded railway networks during the economic growth period in the 1960s.

e) Other accidents

Irrespective of the above cases, we consider adoption of other cases that are thought to be important by Japanese experts in each technical fields and those required for adoption by the MR C/P.

(2) Studying and learning with text books

We use the compiled text books to make the C/P discuss the causes of and preventive measures against accidents by themselves from the standpoint of the railway operator and disseminate the importance of learning from accidents.

(3) Summarization of the results of analysis and countermeasures against accidents.

We hold a workshop to deeper the understanding of MR staff of analysis and establishment of causes measures against accidents, and make MR including the management share the outcome of the workshop.

**4.1.3-B Service level**

The level of passenger services implies widely-ranged factors, such as train speed, punctuality, fare and charge, comfort (ride comfort, cleanliness and train operation diagrams) and also related with comparison with other transport facilities. The evaluation criterion of each factor depends on the subjectivity and sensitivity of individuals. In this Project, we adopt comparatively clear-cut items, such as low levels of scheduled speed, punctuality (frequency of train delays) and ride comfort (vibration of train).

(1) Compilation of text books

We introduce technical measures in Japan to raise train speed, ensure punctuality and improve ride comfort together with the methods (evaluation items and means) to survey customer satisfaction (CS) with railways.

(2) Results of cause analysis for the low service level and countermeasures

We shall be provided with the data in 2011,2012 on "the sections and factors of speed limit" and "delayed operations" of the trains between Yangon and Mandalay, categorize it with constraining conditions such as geographical conditions, conditions of tracks, track beds and bridges, rolling stock performance and train operation procedures and signal/telecommunication facilities and discuss measures against such problems together C/P.

Regarding ride comfort, we make data visible by using vibration measuring instruments. .

We also implement hearing surveys over customers during the Project period.

(3) Summarization of the results of cause analysis for the low service level and countermeasures

We hold a workshop to deeper understanding of MR staff of causes analysis and establishment of measures to improve the service level and make MR including the top management share the outcome of the workshop.

**4.1.4 Recommendation on technical standards relating to administrative and maintenance aspect to improve the service level and safety**

(1) Recommendation on technical standards to improve safety

We clarify the items prioritized for the improvement of safety. To ensure safety, nothing is more important than motivation of employees, with observance of standards and efforts for improvement by employees being a key to attain sustainable success. To prepare an environment for this purpose, therefore, it is important to create organizational norms and climates to allow evaluating the efforts by employees in a visible form.

(2) Recommendation on technical standards to improve the service level

We clarify the items prioritized for MR to improve customer service. It is expected that passenger flows will become more active not only in Myanmar but also to/from other countries as a result of economic development from now on. Improvement of service level is of utmost importance for MR in order to win the competition with other transport facilities and make railways survive and develop further in the future.

**4.1.5 Drawing up of short- , medium- and long-term railway facilities improvement plan**

We organize "Working group to improve the service level and safety (tentative naming )", make it analyze a series of surveys and extract improvement items for each phase based on the outcome of the workshop. After that, we draw an improvement road map for discussion.

(1) Short-term (three-year) improvement items

Items related to the safety of customers are prioritized to anything else, which shall simultaneously be those to promptly yield effect. It is recommended to promote the Project while selecting the Pilot sections and checking the effect through trials to replace components for which the spare part supply period is already overdue.

<Conceivable items>

* Track rehabilitation through ballast refills, renewal of rails, welding rail joints and track irregularities improvement
* Renewal of locomotive and diesel multiple units(DMU) engines and improvement of passenger coach accommodations
* Introduction of electronic interlocking systems into major stations, measures against lightning and improvement of block system between stations
* Renewal of telecommunication systems
* Improvement of staff educating facilities

* Survey of durability of railway civil engineering structure

(2) Medium-term (5- to 10-year) improvement items

We apply the items verified as short-term improvement items to major trunk lines, while targeting modernization of MR to cope with increases in the transport volume and higher speed operation.

<Conceivable items>
* Introduction of the automatic train protection system (ATP)
* Improvement of storage tracks and rolling stock maintenance bases

(3) Long-term (10- to 30-year) improvement items

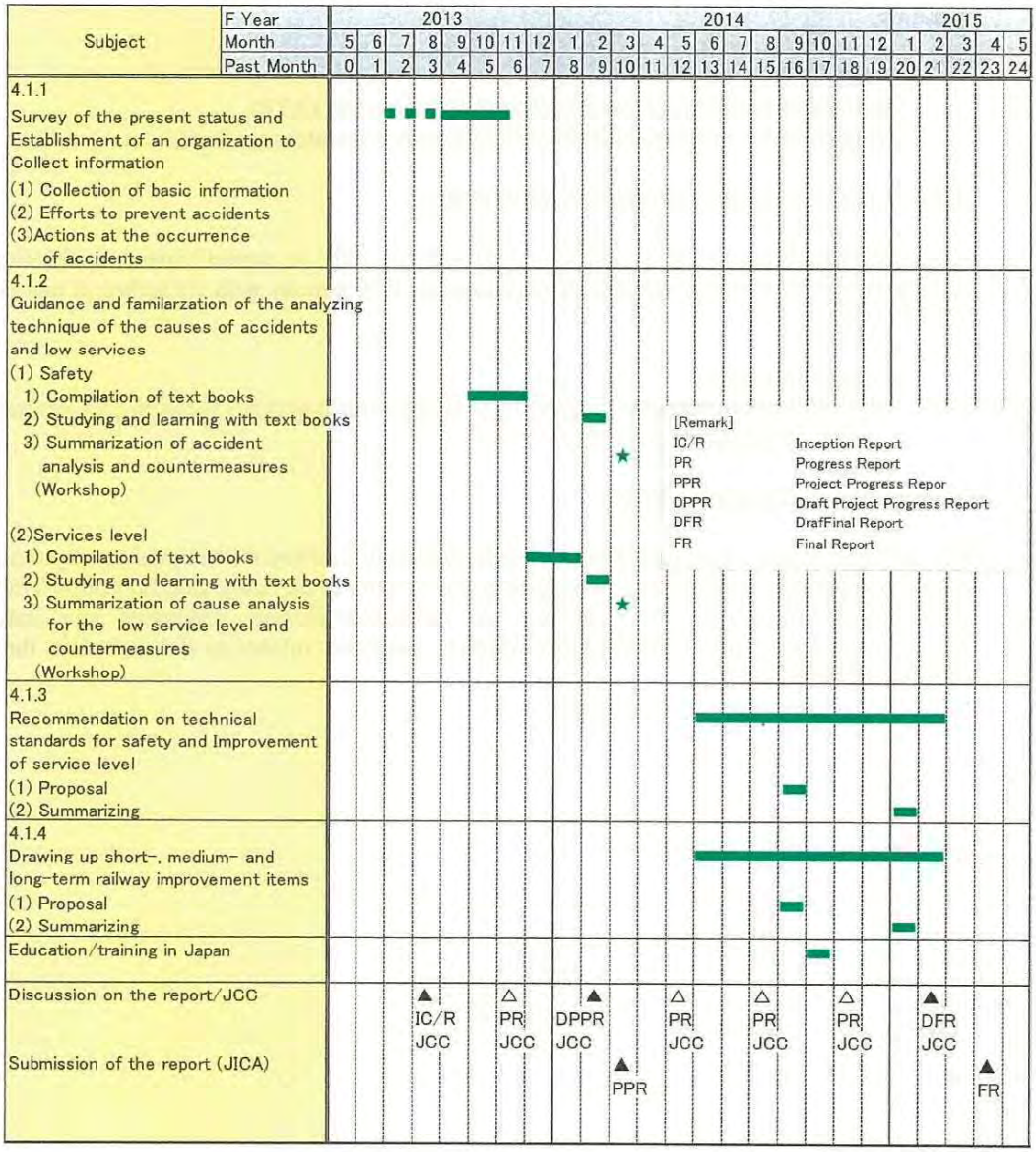
Long-term improvement items shall be selected not only to repeat/expand application of medium-term improvement items but also to consider the harmony with the technical innovation in the future.

<Conceivable items>
* Electrification and introduction of operation control systems including the centralized traffic control system (CTC)

**4.1.6 Education/training in Japan**

We educate and train approximately 11 trainees relating to railway institutional management for two weeks in Japan, including implementation of site tours to the Integrated Education/Training Center (Shin-Shirakawa), JR East, and the Overseas Human Resources and Industry Development Association (HIDA), with concrete programs subject to determination through consultations with MR.

Table4-1 Table of work planning schedule



### 4.2 Technology transfer of track maintenance technologies to improve the level of Service and Safety through implementation of the Pilot Project

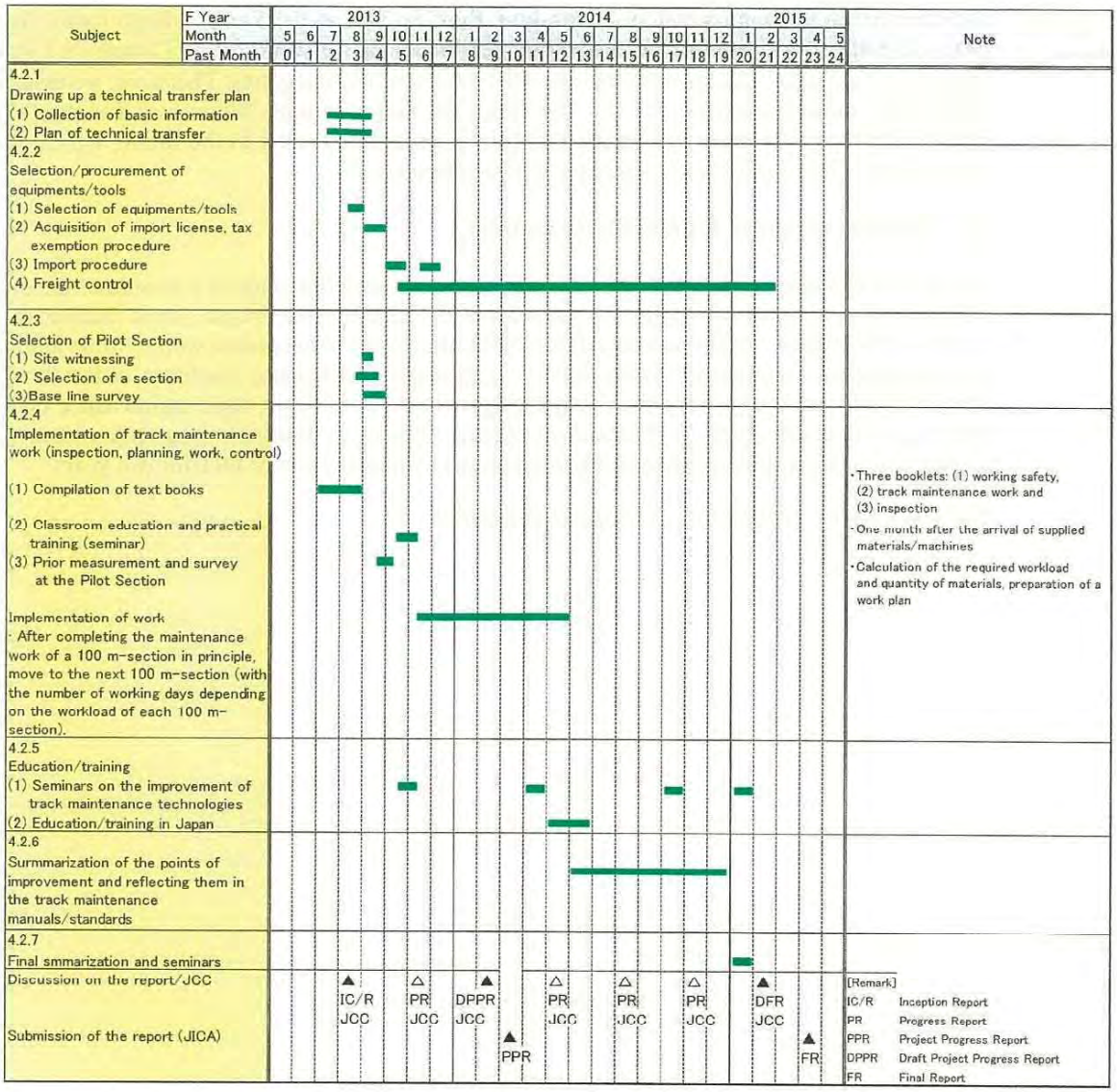
In this Project, the track maintenance OJT is one of the most important subjects, which will be implemented in the approximately 20 km-long Pilot Section in the Yangon–Bago route. As a gang of maintenance workers currently executes maintenance work for a 5.1-mile (8.2 km) segment, it is thought that the Pilot Section can be covered by four gangs. Therefore, we assume performing training and guidance for four gangs for OJT purposes. We expect that the Pilot Section dealt with by these four gangs will become a model section in the future, which will evolve further into a railway network on a nationwide scale.

#### 4.2.1 Drawing up a plan for technology transfer

The system of track maintenance work currently in practice in Myanmar is a version of the old-fashioned system implemented in the past in Japan. Through this Project, track maintenance workers of MR shall receive education/training of basic track maintenance works, while aiming at a mechanized maintenance system to use large-scale maintenance machines in the future. This means a conversion from the current gang system to a larger sized maintenance depot system or a re-construction of maintenance system. Bearing in mind this long-term vision, we prepare a plan for technology transfer focused on the track maintenance OJT for two years.

See Table 4-2 for the schedule of technology transfer.

Table 4-2 Tentative Schedule (Track Maintenance)



### 4.2.2 Procurement of the required equipments / tools

(1) Table 4-3 summarizes the required equipments / tools, which will be procured by the Japan side.

Table 4-3: List of the required equipments / tools

| No. | Item | Unit | Weight (kg) | Size (mm) |
|---|---|---|---|---|
| 1 | Digital standard gauge | 5 | 3 | 1,320×90×108 |
| 2 | Instrument detection for track | 5 | 1 | 200×150×150 |
| 3 | Mesuring instrument for rail wearing depthe | 2 | 0.6 | 200×135×51 |
| 4 | Gap gauge | 5 | 0.5 | 150×20×10 |
| 5 | Taper gauge | 5 | 1 | 200×20×20 |
| 6 | Thermometer for rail | 5 | 0.1 | 81×35×11 |
| 7 | Square for rail | 5 | 5 | 800×1,570×100 |
| 8 | Trackmaster | 1 | 43 | 2,100×1,320×225 |
| 9 | Mesuring instrument for train swing | 1 | 4 | 184×184×159 |
| 10 | Tape | 13 | 0.1 | 200×15×3 |
| 11 | cloth measuring tape (30 m) | 5 | 0.7 | 300×300×30 |
| 12 | steel measuring tape (30 m) | 5 | 0.9 | 300×300×30 |
| 13 | Square | 5 | 0.1 | 161.5×323×2 |
| 14 | Slate pencil , Chalk | 4 | 0.1 | 150×100×20 |
| 15 | Tie tamper | 1 | 29 | 750×180×880 |
| 16 | Beater | 18 | 5 | 910×790×30 |
| 17 | Shovel | 18 | 2 | 1,000×300×50 |
| 18 | Bar | 35 | 10 | 1,500×30×30 |
| 19 | Spike hammer | 13 | 5 | 910×345×30 |
| 20 | Panpuller | 18 | 3 | 1,000×200×50 |
| 21 | Jack for rail | 40 | 16 | 187×155×300 |
| 22 | Equipment for ballast tamping | 5 | 62 | 930×845×360 |
| 23 | Generator | 1 | 97 | 540×910×700 |
| 24 | Generator | 5 | 21 | 510×290×425 |
| 25 | Shovel | 9 | 1 | 1,000×250×300 |
| 26 | Dump shovel | 9 | 3 | 1,000×300×50 |
| 27 | Shovel with blade divided into multiple | 9 | 3 | 1,000×300×50 |
| 28 | Hoe with blade like nail of wild goose | 9 | 1.5 | 760×200×150 |
| 29 | Hand screen | 18 | 3 | 400×600×70 |
| 30 | Hoe with blade of traiangle | 9 | 1.7 | 950×230×110 |
| 31 | Wooden maul | 9 | 5 | 1,000×300×200 |
| 32 | Basket made by bamboo or plastic | 9 | 1 | 400×419×120 |

| No. | Item | Unit | Weight (kg) | Size (mm) |
|---|---|---|---|---|
| 33 | Jack traverser | 10 | 40 | 2,350×1,000×861 |
| 34 | Rail sawing machine | 3 | 50 | 450×550×950 |
| 35 | Rail boring machine | 3 | 25 | 877×294×433 |
| 36 | rail bending machine | 1 | 90 | 1,000×500×250 |
| 37 | rail joint expandor | 1 | 78 | 1,130×620×350 |
| 38 | Sleeper replacing machine | 1 | 12 | 400×150×150 |
| 39 | Rail carrying machine | 9 | 88 | 2,850×956×690 |
| 40 | Rail carrying tongs | 9 | 2 | 220×150×30 |
| 41 | Shovel | 18 | 2 | 1,000×300×50 |
| 42 | Single open ended spanner | 9 | 5 | 800×100×20 |
| 43 | Chisel | 5 | 2.5 | 200×30×30 |
| 44 | Rail fork | 5 | 6.5 | 1,040×100×100 |
| 45 | Disc grinder | 5 | 1.5 | 300×150×150 |
| 46 | Power wrench | 5 | 9 | 400×400×150 |
| 47 | Low joint maintenance machine | 1 | 205 | 1,443×450×995 |
| 48 | Spanner for joint bolt | 9 | 5 | 600×60×20 |
| 49 | Rail grinding machine | 1 | 57 | 2,061×244×380 |
| 50 | Swager for back bolt | 1 | 10 | 300×250×100 |
| 51 | Hydraulic lining machine | 5 | 25.5 | 630×150×148 |
| 52 | Low roller | 7 | 0.5 | 177×30×22 |
| 53 | Chisel with handle | 3 | 3 | 200×490×30 |
| 54 | Spanner for bed plate / rail brace | 7 | 5 | 600×60×20 |
| 55 | Adz | 9 | 2 | 550×150×50 |
| 56 | Hand hammmar | 9 | 0.5 | 350×100×30 |
| 57 | Spanner for huck bolt | 9 | 5 | 600×60×20 |
| 58 | Gimlet for huck bolt | 13 | 0.5 | 250×200×20 |
| 59 | Gimlet for cut spike | 13 | 0.5 | 250×200×20 |
| 60 | gouge | 9 | 0.2 | 250×30×30 |
| 61 | Electric saw | 5 | 2 | 300×100×200 |
| 62 | Boring machine | 3 | 2.5 | 400×100×200 |
| 63 | Sleeper carrying tongs | 9 | 2.5 | 500×300×30 |
| 64 | Pad remover | 9 | 0.1 | 200×100×20 |
| 65 | Light track trolley | 5 | 77 | 1,500×1,232×233 |
| 66 | Gas cutting machine | 2 | 15 | 1,000×1,000×1,000 |
| 67 | Rail lifting machine | 3 | 17 | 867×260×200 |
| 68 | Spanner | 2 | 1.5 | 385×110×25 |

| No. | Item | Unit | Weight (kg) | Size (mm) |
|---|---|---|---|---|
| 69 | Track jack | 9 | 20 | 250×150×550 |
| 70 | Low elasticity pad | 20 | 0.1 | 180×110×10 |
| 71 | Track shim | 20 | 0.5 | 400×50×5 |
| 72 | variable pad | 40 | 0.1 | 200×100×10 |
| 73 | Gravel stop | 20 | 76 | 610×500×400 |
| 74 | Huck bolt | 40 | 1 | 200～400×30×30 |
| 75 | Brushcutter | 4 | 4 | 30×30×1730 |
| 76 | Design for turnout etc | 1 | | |
| 77 | Design for the other materials | 1 | | |

(2) Figure 4-4 illustrates the flow of the import procedure for equipments / tools in the procurement process. Below explained are the major points to be observed.

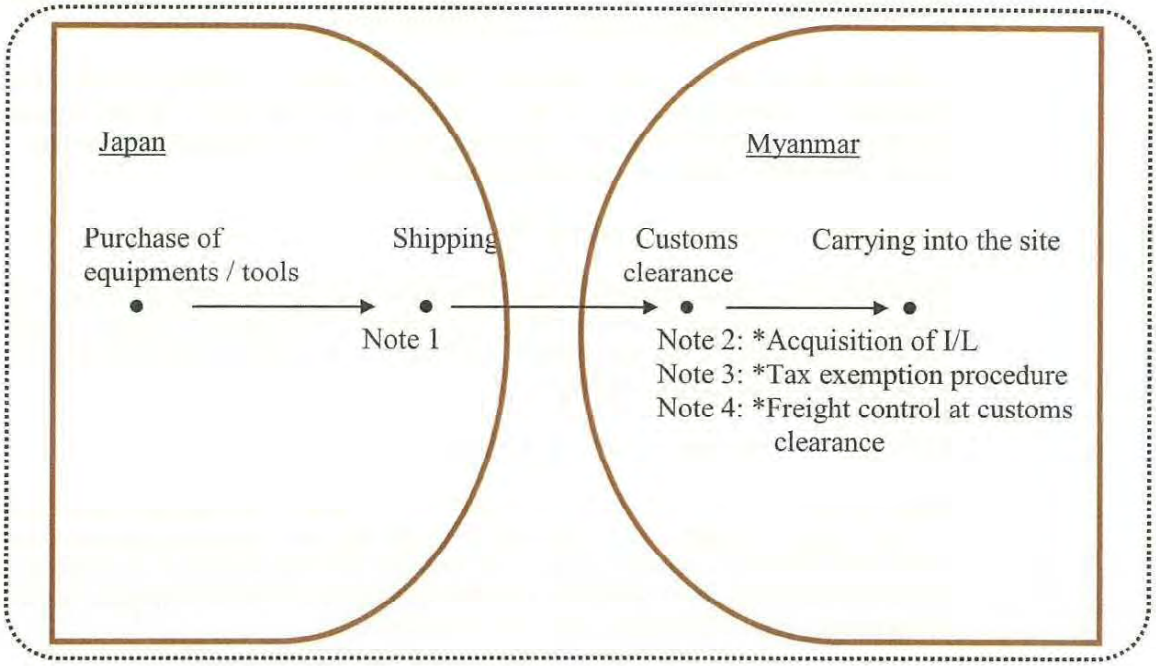



Fig. 4-4: Flow of the equipments / tools import procedure.

1) Acquisition of import license (I/L) (Notes 1 and 2)

Trading in Myanmar requires importers to acquire an import license (I/L) in advance.

Importers shall acquire an import license before shipment (Note 1) as a prior procedure required for import clearance in landing the purchased equipments / tools.

2) Shipping of equipments / tools

If the cargo has been shipped from the export country before the acquisition of an import license, the importer shall be subject to confiscation of cargo or other penalties by Myanmar. Therefore, due attention shall be paid to the dates of I/L acquisition and cargo shipping from the export country. Furthermore, the cargo shall arrive at Myanmar before the last day of import specified in the import license.

3) Import declaration (Note 2)

Although import declaration can be performed by the importer, it is normally entrusted to a professional agent called a customs broker with a fee paid, as the clearance procedure is extremely complicated and requires expertise knowledge of laws.

Checking and signing the documents for clearance can be done only by the registered customs specialists belonging to a customs broker.

4) Import clearance (Note 2)

This is a procedure for importers to obtain permission from the customhouse with the cargo subject to inspection after (1) reporting cargo items, categories, quantities, prices and other particulars and (2) paying custom duties and other relevant taxes.

Until this procedure completes, the cargo retains the status of a foreign article without becoming a domestic one and, therefore, it cannot be handed over to the Myanmar territory from the bond area. As omission/ignorance of this procedure or false file of return constitutes smuggling, due attention shall be paid.

5) Procedure for tax exemption (Note 3)

Importers shall obtain permission of the customhouse for tax exemption before the clearance procedure in importing cargos that fall in the category of tax-free articles. Detailed procedures in this regard shall be subject to prior confirmation with competent offices and customhouses in Myanmar.

6) Freight control at import clearance (Note 4)

After the arrival of the cargo at the landing port of Myanmar, the importer cannot claim it until the import clearance completes. In the meantime, the importer is required to bear warehouse expenses, container yard rental fees and other extra costs. It is required for the importer, therefore, to promptly complete the custom clearance procedure and take other actions to avoid otherwise unnecessary expenses.

### 4.2.3 Selection of Pilot Section

In the 46.5 mile section (74.8 km long) between Yangon and Bago, we implement track maintenance as a means of technical transfer in the approximately 20 km-long Pilot Section, which is selected through a site survey to allow experiencing maintenance of different track structures, such as defective, sound, straight and curved tracks, turnouts in station yards and bridges, so that the effect of technical transfer is readily obtainable.

### 4.2.4 Implementation of track maintenance (inspection, planning, work and control)

(1) Compilation of text book

To use for classroom education and practical training, we compile a text book in three parts, each covering the fields of (1) safety of work, (2) track maintenance work and (3) track inspection.

We implement practical training and maintenance work based on this text book and compile, (1) standards and (2) manuals, for track maintenance work, after modifying, adding or deleting contents of the text book based on review of track maintenance training.

(2) Classroom education and practices (seminars)

Before implementing actual track maintenance work on the Pilot Section, we will have seminars on the particulars related to track maintenance such as inspection, planning and work for the workers to be assigned to the Pilot Section. This is the first classroom education and an important step to assess the level of local staff, which will significantly contribute to the work progress control in the future.

Before starting the maintenance work in the Pilot Section, we will also perform practical training on track maintenance (inspection and work) on non-commercial tracks. As safety is one of the most important concerns for track maintenance workers, we also educate them on safety in practicing track maintenance work, with (1) wearing protectors and other protective equipment and (2) deployment of security guards (train watchmen) subject to prior negotiation with MR. However, we propose at least wearing protective shoes, helmets and safety vests.

Regarding classroom education and practical exercises, we select an inspector and three to four works from each gang; implement education in the classroom in the morning and practical exercises using working tools in the afternoon, for about one month in consideration of the combinations of work category and associated job and the number of object trainees. As a part of base line survey, track irregularities (5 items), train vibration accelerations (Vertical and lateral ), average speed in the Pilot Section will be measured.

(3) Implementation of prior measurement and surveys of the Pilot Section

Before implementing track maintenance work for tracks used for commercial services in the Pilot Section, we measure track levels (transit measurement at curves) to calculate the amount of rail lift and the volume of ballast for the total length of the Pilot Section. Furthermore, we patrol the total length to (1) visually check the conditions of track structure/materials and (2) survey the workload required and the volume of materials in each 100 m-segment to draw up a working plan.

(4) Implementation of inspection, planning and work in the Pilot Section

Based on the working plan for each 100 m-segment compiled according to the results of prior measurement and surveys, we implement in turn education and training for the inspector and workers of each track maintenance gang. In the course of this education/training for a particular gang until the track maintenance work in the range of track section in its charge completes, inspectors and workers for other gangs are expected to observe, witness and help the work in progress when necessary in order to make these gang-wise separated operations yield an extended effect over the whole Pilot Section.

For this education/training, we will in principle use the intervals between trains during the daytime. Based on the experience in practical training, time-consuming work will be shifted to the time zone when tracks are not used for commercial purposes.

See the paragraphs 1) to 11) below for the scheduled track inspection and maintenance work together with the following descriptions for the purpose, points and summaries of the inspection/maintenance work.

1) Ballast compacting work (use of hand tie-tampers, beaters or shovels)

①Inspection of track irregularities and conditions

Twice-yearly inspection of vertical/lateral displacement and settlement of tracks to extract irregular points before they affect the train running safety and ride comfort for compiling an improvement plan.

② Correction of track irregularities

To guarantee the safety of running trains and improve/maintain ride comfort, the ballast layer, which transmits the train load to the tack bed and absorbs vibration/shock, is normally compacted to correct track unevenness and irregularities. The effect of the ballast layer is ensured when a sufficient volume of ballast is supplied to an appropriate thickness under sleepers.

2) Ballast sieving

① Inspection of ballast

The ballast layer loses its function, with elasticity decreased and draining capacity worsened due to sand/soil flying from the surroundings, mud pumping and grain refining caused by the train load. Therefore, ballast layer should be checked once a year and sand/soil in the ballast layer shall be removed approximately.

② Execution of work

Deteriorated ballast shall be sieved to remove sand/soil, with new ballast refilled to recover the lost volume and function. It is normally the case that ballast is compacted simultaneously.

3) Rail renewal work

① Inspection of rail

Rails shall be inspected once a year on a regular basis for wear, corrosions, cracks and other conditions for renewal in case they have flaws, corrosions or worn parts to threaten the safety of train operation.

To extend their life, however, it is often the case at present that some parts of the rail such as cracks due to fatigue and corrugated wear parts are ground before replacing rails.

②Rail renewal work

Rails are normally replaced by suspending trains rather than utilizing the intervals of train operation. To replace a rail, prepare a new one in advance at the renewal site.

Rails are normally replaced through (1) manual operation in case the length of renewal section is 10 m or less and (2) by using dedicated machines such as an crane type rail traverser (a carrier to hang and move rails) and rail replacer in case the length of renewal section is longer than 10m .

4) Rail joint work (rework on rail clearance (rail joint clearance), correction of rail joint depression)

①Inspection of rail joint

Insufficient rail joint clearances generate an axial force in rails due to the loss of allowance for elongation and cause rail buckling. On the other hand, excessively large rail joint clearances increase the shock at train passage to worsen ride comfort, cause joint depression, damage rails and break fish bolts. To prevent these phenomena, rail clearances sball be inspected twice a year, in spring and autumn, to ensure proper clearances.

Implement a maintenance plan to correct irregular rail joint clearances.

②Clearance correcting work

After the above inspection, defective points where rail joint clearance is excessively small or insufficient in summer shall be corrected to an appropriate clearance value according to atmospheric temperature (that shall be specified in advance in the relevant rule for different rail lengths).

③ Fail joint correcting work

In particular, excessively large joint clearances are disadvantageous from the viewpoint of maintenance work, as they cause track settlement, joint edge battering (deterioration of rail top) and damage on track materials, which shall be corrected, therefore, by rectifying joints, using processed fishplates (new design) and increasing sleepers.

5) Track realignment work

① Inspection of track displacement

Track displacement (lateral displacement: horizontal alignment) shall be inspected regularly or

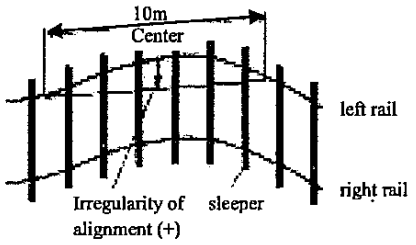



Fig. 4-5: irregular alignment

approximately twice a year.

Large displacement in the lateral direction significantly affects the safety of running trains and ride comfort. This requires preparation of a plan for correction.

② Irregular alignment correcting work

To correct the irregularities of alignment, the horizontal displacement of the rail side in the lateral direction shall be corrected under the direction of a gang leader. Straighten the rails in straight sections and rectify those to a constant curvature in curved sections. Where the section for rectifying work is long, MTTs are frequently used to ensure the efficiency of correcting work.

6) Turnout maintenance work

① Inspection of turnout

When compared with other sections, turnout sections feature a number of rail joints and discontinued rail portions. This causes large degrees of shock, lateral force and vibration at train passage, which tends to lead to track irregularities and wear/damage of component members. Therefore, turnouts shall also be inspected regularly once to twice a year (function inspection twice a year and inspection of materials once). Inspect tracks for alignment/depression and turnouts for the switching function twice a year and track materials for damage, wear, corrosion and breakage once a year.

In any event, systematically rectify abnormalities that would threaten running safety or ride comfort proposed and replace deteriorated materials and parts. New type of turnout will be proposed.

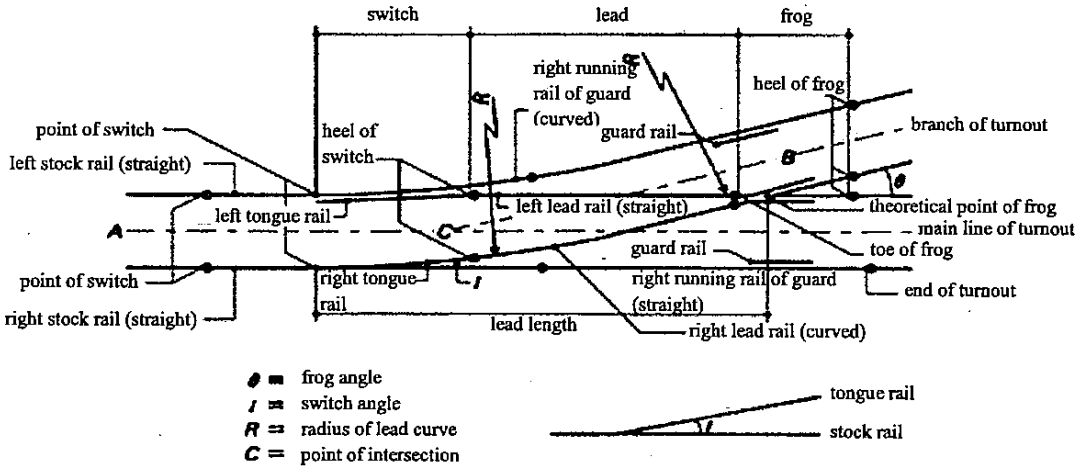



Fig. 4-6: Structure and components of a turnout

② Repair and renewal of turnouts

Minute attention shall be paid in the turnout maintenance work to renew improper materials found in inspection without delay. Joint raising work (compacting) is frequently required in turnout sections, as they are studded with rail joints.

7) Inspection and maintenance of bridge sections

① Inspection

Unlike in ordinary sections, tracks on bridges are composed of wooden sleepers simply placed on bridge girders. Maintenance of the tracks on bridges will be practiced. Inspection centers on the inspection of sleepers, fasteners and guard rails. In the same way as in the maintenance of ordinary tracks, inspect tracks for (1) track irregularities and wear/damage on rails and (2) conditions of aforementioned members and function/conditions of materials approximately once a year. Replace defective parts in the maintenance work.

② Maintenance work

Currently in MR, sleepers are not fixed at girders on bridges, so they tend to creep into the direction of running of trains to make the intervals between sleepers inappropriate. Therefore, fix hook bolts to make sleepers immovable. Replace sleepers or correct their position, and replace hook bolts and install angles for fixing sleepers as necessity arises.

Note) Cautions for bridge work

Safety measures are not taken against falling on bridges at the moment. We discuss with MR safety measures including adoption of safety nets.

8) Correction of track gauge

① Inspection

Irregular track gauge directly governs the safety of running trains. Inspect the gauge together with other track irregularity items (longitudinal/cross level, alignment, distortion) approximately twice a year.

Irregular track gauge is often caused due to rail wear and loosened/lost fasteners. Systematically rectify the points of incorrect track gauge.

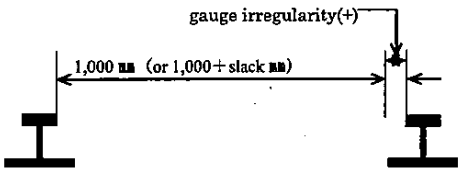



Fig. 4-7: Track gauge

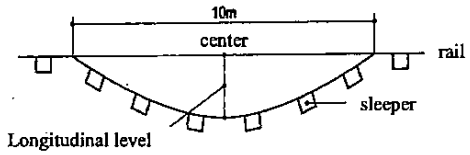



Fig. 4-8: Irregular longitudinal level

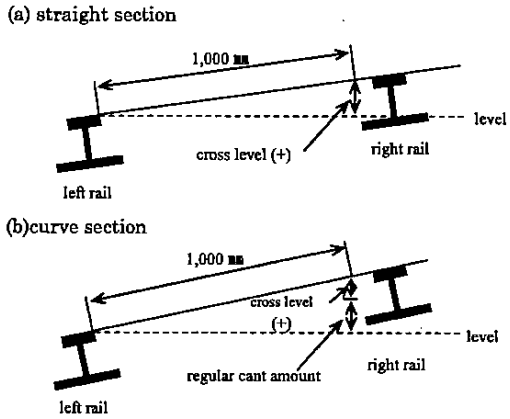



Fig. 4-9: Irregular cross level

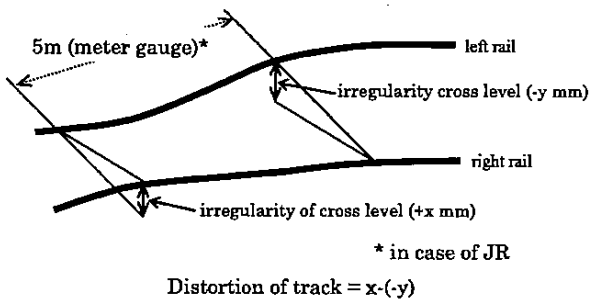



Fig. 4-10: Distortion of track

② Correction work

The track gauge, a distance between left and right of rails, tends to lose precision due to (1) displacement of rails pushed by lateral force or (2) wear of the rail side. To correct the track gauge, remove the rail fasteners in the vicinity of the irregular point and laterally move the rail to the correct position.

9) Welding of rails (preparation of long-rails and a measure to strengthen rail joints)

Welding of rails is an ultimate measure to strengthen rail joints.

Elimination of rail joints by welding rails dramatically strengthens and improves the track structure (introduction of long-rails). It is thought that rails shall be welded through consultations with MR for the scope of work and welding methods. There are several rail-welding methods for MR. However as the welding results are featured by insufficient qualities, finishing precisions and reliability levels, we educate and guide Myanmar workers on welding methods and the control of welding quality.

Note) We introduce other non-welding joint strengthening measures adopted in Japan and support Myanmar on this issue after consulting with MR.

10) Improvement of formation

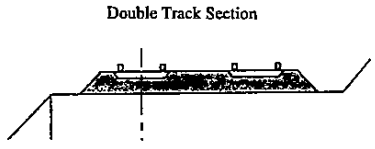



Fig. 4-11: Width of formation (= L)

① Inspection of ballast and roadbed

Inspect ballast and roadbed approximately once a year.

Roadbeds play an important role to maintain the track structure/alignment and make working passes/evacuation routes in emergency. It is required to prepare an improvement plan to expand widths and install gravel retaining walls for the places found defective through inspection.

②Although a standard width of formation is specified in Myanmar, we found through site surveys that sufficient widths are not maintained. To fully exert the effect of aforementioned ballast compacting work, we guide MR to expand the width of formation where it is insufficient.

11) Control and evaluation of track conditions

As the indexes to control and evaluate track conditions, we generally adopt the values of five track irregularities items (track gauge, longitudinal/cross levels alignment and distortion of track), which can be measured by simple means (track gauge, strings and pieces, etc.) or simplified measuring instruments (Track Master).

For the purpose of track control, set threshold values for maintenance for track irregularity items that guarantee the safety of running trains, measure irregularities periodically and provide maintenance services within the pre-set time length in case the value of an item has exceeded the threshold value.

To maintain appropriate track conditions after providing maintenance services and aim at extending the maintenance periodicity, also set the target values of track irregularities for finishing work to judge whether the maintenance services are appropriate.

To evaluate track conditions, measure track irregularities at constant intervals and count the number of the points where the threshold value has been exceeded. Judge whether the track conditions are appropriate thereafter by the changes in the number of points exceeding threshold values. If the track maintenance is improved by such an evaluating system, it is thought that the points where a threshold value is infringed will decrease.

We also discuss a method to assess track conditions by measuring train vibration, acceleration at a constant periodicity, though this measurement includes the influence of rolling stock performance. In this case as well, set the threshold value for (vertical/lateral vibration acceleration or vibration piece,) and correct the points where the threshold values have been violated. If the track maintenance is improved by this evaluating system, it is thought that the overall level of train vibration acceleration (amplitude) will decrease, followed by the decrease of the number of the points where a threshold value is infringed.

After the completion of track maintenance operation described in the above paragraphs 1) to 11), we will discuss improvement measures, renew the essentials of track maintenance manual and make efforts thereafter to disseminate the renewed version of the essentials of maintenance manuals.

### 4.2.5 Education/training

In Myanmar, a rainy season starts every year at the end of May. As the track maintenance work in a rainy season is apprehended to adversely affect track beds, we will primarily implement education/training from the end of May to October, 2014.

(1) Seminars to improve track maintenance technologies

We assess the level of track maintenance technologies of MR employees and compile appropriate text books. Thereafter, we hold seminars to improve track maintenance technologies for those participated in the maintenance of pilot section (approximately 20 members) three

times: at the start of track maintenance OJT, after completion of track maintenance and at the final summarization of track maintenance OJT.

(2) Education/training in Japan

We implement a two-week education/training program twice in Japan each for approximately 11 trainees including some MTT operators, in which education/training on track technologies (centering on lectures and practical training) will be performed under the cooperation of JR East and Japan Railway Track Consultants, at the Integrated Education/Training Center (Shin-Shirakawa), JR East, and at the Overseas Human Resources and Industry Development Association (HIDA). MTT operators are included in the above program to prepare for introduction of MTTs into track maintenance in the future.

We practice actual work at the side tracks, and observe the nighttime work to use MTTs in the suburbs of Tokyo.

We discuss the detailed contents of curriculum so as to reflect the level of MR engineers, and also discuss with MR about suitable timing of training in Japan.

### 4.2.6 Summarization of the points of improvement and reflecting them in the track maintenance manuals/standards

We summarize the points of reflection through the whole of maintenance work and compile the maintenance manuals to meet the present status of the track maintenance in Myanmar in consideration of the local organizations, working conditions and climates. The essentials of maintenance manuals will be easy to use, while including the steps of work and handling of machines/materials for track maintenance.

### 4.2.7 Final summarization and seminars

In closing the above technical transfer course on track maintenance work, we will open seminars for the trainees participated in the program and track maintenance members for other sections selected through consultation with MR. As this is the final step for MR employees to receive technology transfer, which is expected to evolve as a model shop to every section of the country in the future, we will avail ourselves of this opportunity to totally wipe unknowns out of MR members regarding the whole of track maintenance work.

## 5. Project implementation Organization

### 5.1 Structure of project implementation Organization

Based on R/D, we will organize a project implementation Organization shall be organized as shown in Fig. 5-1.

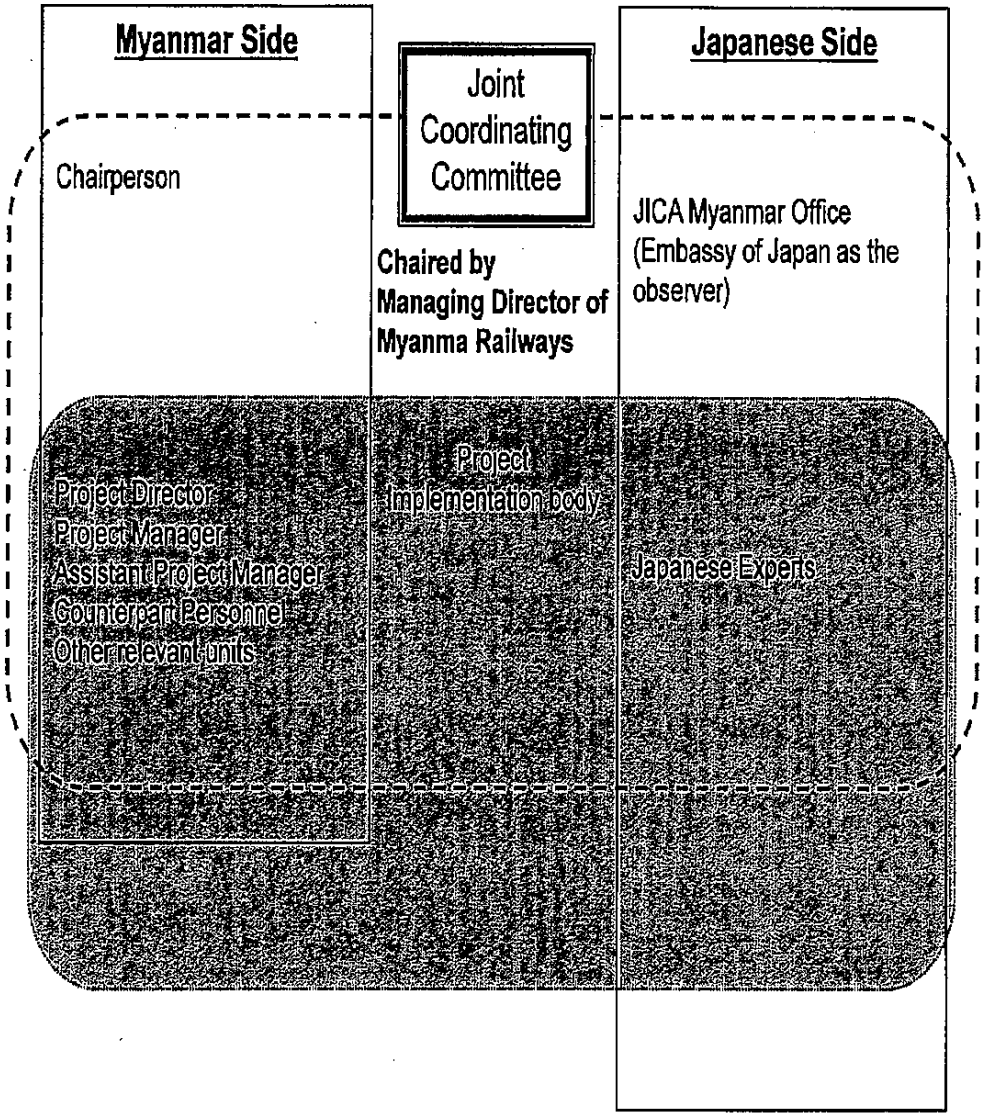



Fig. 5-1: Structure of project implementation Organization

This project will be promoted as a scheme of "technical cooperation" that shall be addressed (1) by Myanma Railways (MR) supported by the Ministry of Rail Transportation on the Myanmar side and (2) by JICA and a tripartite consortium (JV) composed of Japan International Consultants for Transportation Co., Ltd. , Oriental Consultants Co., Ltd. , and Sumitomo

Corporation, who are entrusted with this Project by JICA, with hand tie-tampers offered by the Institute for Transport Policy Studies on the Japan side. To ensure smooth implementation of the whole project, the Joint Coordinating Committee (JCC) will be instituted as referred to later in 5.4.

**5.2 Implementation body on the Myanmar side**

MR will play a central role on the Myanmar side. To correspond to Japanese experts, a Counterpart Team is organized for this project. See Table 5-1. Project Director commands the general affairs and implementation of the project, while Project Manager manages the projects and directs technical affairs.

In the OJT project for the pilot section between Yangon and Bago, track maintenance is the mainstream of the field work, which will be led by (1) the leaders for civil engineering departments of Division 7 (Yangon) and Division 6 (Insein) in charge of the Yangon–Bago section and (2) those supporting the area of Lower Myanmar Administration and (3) the civil engineering staff at the Head Office. Regarding the safety and service improvement project based on the analysis of accidents, the MR Head Office located at Naypyitaw has the initiative to the implementation of the Project.

**5.3 Implementation body on the Japan side**

The JICA experts selected from the above tripartite consortium will guide/advise the personnel on the Myanmar side and offer recommendations where necessary for the project. See Table 5-1 for the list of the expert members.

Japan International Consultants for Transportation Co., Ltd. , a leader of the consortium, which was instituted in November 2011 by JR Companies, private railways and other enterprises as a comprehensive consultant for overseas railways, is privileged to enjoy whole hearted cooperation for this project from JR Companies and also from Japan Railway Track Consultants, an expert consultant on track technologies established by JR Companies..

**5.4 Establishment of Joint Coordinating Committee (JCC) and Its Functions**

JCC is the committee to confirm the progress of the Project, discuss important matters and make decisions for the better implementation of the Project.

It fulfills the following functions;

(1) To discuss and approve the annual work plan of the Project to be formulated under the framework of the R/D,

(2) To evaluate the achievement of the annual work plan and overall progress of the Project;

(3) To facilitate the necessary authorization of the Project outputs,

(4) To review and exchange opinions on major issues that arise during implementation of the Project.

Managing Director of MR will be the chairperson of the JCC. The members are listed in Table 5-2.

Originally it was planned to be held at least twice a year and when necessary arises.

However on the request of Myanmar side, it is planned to be held around once every 3 months.

## 6. P.D.M.

### 6.1 Modification of P.D.M.

With respect to P.D.M. attached to R/D as annex I, mainly the description of 「Objectively Verifiable Indicators」 and 「Means of Verification」 corresponding to 「Overall Goal 」 and 「Project Purpose」 are modified. The modified descriptions are shown in Table 6-1. The reasons for modification are given as follows.

(1) Overall Goal : Objectively Verifiable Indicators

① Number of annual accidents

Because (a) the Pilot Section is rather short, only 20km, accordingly rehabilitation of track is limited in length, (b) the rehabilitation/modernization of various railway facilities on the Yangon-Mandalay line is not made clear, accordingly it may be difficult to show how much the accidents caused by the deteriorated railway facilities can be reduced, and (c) number of accidents fluctuates considerably year to year mainly due to weather conditions, quantitative expression for reduction of accidents is avoided.

② 「Reduction of Number of Limited Speed Locations」, 「Improvement of Journey Speed」, 「Improvement of Punctuality of Train Operation」

Without the modernization of signaling systems, it may be difficult to raise the train speed, while ensuring the train operation safety. Accordingly 「Reduction of Number of Limited Speed Locations」, 「Improvement of Journey Speed 」, and 「Improvement of Punctuality of Train Operation」 are adopted as evaluation items, and also quantitative expressions are avoided.

(2) 「Overall Goal : Means of Verification」,

「Project purpose : Objectively Verifiable Indicators」, 「Project Purpose : Means of Verification」

The meanings are not changed, but the description is modified as given in Table 6-1.

(3) Others : Counterpart Training in Japan

Number of trainees is increased.

- Railway Institutional Management Improvement : 11persons×2weeks
- Track Maintenance : 11persons ×2×2weeks

### 6.2 Establishment of Base Line

**6.2.1 Based on accident analysis, recommendation on technical standards relating to administrative and maintenance aspect and drawing up railway facilities improvements plan to improve service and safety level.**

The following are established as the Base Line for Yangon-Mandalay Line, in 2012/2/2013,

① Number of train accidents classified by kinds

(per one million train km)

② Delay time of express passenger train (average value and maximum value)

③ Limited speed and Journey speed.
④ Satisfaction level of the clients. (Interview)
⑤ Number of passengers per year

### 6.2.2 Technology Transfer of Track Maintenance Technology to improve the level of Service and Safety through Implementation of The Pilot Project

① Track irregularities (gauge, cross level, longitudinal level, longitudinal alignment, twist ).Their means, maximum values, standard deviation
② Vertical and lateral vibration accelerations. Their means, maximum values, standard deviation
③ Average train speed.

## Table 6-1 Modification of PDM

Annex 1
PDM

Project Design Matrix
The Project on Improvement of Service and Safety of Railway — Project Implementation Period : 2013 to 2015
Excuting Agency:Myanma Railway(MR) ,Ministry of Rail Transportation — Project Site: Yangon — (24months)

| Narrative Summary | Objectively Verifiable Indicators | Means of Verification | Important Assumption |
|---|---|---|---|
| Overall Goal<br>Service and safety level of Myanma Railways is improved. | ①Number of annual accidents on Yangon-Mandalay line decreases compared with the pesent and past records.<br>②Number of speed ristricted locations on Yangon-Mandalay line decreases compared with their present number.<br>③Journey speed on Yangon-Mandalay line increases compared with the present journey speed.<br>④Punctuality of express passenger trains on Yangon-Mandalay line is improved compared with the present situation.<br>⑤Satisfaction level of clients is enhanced.<br>⑥Number of passenger | -Statistics on safety<br>-Reporting of accidents cause analysis and discussion of countermeasures are executed.<br>-Satistics on operation<br>-Interview/questionnaires to clients<br>-Satistics on operation | |
| Project Purpose<br>Administration and maintenance ability is improved for the enhancement of sevice and safety of Myanma Railways. | ①Accident cause analysis and countermeasures to prevent the similar accidents, and means to improve service levels are established and executed ,and inherited by MR<br>②Administrative and managerial capacity of track maintenance is improved and improved level is kept by MR | -Reflection on organization,management/ operation rules,facilities renewal plans<br>-Utilization,modification of administration management manuals<br>-Actual results of maintenance execution, such as the record of maintenance | -Administration staff members are not relocated drastically<br>-Technical staff members are not relocated drastically |
| Output | | | |
| 1. Issues are clarified for the enhancement of service and safety in the administration and maintenance process, and the improvement plan is drawn. | 1-1 System for collecting information of track, rolling stock, signal and communication, and operation is established.<br>1-2 Safety issues are listed based on the investigation and analysis of cause of accident.<br>1-3 Service issues are listed.<br>1-4 Service and safety improvement plan is drawn so as to tackle the issues. | 1-1 Related management document(s) of System for collecting information<br>1-2 Listed issues<br>1-3 Listed issues<br>1-4 Service and safety improvement plan | -The Government support to the Myanma Railways, especially financial support is secured. |
| 2. Technical capability is improved through emergency track maintenance to improve the level of sevice and safety. | 2-1 Technical transfers are made effectively at each measure (targeted numbers of technical staff 30 persons).<br>2-2 Working manual of emergency track maintenance is prepared.<br>2-3 Proper equipment and materials are procured both qualitatively and quantitatively.<br>2-4 Counterpart personnel acuired necessary proficiency through seminars(3 times), trainings(3 times) for technical improvement on the rail maintenance and others. | 2-1 Record of technical transfers<br>2-2 Set of Working manual<br>2-3 Inventory list of equipment and materials<br>2-4 Record of seminar and training | |

## Table 6-1 (continued)

Annex 1

| Activities | Input (Japanese side) | Input (Myanmar side) | Preconditions |
|---|---|---|---|
| **1. Preparation of Railway Service and Safety Improvement Plan**<br>1-1 To conduct current situation survey regarding track, rolling stock, signal and communication, and operation, and establish system for collecting information.<br>1-2 To promote familiarization on the investigation and analysis method of accident cause based on the comprehensive factors of track, rolling stock, signal and communication, and operation.<br>1-3 To coinduct the investigation and analysis mentioned above.<br>1-4 To provide recommendation based on above analysis on necessary technical standards to improve service and safety level.<br>1-5 To draw the improvement plan of railway facilities through discussion with the "Working Group for service and safety imprivement(tentative name) "<br>**2. Enhancement of Technical Capabilities of Track Maintenance**<br>2-1 To draw the technology transfer plan.<br>2-2 To procure the necessary equipment and materials.<br>2-3 To conduct emergency track maintenance.<br>2-4 To summarize betterment point(s) obtained during emergency track maintenance operation, and to feedback to the successive measures.<br>2-5 To draw the working manual of emergency track maintenance.<br>2-6 To conduct seminars, trainings for technical improvement on the rail maintenance and others. | **1. Dispatch of Japanese Experts**<br>Fields of Experts(several person)<br>-Railway OM improvement<br>-Technical Standards<br>-Track Maintenance<br>-Procurement of Equipment and Materials/Project Coordination<br>**2.Counterpart training in Japan**<br>-Railway Institutional Management Improvement: 11person ×2weeks<br>-Track Maintenance:<br>22person (11p×2×2weeks)<br>**3.Equipment**<br>Necessary handy equipment of emergency track maintenance, such as Tie Tamper.<br>**4.Expense**<br>-For research, travelling, training, the other activities for Japanese experts | **1. Assignment of Counterpart**<br>-Project Drector: 1person<br>-Project Manager: 1person<br>-Railway Polocy/OM Improvement: 1person<br>-Rail Maintenance: 1person<br>-Procurement of Equipment and Materials: 1person<br>-Others: As approproate<br>**2.Provision of facilities for the Project implementation:**<br>-Project office (in the Myanmar Railways, Lower Myanma Regional Office)<br>-Working tools and furniture for Project Office<br>-Internet connection in the Project office<br>**3.Joint Coordination Committee(JCC)**<br>-Establishment of JCC<br>**4.Expense**<br>-Local cost for personnel<br>-Cost for office rent and quipment.<br>-Expense for the pilot project,such as gravels,sleepers,rail materials and others.<br>-Other expenses:<br>For research,travelling,training,the other activities for counterpart personnel<br>**5.Others**<br>-Status guarantees of Japanese experts, ID card for access into the Myanma Railways properties.<br>-Access to the necessary statistical data and related information<br>-Other necessary local cost | Natural Disaster does not hit the railway facilities fatally. |

## 7. Dispatching Schedule of JICA Expert.

Table 7-1 Personnel Planning

| Assignment | Name | Belongs | 2013 | | | | | | | | 2014 | | | | | | | | | | | | 2015 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 |
| Leader/ Track maintenance | Sadaaki KURODA | JIC | | 6/25 | 7/10 | 8/25 | 9/8 | (10/15) (11/15) | (10/31) (11/30) | | | (2/16) | (3/4) | | (5/14) | (5/30) | | (8/18) | (9/3) | (10/15) | (10/31) (11/15) | (11/30) | | (2/16) | (3/4) | | |
| Deputu leader/ Maintenance planning | Nobuyuki MATSUO | JIC | | 6/25 | 7/10 7/23 | 8/25 7/28 | | 10/28 (11/15) | | (12/12) | (1/6) | | (3/11) | | (5/15) | | (7/13) | | (9/1) | (10/30) | | | (1/15) | (2/28) | | | |
| Operation Maintenance | Hiroshi KOMATSU | JIC | | 6/25 | 7/13 | 8/21 | 9/20 | (10/20) | (12/28) | | (1/19) | | (3/25) | (4/10) | | (6/8) | (7/1) | | (8/29) (9/15) | | (11/1) (10/20) | (12/30) | | (2/10) | (3/29) | | |
| Procurement of equipment and material | Yuuichi TANIGUCHI | Sumitomo | | | | 8/25 | (9/23) (10/15) | | (11/13) | | | | | | | | | | | (10/1) | (10/30) | | | | | | |
| Signalling and Telecommunications | Kiichi TAKEMURA | JIC | | | | | 9/16 | 9/27 | | | (1/6) | (1/23) | | | | (6/1) | (6/15) | | | | | | | (2/1) | (2/15) | | |
| Rolling Stock | Makoto ISHIKAWA | OC | | | | 8/25 | (9/8) | | | | (1/6) | (1/23) | | | | (6/1) | (6/15) | | | | | | | (2/1) | (2/15) | | |
| Track Maintenance | Kazuhiko MURAO | JIC | | | | | (9/20) | | (11/18) | | (1/6) | | (3/5) | (4/10) | (5/31) | | | | | | | | (1/5) | (2/18) | | | |
| Track Maintenance(2) | Kiyoshi MIYAMOTO | OC | | | | | | | (11/15) | (12/14) | | | | | | | | | | | (11/15) | (12/14) | | | | | |
| Coordination | Mitsuru TAKAMI | JIC | | 6/25 (0.63) | 7/13 | 8/19 | 9/27 | | | | | | (3/22) | (4/10) | | | | | | | | | | (3/1) | (4/10) | | |
| Train Operation | Hideharu IGARASHI | JIC | | | | 8/25 | (9/8) | | | | (1/6) | (1/23) | | | | (6/1) | (6/15) | | | | | | | (2/1) | (2/15) | | |
| Track working | * * * * | JIC | | | | | 9/9 | 9/13 | | | | | | | | | | | | | | | | | | | |
| Railway Advisor | Mitsuo HIGASHI | JR East/JIC | | | | | | | | | | | | | | | | | | | | | | | | | |

## 8. Undertakings of Myanma Railways and the government of Myanmar

According to R/D signed between Managing Director of MR and Chief Representative, Myanmar Office of JICA, on March 28, 2013. Government of Myanmar and Myanma Railways provide JICA Expert Team with the following.

### 8.1 UNDERTAKINGS OF Myanma Railways AND the government of Myanmar

8.1.1 Myanma Railways ("and the government of Myanmar") will take necessary measures to:

(1) ensure that the technologies and knowledge acquired by the Republic of the Union of Myanmar nationals as a result of Japanese technical cooperation contributes to the economic and social development of the Republic of the Union of Myanmar, and that the knowledge and experience acquired by the personnel of the Republic of the Union of Myanmar from technical training as well as the equipment provided by JICA will be utilized effectively in the implementation of the Project; and

(2) grant privileges, exemptions and benefits to the JICA experts and their families, which are no less favorable than those granted to experts of third countries performing similar missions in the Republic of the Union of Myanmar under the Colombo Plan Technical Cooperation Scheme.

8.1.2 Myanma Railways (and the government of Myanmar) will take necessary measures to:

(1) provide security-related information as well as measures to ensure the safety of the JICA experts;

(2) permit the JICS experts to enter, leave and sojourn in the Republic of the Union of Myanmar for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees.

(3) exempt the JICA experts from taxes and any other charges on the equipment, machinery and other material necessary for the implementation of the Project;

(4) exempt the JICA experts from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to them and/or remitted to them from abroad for their services in connection with the implementation of the Project; and

(5) meet taxes and any other charges on the equipment, machinery and other material, necessary for the implementation of the Project.

8.1.3 Myanma Railways / the government of Myanmar will bear claims, if any arises, against the JICA experts resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the project, except when such claims arise from gross negligence or willful misconduct on the part of the JICA experts.

8.2 Input by Myanma Railways

Myanma Railways will take necessary measures to provide at its own expense:

(a) Services of Myanma Railways' counterpart personnel and administrative personnel;
(b) Suitable office space with necessary equipment;
(c) Supply or replacement of machinery, equipment, instruments, vehicles, tools, spare parts and any other materials necessary for the implementation of the Project other than the equipment provided by JICA;
(d) Means of rail transport for the JICA experts for official travel within the Republic of the Union of Myanmar;
(e) Information as well as support in obtaining medical service;
(f) Credentials or identification cards;
(g) Available data (including maps and photographs) and information related to the Project;
(h) Running expenses such as fuels for generator, related materials necessary for the implementation of the Project;
(i) Expenses of necessary for transportation within the Republic of the Union of Myanmar of the equipment as well as for the installation, operation and maintenance thereof; and
(j) Necessary facilities to the JICA experts for the remittance as well as utilization of the funds introduced into the Republic of the Union of Myanmar from Japan in connection with the implementation of the Project
(k) Various local cost

- Local cost for personnel
- Cost for office rent and equipment.
- Expenses for the pilot project, such as gravels, sleepers, rail materials and others.
- Other expenses:

  For research, travelling, the other activities for counterpart personnel, and other necessary local cost

## 9. Cooperation and assistance by Japan and other countries (governments and private enterprises) in the field of railways

### 9.1 Cooperation and assistance by the governments and private enterprises of Japan and other countries in the field of railways

#### 9.1.1 Assistance by the governments

We will survey the contents of assistance, amounts of funds and conditions of loans and other matters regarding the assistance (ODA) extended by the governments of Japan and other countries in the filed of railways.

#### 9.1.2 Cooperation by private enterprises

We will survey the contents of cooperation, scales/conditions of financial cooperation/investment and other conditions extended by the private enterprises of Japan and other countries in the field of railways.

### 9.2 Technical training center (Myanma Railways Technical Training Center (RTTC)) established with the assistance by Germany

We will survey the circumstances surrounding the establishment of the above RTTC, contents and methods of assistance therefor and the status of its operation by MR after completion of German assistance and reflect the resultant findings in the better implementation of this Project.

# The Project on Improvement of Service and Safety of Railway in Myanmar

Inception Report
August 28th, 2013 at Nay Pyi Taw

JICA EXPERT TEAM

Japan International Cooperation Agency



## Table of Content



Japan International Cooperation Agency

## 1. Project Summary

(1)Project Background

Train operation safety and service levels are major issues for MR.

(2)These circumstances led to this Project, stated in the Record of Discussion, signed in last March between Managing Director, Myanma Railways, and Chief Representative, Myanmar Office, JICA.



## 2. Basic Plan of Project Implementation

Program Target

- Enforcement of management and O&M ability of MR, contributing to upgrading service and safety level.

Output 1

- Based on accident analysis, issues are clarified for the enhancement of service and safety in the administration and maintenance process, and the improvement plan is drawn up.

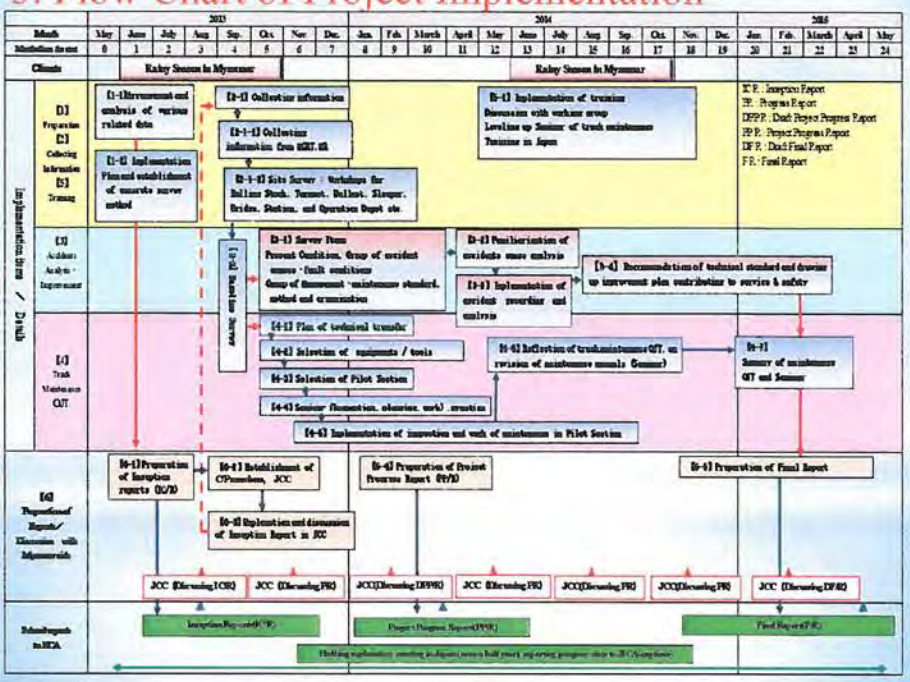
Output 2

- Technology transfer of track maintenance technology through implementation of the Pilot Project

Project Site

Yangon – Bago Section. Pilot section about 20km

# 3. Flow Chart of Project Implementation



# 4 Detailed Methods for the Project Implementation

## 4.1 Implementation Plan for Output 1

Based on accident analysis, recommendation on technical standards and drawing up railway facilities improvement plan to improve service and safety level

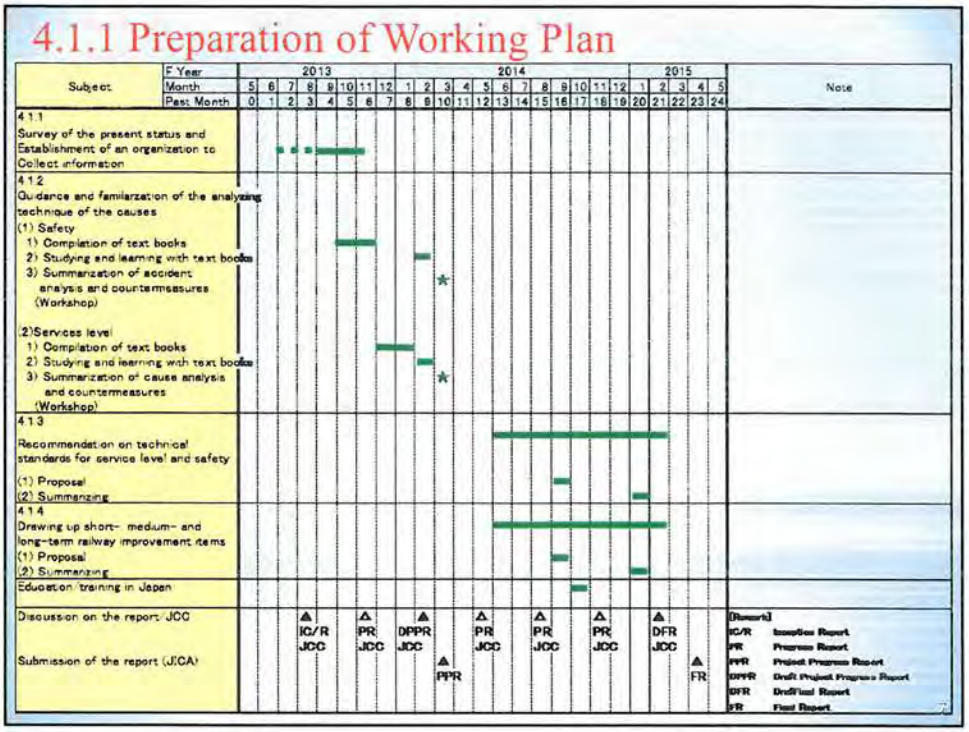
**Train collision due to shunting signal violation**

**(JR Chuo Line in 1997)**

**Breakage of Pier due to scouring**

**(JR Hanawa Line in 1997)**

## 4.1.1 Preparation of Working Plan




## 4.1.2 Survey of the present status and establishment of organization to collect information

（1） Collection of basic information

（2） Effort to prevent accidents

（3） Actions at the occurrence of accidents

Japan International Cooperation Agency

## 4.1.3 Guidance and familiarization of the analyzing technique for the causes of accidents and low service level based on the comprehensive factors of railway

- Compilation of the text book
- Familiarization of cause analysis and to conduct cause analysis and establish countermeasures together with MR staff.
- Summarization

**Concept Sentence**

| (Safety) | (Service) |
|---|---|
| ***・Lesson and learning from past accidents.*** | ***・To win the competition with other traffic modes.*** |
| ***・Never again same ones.*** | |



## 4.1.4 Recommendation on technical standards to improve the service level and safety

## 4.1.5 Drawing up of short(3years)- , medium(5-10years)- and long-term(10-30years) railway facilities improvement plan through discussion with the “Working Group for service and safety improvement”

## 4.1.6 Education/training in Japan

11 trainees relating to railway institutional management for two weeks

## 4.2 Implementation Plan for Output 2

Technology transfer of track maintenance technology through implementation of the Pilot Project

Track Master

Inspection of turnout

Japan International Cooperation Agency



## 4.2.1 Drawing up a plan for technology transfer

| Subject | F.Year | 2013 | | | | | | | | | | | | 2014 | | | | | | | | | | | | 2015 | | | | | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | | | | | |
| | Past Month | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | | | | | |
| 4.2.1 Drawing up a technical transfer plan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2.2 Selection/procurement of equipments/tools (1) Selection of equipments/tools (2) Acquisition of import license, tax exemption procedure (3) Import procedure (4) Freight control | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2.3 Selection of Pilot Section (1) Site witnessing (2) Selection of a section (3)Base line survey | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2.4 Implementation of track maintenance work (inspection, planning, work, control) (1) Compilation of text books (2) Classroom education and practical training (seminar) (3) Prior measurement and survey at the Pilot Section Implementation of work | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | -Three booklets: (1) working safety, (2) track maintenance work and (3) inspection -One month after the arrival of supplied materials/machines -Calculation of the required workload and quantity of materials, preparation of a work plan |
| 4.2.5 Education/training (1) Seminars (2) Education/training in Japan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2.6 Summarization of the points of improvement and reflecting them in the track maintenance manuals/standards | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2.7 Final summarization and seminars | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Discussion on the report/JCC | | | | ▲ IC/R JCC | | | △ PR JCC | | | ▲ DPPR JCC | | | | △ PR JCC | | | △ PR JCC | | | △ PR JCC | | | ▲ DFR JCC | | | | | | [Remark] IC/R Inception Report PR Progress Report PPR Project Progress Report DPPR Draft Project Progress Report FR Final Report |
| Submission of the report (JICA) | | | | | | | | | | | | ▲ PPR | | | | | | | | | | | | | ▲ FR | | | | | |

## 4.2.2 Procurement of the required equipments/tools

- 75 kinds of equipments/tools are being prepared by Japan side
- Track materials such as rails, sleepers, ballasts and manpower are necessary for implementation of the Pilot Project and should be provided by MR.
- MR and JICA experts must cooperate closely for early arrival of equipments and tools necessary for the Pilot Project



## 4.2.3 Selection of the Pilot Section

（1）20km between Yangon and Bago

（2）It will be selected through a site survey to allow experiencing maintenance of different track structures such as defective, sound, straight and curved tracks, turnout, bridges.

## 4.2.4 Implementation of track maintenance (Inspection, Planning, Work and Control)

（１）Compilation of text book
（２）Classroom education and practices (seminars)
（３）Implementation of prior measurement and surveys in the Pilot Section
（４）Implementation of inspection, planning and work in the Pilot Section

Select 11 kinds of track maintenance works including maintenance works of rail, ballast, turnout, bridge, welding, alignment, gauge, roadbed etc.



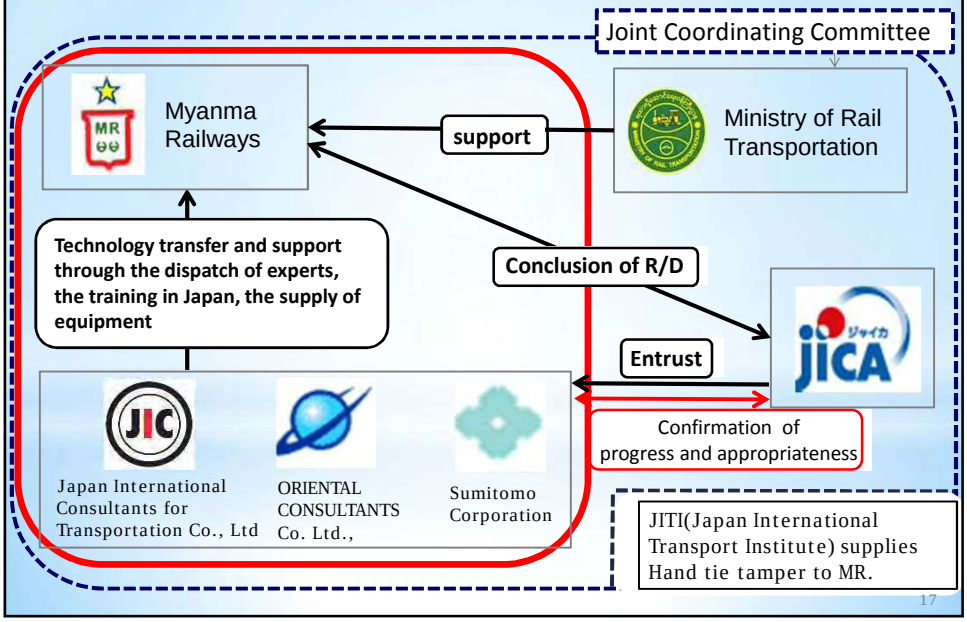
## 4.2.5 Education/training

（１）Seminars to improve track maintenance technologies
（２）Education/training in Japan

## 4.2.6 Summarization of the points of improvement and reflecting them in the track maintenance manuals/standards

## 4.2.7 Final summarization and seminars

## 5. Project Implementation Organization

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## Administrative and Counterpart Personnel for the project

| Fields | Myanma Railways | Japanese Side（JICA Expert Team） |
|---|---|---|
| Project Director | U Saw Valentine, General Manager (Technical & Admin. support) | Sadaaki KURODA (Leader) |
| Project Manager | U Tin Soe, General Manager(Civil) | Nobuyuki MATSUO (Duputy Leader) |
| Railway Policy / OM Improvement | U Kyaw Kyaw Myo, Assistant General Manager(Operating) | Hiroshi KOMATSU |
| Track Maintenance | U Maung Maung Than, Assistant, General Manager(Civil) | Kazuhiko MURAO<br>Kiyoshi MIYAMOTO |
| Procurement of Equipment and Materials | U Win Htein, Deputy General Manager (Supply) | Yuichi TANIGUCHI |
| Signalling and Telecommunications | U Myint Lwin, Assistant Engineer (Signalling & Telecommunications) | Kiichi TAKEMURA |
| Rolling Stock | U San Myint (Train Operation ) | Makoto ISHIKAWA |
| Train Operation | U Zaw Pe Sein (Divisional Traffic Manager) | (Hideharu IGAGASHI) |
| | | Mitsuru TAKAMI (Coordination) |

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# Joint Coordinating Committee

| Chairman U Thurein Win Managing Director of Myanma Railways | | | |
|---|---|---|---|
| Myanmer Side | | Japanese Side | |
| Name | Position (Major) | Name | Position (Major) |
| U Saw Valentine | General Manager (Technical & Admin Support) | Sadaaki KURODA | Leader of Japanese Expert Team (Track maintenance) |
| U Myint Wai | General Manager (Operating) for analyzing accidents | Nobuyuki MATSUO | Duputy Leader (Maintenance planning) |
| U Aung Win | General Manager (Mechanical & Electrical) for rolling stocks | Hiroshi KOMATSU | Railway Administration and Management Expert |
| U Tin Soe | Project Manager, General Manager (Civil) | Yuichi TANIGUCHI | Procurement of Equipment and Materials Expert |
| U Than Htay | Assistant Project Manager, Deputy General Manager (Civil) | Kiichi TAKEMURA | Signalling and Telecommunications Expert |
| U Khin Maung Thein | Assistant Project Manager, Deputy General Manager (Signalling & Telecommunications) | Makoto ISHIKAWA | Rolling Stock Expert |
| U Min Aung | Counterpart Personnel, Assistant Engineer (Civil) | Kazuhiko MURAO | Track Maintenance Expert |
| U Myint Lwin | Counterpart Personnel, Assistant Engineer (Signalling &Telecommunications) | Kiyoshi MIYAMOTO | Earth Roadbed Expert |
| Daw Thi Thi Nwe | Assistant General Manager (Finanace) | Mitsuru TAKAMI | Coordinating Expert |
| U Aung Thu Latt | Assistant General Manager (Admin) | (Hideharu IGAGASHI) | Operation Expert |
| | | Mituso HIGASHI | Railway Management Adviser |
| | | | Representative of JICA |
| | | | Representative of JICA |
| | | | Representative of Embassy of Japan : Observer |

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# 6. PDM Modification

## 6.1 Modification of PDM

The major modifications are given in the following Table.

| | Original | Modification | Reasons of modification |
|---|---|---|---|
| **Overall Goal**<br>Objectively Verifiable Indicators | ①Decrease of number of accidents by 20%<br>②Increase of average sanction speed by 10%<br>③Enhancement of satisfaction level of clients | ①Decrease of number of accidents compared with past/present number<br>②Decrease of number of speed restricted location<br>③Increase of journey speed<br>④Improvement of punctuality of express passenger train<br>⑤Enhancement of satisfaction level of clients<br>⑥Increase of passenger numbers | ①Increase of indicators:Efforts to identify "service level" from the wider viewpoint<br>② Avoidance of % expression<br>(a)short length of Pilot Section<br>(b)unsettled improvement plan of various railway facilities including signalling system<br>(c)yearly fluctutation of number of accidents due to weather |
| **Counterpart Training in Japan** | | | |
| Railway instistutional management program | 4 persons × 2weeks | 11 persons × 2weeks | |
| Track maintenance | 4 persons × 2 × 2 weeks | 11 persons × 2 × 2 weeks | |

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# 6.2 Establishment of base lines

6.2.1 Based on accident analysis, recommendation on Technical Standards and drawing up railway facilities improvement plan to improve service and safety level.

The Base Line for Yangon-Mandalay Line, in 2012/2013.

①Number of train accidents classified by kinds (per one million train km)
②Delay time of express passenger train (average value and maximum value)
③Limited speed and journey speed.
④Satisfaction level of the clients.
⑤Number of passengers

6.2.2 Technology transfer of track maintenance technology through Pilot Project

The Base Line in the Pilot Section

①Track irregularities (gauge, cross level, longitudinal level, longitudinal alignment, twist ).Their means, maximum values, standard deviation
②Vertical and lateral vibration accelerations. Their means, maximum values, standard deviation
③Average train speed.

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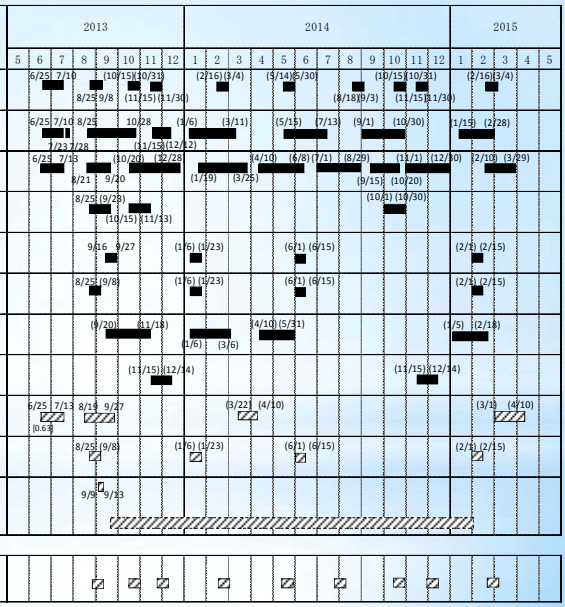
# 7.Dispatching schedule of JICA Expert

| Assignment | Name | Belongs |
|---|---|---|
| Leader/ Track maintenance | Sadaaki KURODA | JIC |
| Deputu leader/ Maintenance planning | Nobuyuki MATSUO | JIC |
| Operation Maintenance | Hiroshi KOMATSU | JIC |
| Procurement of equipment and material | Yuuichi TANIGUCHI | Sumitomo |
| Signalling and Telecommunications | Kiichi TAKEMURA | JIC |
| Rolling Stock | Makoto ISHIKAWA | OC |
| Track Maintenance | Kazuhiko MURAO | JIC |
| Track Maintenance(2) | Kiyoshi MIYAMOTO | OC |
| Coordination | Mitsuru TAKAMI | JIC |
| Train Operation | Hideharu IGARASHI | JIC |
| Track working | * * * * | JIC |
| Railway Advisor | Mitsuo HIGASHI | JR East/JIC |

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## 8. Support by Myanma Railway and the Government of Myanmar

According to R/D signed between Managing Director of MR and Chief Representative, Myanmar Office of JICA, on March 28, 2013, Government of Myanmar and Myanma Railways will support the JICA Expert Team in the implementation of the Project.



Thank you for your attention.

## Implementation Plan for Output 1

1. To survey current situations of various areas of MR, and to establish system for collecting information.
2. To promote familiarization of the analysis method of causes of accident and low service level based on the comprehensive factors of railway.
3. To conduct the cause analysis mentioned above together with MR staff.
4. To provide recommendation on necessary technical standards to improve service and safety level
5. To draw up the improvement plan of railway facilities through discussion with the “Working Group of service and safety improvement”



## Implementation Plan for Output 2

1. To draw up technology transfer plan of track maintenance through OJT in the Pilot Section.
2. To procure the necessary equipments and tools.
3. To conduct track maintenance (inspection, planning, work) jointly with MR staff.
4. To summarize points to be improved obtained during track maintenance operation.
5. To revise the track maintenance manual.
6. To conduct seminars, training for technical improvement of the track maintenance

Myanma Railways (MR)
Japan International Cooperation Agency (JICA)

# PROJECT ON IMPROVEMENT OF SERVICE AND SAFETY OF RAILWAY IN MYANMAR

## PROGRESS REPORT

## For 2nd JCC

## February 2014

JAPAN INTERNATIONAL CONSULTANTS FOR TRANSPORTATION CO., LTD
ORIENTAL CONSULTANTS CO., LTD
SUMITOMO CORPORATION

# Project on Improvement of Service and Safety of Railway in Myanmar
# Progress Report for 2nd JCC

## Table of Contents

## 1. Project Summary

### 1.1 Project background

In recent years, Myanma Railways (MR) and Ministry of Rail Transportation have come to recognize the importance of maintenance/repair of existing lines. In the past, however, MR invested more than a half of the budget in the construction of new railway lines, with only a small portion appropriated for the renewal of existing facilities and equipment. As a result, MR now have crucial subjects how to recover the deteriorated safety level and passenger services. In concrete terms, facilities and equipment have extremely superannuated and machines, tools and materials are running short. Maintenance, and management have not been implemented appropriately in the past. As a matter of fact, 118 accidents including derailment and collision have occurred in fiscal 2011 in the Yangon–Mandalay section. There are a number of problems in the section relating to safety and service such as frequent accidents, delays of train operation, lowered train speed and worsened ride comfort.

The status of the safety of train operation is as follows. From 2011 through 2012, 118 accidents occurred in the 620.4 km-long Yangon–Mandalay section, of which those attributed to tracks, rolling stock and others accounted for 50, 29 and 21%, respectively. This means that most of the accidents were caused by deteriorated tracks.

The status of services is as follows according to the statistics from 2011 to 2012.
There are a number of factors that govern the service level, such as train speed, punctuality, comfort (ride comfort, cleanliness in the passenger room) and fare and charge. The scheduled speed between Yangon and Mandalay is as low as 39 km/h, with train speed limited at various points. The on-time operation rate of express passenger trains in the same section is as low as 41% during the past three years of 2009 - 2011, with trains delayed 59% by improper track conditions and 22% by malfunction of rolling stock. This means that train delay is caused mostly by deteriorated tracks and rolling stock. Furthermore, trains vibrate excessively and passenger rooms are not clean. MR is required to eliminate these drawbacks and improve passenger services.

### 1.2 Circumstances having led to the project

With the above facts in the background, the government of Myanmar requested the government of Japan to implement a project of technical cooperation, namely "The Project on Improvement of Service and Safety of Railway." Based on this request, JICA delegated a detailed project planning study team in October 2012 and surveyed the present status of the railways around Yangon and in the suburbs of Naypyidaw and also had the consultations with MR.

According to the Record of Discussion (hereinafter referred to as R/D) signed on March 25, 2013, between President of MR and General Manager, JICA office in Myanmar, agreement was reached upon the detailed contents of the Project and cooperation of JICA to be extended thereto.

### 1.3 Purpose of the Project

Administration and maintenance ability is improved for the enhancement of service and safety of Myanma Railways.

## 2. Basic Plan of Project Implementation

### 2.1.1 Overall goal and Project purpose

Overall goal and Project purpose of this Project and expected outputs are as follows.

| Overall goal and Project purpose | |
|---|---|
| 1 | Service and safety level of Myanma Railways is improved (Overall goal) |
| 2 | Administration and maintenance ability is improved for the enhancement of service and safety of Myanma Railways (Project purpose) |

⇩

| Expected outputs | |
|---|---|
| Output1 | Based on accident analysis, issues are clarified for the enhancement of service and safety in the administration and maintenance process, and the improvement plan is drawn. |
| Output2 | Technical Transfer of Track Maintenance Technology to improve the level of Service and Safety through implementation of the Pilot Project |

### 2.1.2 Implementation plan

Implementation plans which accomplish the project purpose are as follows.

| Implementation plan for Output1 |
|---|
| To survey current situations of track, rolling stock, signal and telecommunication, and operation, and to establish system for collecting information in these various areas above. |
| To promote familiarization on the investigation and analysis method of accident cause based on the comprehensive factors of track, rolling stock, signal and telecommunication, and operation. |
| To conduct the investigation and analysis mentioned above with due consideration on hardware (facilities, equipments), and software (operational and maintenance standards, human errors etc.) |
| To provide recommendation based on the above analysis on necessary technical standards relating to operational and maintenance aspects to improve service and safety level |
| To draw up the improvement plan of railway facilities through discussion with the "Working Group of service and safety improvement" |

| Implementation plan for Output2 |
|---|
| To draw up technology transfer plan of track maintenance through OJT in the Pilot Section. |
| According to the technology transfer plan above, to procure the necessary equipments and materials. |
| To conduct track maintenance (inspection, planning, work) jointly with MR staff, making use of the equipments and the materials. |
| To summarize points to be improved obtained during track maintenance operation mentioned above, and to feed back to the successive measures. |
| To revise the track maintenance manual based on the feedback above. |
| To conduct seminars, training for technical improvement of the track maintenance |

### 2.1.3 Project Section

The site between Yangon and Bago in the Yangon suburban area. Pilot section of about 20km are selected between Yangon and Bago.

## 2.2 Flow Chart of project implementation

The flow chart of the project implementation is shown in Figure2-1.

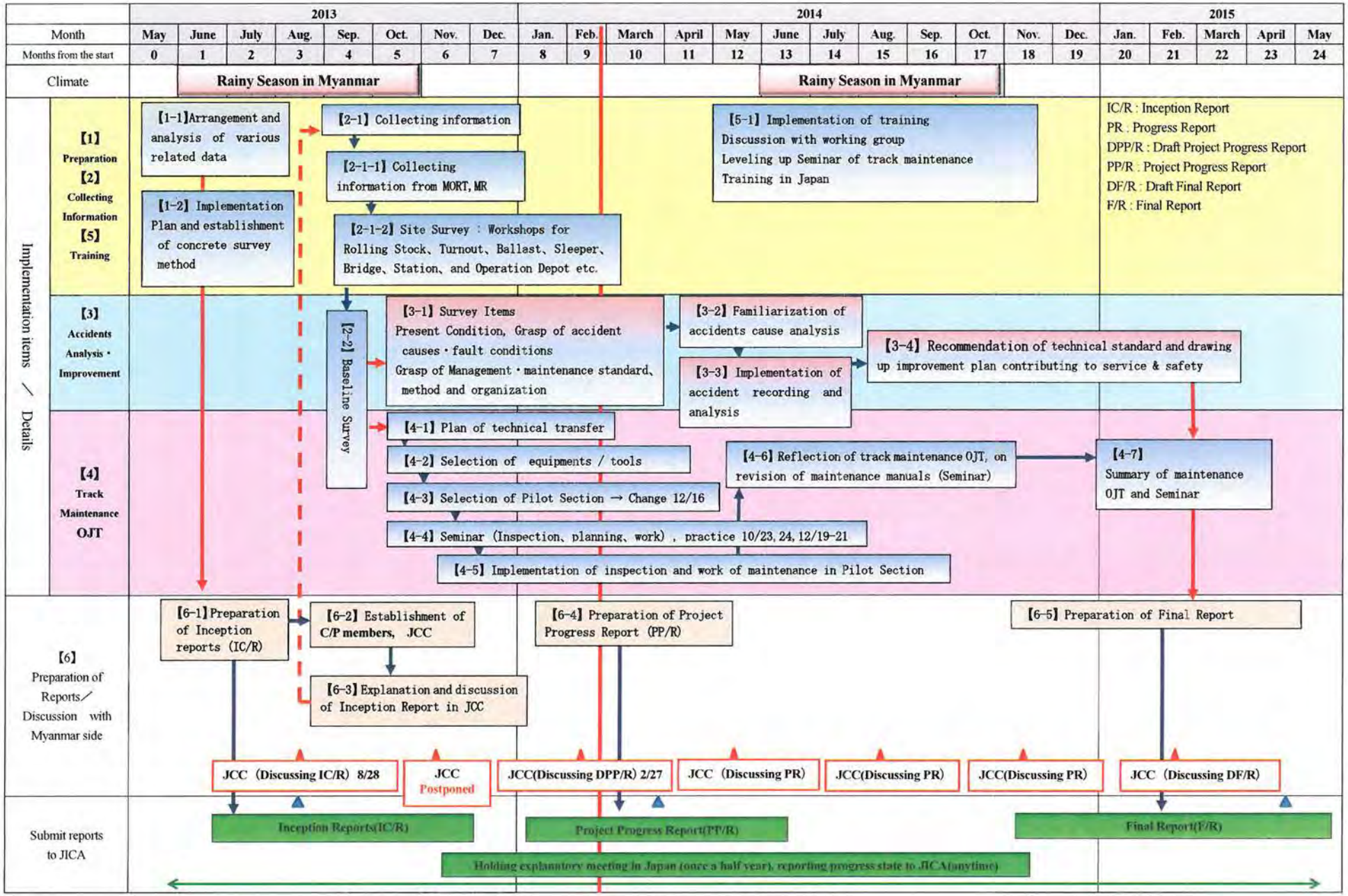



Figure 2-1 Project Implementation

## 3. Detailed Methods for the Project Implementation

### 3.1 Recommendation of technical standards relating to administrative and maintenance aspect and drawing up railway facilities improvement plan to improve service and safety level.

Safety can be compared to "air" not only in railways but also in other traffic, and transport services cannot exist without safety, though it is not visible or tangible. Further, the improvement of customer services is an indispensable element for existence for any transport systems that are being exposed to the waves of modal shift and competition with other transport modes.

Bearing in mind such a concept, JICA Team surveys in this project the present status of safety and customer services of MR and present recommendation on technical standards related to its maintenance and management. We also extract items for improvement and have discussions with Working Groups (W/G), and based on the results of which we aim at determining the items of improvement for the short-, medium- and long-term phases.

#### 3.1.1 Preparation of a working plan

The working plan Table 3-1 was proposed as described in the Inception Report. It should be noted that 2nd JCC was postponed from Nov. 28th 2013 to Feb 27th 2014, according to the agreement between MR side and JICA Expert team.

#### 3.1.2 Survey of the present status and establishment of organization to collect information

To ensure smooth implementation and high efficiency of project activities, JICA Team grasps the present status and collect relevant information on the basic/general item, methods of accident prevention and action at the occurrence of accidents through the newly appointed counterpart (C/P).

#### 3.1.3 Guidance and familiarization of the technique to analysis the present status and causes of accidents and poor services.

Safety of railways assumes learning from the heavy toll of human lives of properties caused by the past accidents and makes it a prerequisite to disseminate among employees an oath never to repeat the same accidents. Regarding passenger services on the other hand, employees shall understand that the closer to customers they are, the heavier responsibilities they are supposed to have.

Aiming at "visualized management," we create a database on accidents and malfunctions in MR from 2010 through 2012 together with the C/P using Excel and other software for calculation. Based on the database, we analyze the trend of the occurrence of accidents/malfunctions and discuss counter measures against. We also guide the C/P on the method to create a simplified database on accidents and introduce cases of compiling monthly and yearly reports.

### 3.1.3-A Safety

We adopt cases of collision, derailment, train separation and level crossing accidents recently experienced by MR, and compile a text book to introduce methods to verify/analyze causes of selected accidents and accident preventing measures.

In selecting cases of accident for the above purpose, we consult with the C/P and consider the important items and those in which MR is interested.

By utilizing the text book, we familiarize the MR staff methods to analyze causes of accidents and to establish measures for accident prevention.

(1) Compilation of the text book

1) Introduction of the efforts of Japan and European countries towards to analysis of accidents and improvement of safety level.

MR currently relies not on national railway technical standards, but on railway technical standards adopted by International Union of Railways (UIC) and the European Railway Industry (UNIFE). Therefore, we introduce the accident preventing measures adopted not only in Japan but also in European countries.

As a successful case in Japan, we cite the measures to prevent level crossing accidents to make MR understand that, in order to decrease the total number of accidents, it is effective to respond to the most frequently occurring incidents on a preferential basis, and to allocate a budget for hardware measures.

Simultaneously, we introduce the importance of human factors that allows prompt application without requiring particular budgetary arrangements, but requires five- to 10-year for generating successful results.

2) Introduction of the causes of and countermeasures against typical accidents in the past in Japan

It includes accidents of collision, derailment, train fire, ones caused by natural disasters and others.

(2) Studying and learning with text books

We use the compiled text books to make the C/P discuss the causes of and preventive measures against accidents by themselves from the standpoint of the railway operator and disseminate the importance of learning from accidents.

(3) Summarization of the results of analysis and countermeasures against accidents.

We hold a workshop to deeper the understanding of MR staff of analysis and establishment of causes measures against accidents, and make MR including the management share the outcome of the workshop.

### 3.1.3-B Service level

The level of passenger services implies widely-ranged factors, such as train speed, punctuality, fare and charge, comfort (ride comfort, cleanliness and train operation diagrams) and also related with comparison with other transport facilities. The evaluation criterion of each factor depends on the subjectivity and sensitivity of individuals. In this Project, we adopt comparatively clear-cut items, such as low levels of scheduled speed, punctuality (frequency of train delays) and ride comfort (vibration of train).

(1) Compilation of text books

We introduce technical measures in Japan to raise train speed, ensure punctuality and improve ride comfort together with the methods (evaluation items and means) to survey customer satisfaction (CS) with railways.

(2) Results of cause analysis for the low service level and countermeasures

We shall be provided with the data in 2011,2012 on "the sections and factors of speed limit" and "delayed operations" of the trains between Yangon and Mandalay, categorize it with constraining conditions such as geographical conditions, conditions of tracks, track beds and bridges, rolling stock performance and train operation procedures and signal/telecommunication facilities and discuss measures against such problems together C/P.

Regarding ride comfort, we make data visible by using vibration measuring instruments. .

We also implement hearing surveys over customers during the Project period.

(3) Summarization of the results of cause analysis for the low service level and countermeasures

We hold a workshop to deepen understanding of MR staff of causes analysis and establishment of measures to improve the service level and make MR including the top management share the outcome of the workshop.

### 3.1.4 Recommendation on technical standards relating to administrative and maintenance aspect to improve the service level and safety

We clarify the items prioritized for the improvement of safety and service level. To ensure safety, nothing is more important than motivation of employees, with observance of standards and efforts for improvement by employees being a key to attain sustainable success. To prepare an environment for this purpose, therefore, it is important to create organizational norms and climates to allow evaluating the efforts by employees in a visible form.

It is expected that passenger flows will become more active not only in Myanmar but also to/from other countries as a result of economic development from now on. Improvement of service level is of utmost importance for MR in order to win the competition with other transport facilities and make railways survive and develop further in the future.

### 3.1.5 Drawing up of short- , medium- and long-term railway facilities improvement plan

We organize "Working group to improve the service level and safety (tentative naming )", make it analyze a series of surveys and extract improvement items for each phase based on the outcome of the workshop. After that, we draw an improvement road map for discussion.

Improvement plan consists of short-term (three-year) improvement plan, medium-term (5- to 10-year) improvement plan, and long-term (10- to 30-year) improvement plan.

### 3.1.6 Education/training in Japan

We educate and train approximately 11 trainees relating to railway institutional management for two weeks in Japan, including implementation of site tours to the Integrated Education/ JR East, and the Overseas Human Resources and Industry Development Association (HIDA), with concrete programs subject to determination through consultations with MR.

### 3.1.7 Major issues to be tackled with, good schemes for better implementation, lessons obtained through implementation

(1)Working group to improve the service level and safety has been established with the consensus between MR and JICA expert team, as shown in Table 4.3.

(2)To implement the Project more smoothly, additional counterpart experts were added to the original counterpart experts as shown in Table 4.1.

(3)Workshop in the training program was arranged such that not only the cause analysis of accidents and low service level and establishment of countermeasures are to be presented by MR experts, but also JICA experts can deepen the understanding of the current situation of MR system in tackling with prevention of accidents and low service level, and their improvement.

Table 3.1 Table of working planning schedule

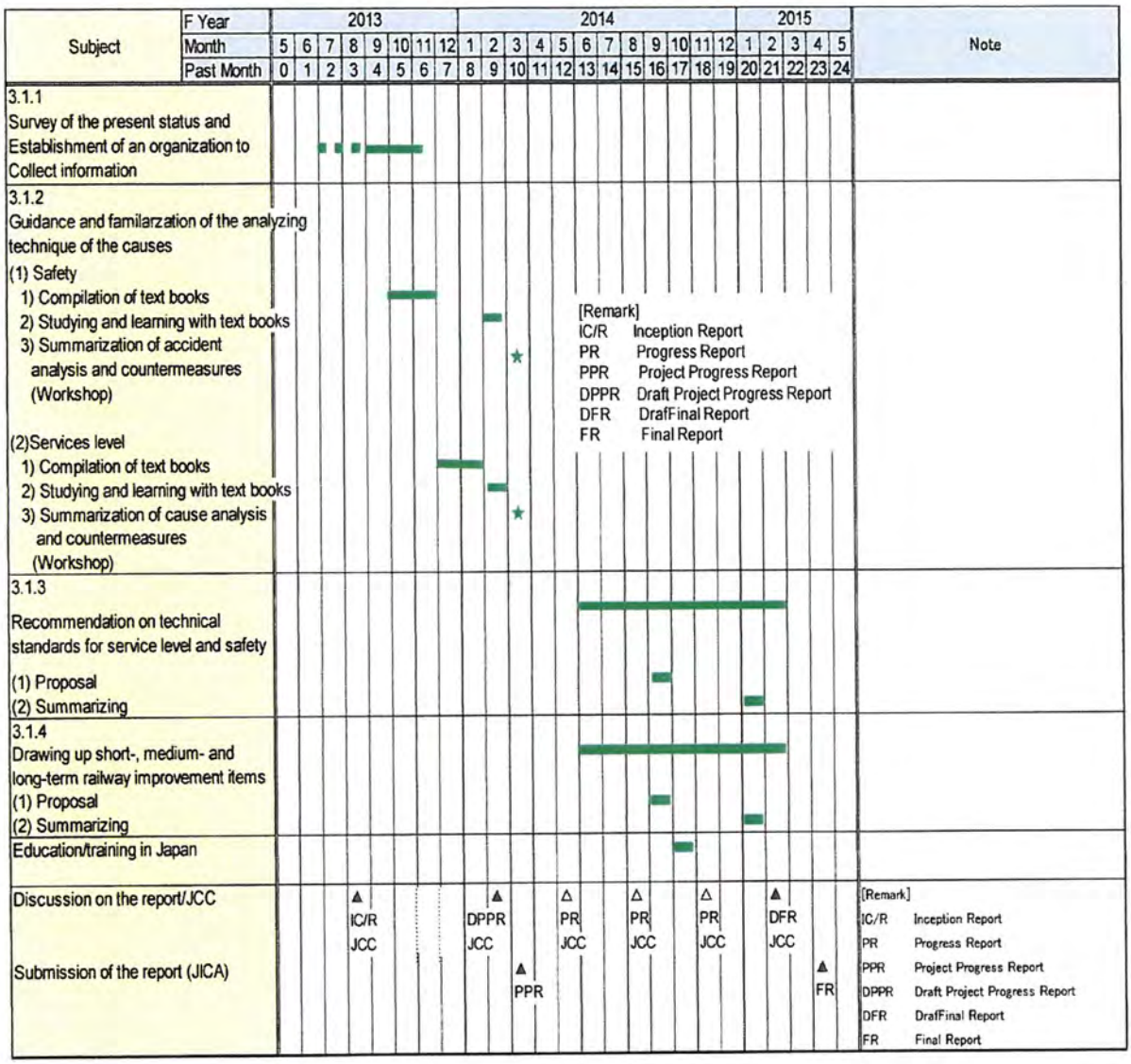


Table 3.2 Tentative Schedule(Track Maintenance)

| Subject | F Year | 2013 | | | | | | | | | | | | 2014 | | | | | | | | | | | | 2015 | | | | | The degree of achievement (%) | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | | | | | | |
| | Past Month | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | | | | | | |
| 4.2.1 Drawing up a technical transfer plan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 100 | |
| (1) Collection of basic information | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 100 | |
| (2) Plan of technical transfer | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2.2 Selection/procurement of equipments/tools | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Selection of equipments/tools | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 100 | |
| (2) Acquisition of import license, tax exemption procedure | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 100 | |
| (3) Import procedure | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 100 | |
| (4) Freight control | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 15 | |
| 4.2.3 Selection of Pilot Section | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Site witnessing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 100 | |
| (2) Selection of a section | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 100 | Change pilot section in December |
| (3)Base line survey | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 100 | |
| 4.2.4 Implementation of track maintenance work (inspection, planning, work, control) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Compilation of text books | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 100 | |
| (2) Classroom education and practical | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 66 | |
| (3) Prior measurement and survey at the Pilot Section | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 10 | Pallarell with Implementation of work |
| Implementation of work · After completing the maintenance work of a 100 m-section in principle, move to the next 100 m-section (with the number of working days depending on the workload of each 100 m-section). | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 10 | |
| 4.2.5 Education/training | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Seminars on the improvement of track maintenance technologies | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 25 | |
| (2) Education/training in Japan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | |
| 4.2.6 Summarization of the points of improvement and reflecting them in the track maintenance manuals/standards | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | |
| 4.2.7 Final summarization and seminars | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | |
| Discussion on the report/JCC | | | | | ▲ IC/R JCC | | | | | | ▲ DPPR JCC | | | △ PR JCC | | | △ PR JCC | | | △ PR JCC | | | ▲ DFR JCC | | | | | | | [Remark] | |
| Submission of the report (JICA) | | | | | | | | | | | | ▲ PPR | | | | | | | | | | | | | ▲ FR | | | | | | IC/R: Inception Report; PR: Progress Report; PPR: Project Progress Report; DPPR: Draft Project Progress Report; FR: Final Report |

Planning

Result

## 3.2 Technology Transfer of Track Maintenance Technology to improve the level of Service and Safety through Implementation of The Pilot Project

### 3.2.1 Drawing up a plan for technology transfer

The system of track maintenance work currently in practice in Myanmar is a version of the old-fashioned system implemented in the past in Japan. Through this Project, track maintenance workers of MR shall receive education/training of basic track maintenance works, while aiming at a mechanized maintenance system to use large-scale maintenance machines in the future. This means a conversion from the current gang system to a larger sized maintenance depot system or a re-construction of maintenance system. Bearing in mind this long-term vision, we prepare a plan for technology transfer focused on the track maintenance OJT for two years.

See Table 3.2 for the schedule of technology transfer.

### 3.2.2 Procurement of the required equipments / tools

(1) Table 3.3 summarizes the required equipments / tools, which will be procured by the Japan side.

Table 3.3 : List of the required equipments / tools

| No. | Item | Unit | Manufacturer |
|---|---|---|---|
| 1 | Analog standard gauge | 5 | KANEKO CO., LTD. |
| 2 | Instrument detection for track | 5 | GIDOU GIKEN |
| 3 | Mesuring instrument for rail wearing depthe | 2 | HARADA SEISAKUSYO |
| 4 | Gap gauge | 5 | TRSUKO NAKAYAMA CO., LTD. |
| 5 | Taper gauge | 5 | KANEKO CO., LTD. |
| 6 | Thermometer for rail | 5 | KANEKO CO., LTD. |
| 7 | Square for rail | 5 | KANEKO CO., LTD. |
| 8 | Trackmaster | 1 | KANEKO CO., LTD. |
| 9 | Mesuring instrument for train swing | 1 | SHINYEI TECHNOLOGY CO.,LTD |
| 10 | Cloth measuring tape (30 m) | 5 | YAMAYO SOKUTEKI CO., LTD. |
| 11 | Steel measuring tape (30 m) | 5 | YAMAYO SOKUTEKI CO., LTD. |
| 12 | Square | 5 | TETUYU KOGYO CO., LTD |
| 13 | Slate pencil , Chalk | 4 | NIHON HAKUBOKU KOGYO CO., LTD. |
| 14 | Tie tamper | 1 | SHIBAURA ELRTEC CORPORATIO |
| 15 | Beater | 18 | ISHI TEKOU CO., LTD |
| 16 | Shovel | 18 | TONBO KOGYO CO.,LTD. |
| 17 | Bar | 35 | ISHI TEKOU CO., LTD |
| 18 | Spike hammer | 13 | ISHI TEKOU CO., LTD |
| 19 | Panpuller | 18 | HOSEN KIKI SEIBI CO.,LTD |
| 20 | Jack for rail | 40 | NICH CO., LTD. |
| 21 | Equipment for ballast tamping | 5 | HITACHI KENKI KAMINO CO., LTD. |
| 22 | Generator | 1 | SHIBAURA ELRTEC CORPORATIO |
| 23 | Generator | 5 | HONDA MOTOR CO., LTD. |

| | | | |
|---|---|---|---|
| 24 | Shovel | 9 | TONBO KOGYO CO.,LTD. |
| 25 | Dump shovel | 9 | KATOU SEISAKUSYO CO., LTD. |
| 26 | Shovel with blade divided into multiple | 9 | KATOU SEISAKUSYO CO., LTD. |
| 27 | Hoe with blade like nail of wild goose | 9 | KYOUWA CO., LTD. |
| 28 | Hand screen | 15 | IRIE KOUGYO CO., LTD. |
| 29 | Hoe with blade of traiangle | 9 | IRIE KOUGYO CO., LTD. |
| 30 | Wooden maul | 9 | KONDO KASHIZAI MOKOUSYO CO., LTD. |
| 31 | Basket made by bamboo or plastic | 9 | SEKISUI KAGAKU KOGYO CO., LTD. |
| 32 | Jack traverser | 10 | TOKO SANGYO CO., LTD. |
| 33 | Rail sawing machine | 3 | TETUYU KOGYO CO., LTD |
| 34 | Rail boring machine | 3 | KOBORI TEKOUSYO CO., LTD. |
| 35 | Core cutter | 10 | KOBORI TEKOUSYO CO., LTD. |
| 36 | Rail bending machine | 1 | RIKEN KIKI CO., LTD. |
| 37 | Rail joint expandor | 1 | TETUYU KOGYO CO., LTD |
| 38 | Sleeper replacing machine | 1 | HOSEN KIKI SEIBI CO.,LTD |
| 39 | Rail carrying machine | 9 | YOSHIIKE KAKEN KIKI CO., LTD. |
| 40 | Rail carrying tongs | 9 | YOSHIIKE KAKEN KIKI CO., LTD. |
| 41 | Shovel | 18 | TONBO KOGYO CO.,LTD. |
| 42 | Single open ended spanner | 9 | ISHI TEKOU CO., LTD |
| 43 | Chisel | 5 | ISHI TEKOU CO., LTD |
| 44 | Rail fork | 5 | NICH CO., LTD. |
| 45 | Disc grinder | 5 | HITACHI KOUKI HANBAI CO., LTD. |
| 46 | Power wrench | 5 | MAKITA CO., LTD. |
| 47 | Low joint maintenance machine | 1 | L. GEISMAR |
| 48 | Spanner for joint bolt | 9 | IIJIMA KIKOU CO., LTD. |
| 49 | Rail grinding machine | 1 | YOSHIIKE KAKEN KIKI CO., LTD. |
| 50 | Swager for back bolt | 1 | NIPPON POP RIVETS AND FASTENERS LTD |
| 51 | Hydraulic lining machine | 5 | TETUYU KOGYO CO., LTD |
| 52 | Low roller | 7 | HOSEN KIKI SEIBI CO.,LTD |
| 53 | Chisel with handle | 3 | ISHI TEKOU CO., LTD |
| 54 | Spanner for bed plate / rail brace | 7 | IRIE KOUGYO CO., LTD. |
| 55 | Adz | 9 | ISHI TEKOU CO., LTD |
| 56 | Hand hammmar | 9 | TORASUKO NAKAYAMA CO., LTD. |
| 57 | Spanner for huck bolt | 9 | IIJIMA KIKOU CO., LTD. |
| 58 | Engine Drilling Machine | 13 | NIKOU TANAKA ENJINYARING CO., LTD. |
| 59 | Drill 22mm | 13 | NIKOU TANAKA ENJINYARING CO., LTD. |
| 60 | Gouge | 9 | KAKURI SANGYO |
| 61 | Electric saw | 5 | HITACHI KOUKI HANBAI CO., LTD. |
| 62 | Boring machine | 3 | MAKITA CO., LTD. |
| 63 | Sleeper carrying tongs | 9 | KATOU SEISAKUSYO CO., LTD. |
| 64 | Pad remover | 9 | ORUHA CO., LTD. |
| 65 | Light track trolley | 5 | YOSHIIKE KAKEN KIKI CO., LTD. |
| 66 | Gas cutting machine | 2 | YAMATO SANGYO CO.,LTD |

| No. | Item | Unit | |
|---|---|---|---|
| 67 | Rail lifting machine | 3 | TOKO SANGYO CO., LTD. |
| 68 | Spanner | 2 | TOPU KOGYO CO., LTD. |
| 69 | Track jack | 9 | TETUYU KOGYO CO., LTD> |
| 70 | Low elasticity pad | 20 | NIHON ESURAITO CO., LTD. |
| 71 | Track shim | 20 | TETUDOU YOUHIN CO., LTD. |
| 72 | Huck bolt | 40 | KONDO TEC CO., LTD. |
| 73 | Brushcutter | 4 | HONDA MOTOR CO., LTD. |
| 74 | Chip cutter for Brushcutter | 4 | HONDA MOTOR CO., LTD. |

(2) Figure 3-1 illustrates the flow of the import procedure for equipments / tools in the procurement process. Below explained are the major points to be observed.

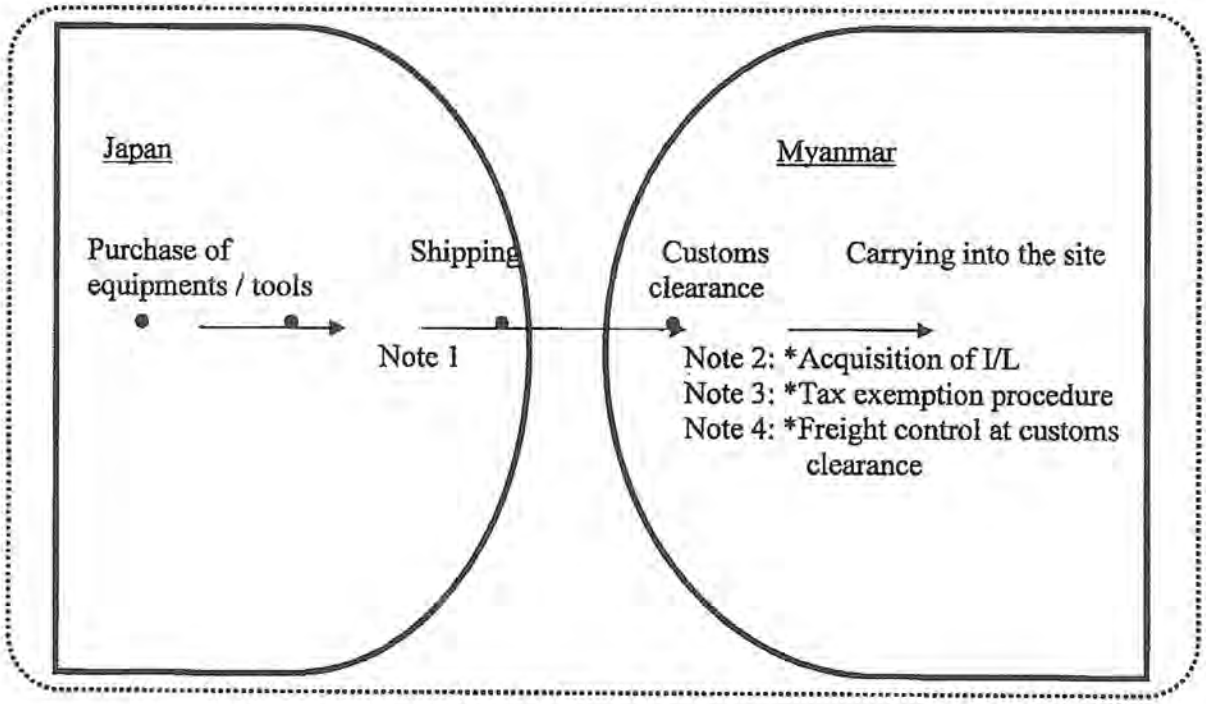



Fig. 3-1 : Flow of the equipments / tools import procedure.

1) Acquisition of import license (I/L) (Notes 1 and 2)

Trading in Myanmar requires importers to acquire an import license (I/L) in advance.

Importers shall acquire an import license before shipment (Note 1) as a prior procedure required for import clearance in landing the purchased equipments / tools.

2) Shipping of equipments / tools

If the cargo has been shipped from the export country before the acquisition of an import license, the importer shall be subject to confiscation of cargo or other penalties by Myanmar. Therefore, due attention shall be paid to the dates of I/L acquisition and cargo shipping from the export country. Furthermore, the cargo shall arrive at Myanmar before the last day of import specified in the import license.

3) Import declaration (Note 2)

Although import declaration can be performed by the importer, it is normally entrusted to a professional agent called a customs broker with a fee paid, as the clearance procedure is extremely complicated and requires expertise knowledge of laws.

Checking and signing the documents for clearance can be done only by the registered customs specialists belonging to a customs broker.

4) Import clearance (Note 2)

This is a procedure for importers to obtain permission from the customhouse with the cargo subject to inspection after (1) reporting cargo items, categories, quantities, prices and other particulars and (2) paying custom duties and other relevant taxes.

Until this procedure completes, the cargo retains the status of a foreign article without becoming a domestic one and, therefore, it cannot be handed over to the Myanmar territory from the bond area. As omission/ignorance of this procedure or false file of return constitutes smuggling, due attention shall be paid.

5) Procedure for tax exemption (Note 3)

Importers shall obtain permission of the customhouse for tax exemption before the clearance procedure in importing cargos that fall in the category of tax-free articles. Detailed procedures in this regard shall be subject to prior confirmation with competent offices and customhouses in Myanmar.

6) Freight control at import clearance (Note 4)

After the arrival of the cargo at the landing port of Myanmar, the importer cannot claim it until the import clearance completes. In the meantime, the importer is required to bear warehouse expenses, container yard rental fees and other extra costs. It is required for the importer, therefore, to promptly complete the custom clearance procedure and take other actions to avoid otherwise unnecessary expenses.

### 3.2.3 Selection of Pilot Section

In the 46.5 mile section (74.8 km long) between Yangon and Bago, we implement track maintenance as a means of technical transfer in the approximately 20 km-long Pilot Section, which is to be selected through a site survey to allow experiencing maintenance of different track structures, such as defective, sound, straight and curved tracks, turnouts in station yards and bridges, so that the effect of technical transfer is readily obtainable.

Japan side proposed the pilot section consisting of Pilot Section 1 and Pilot Section 2 at the 1st JCC. This is selected by the reason that there are many types of tracks and structures such as straight line, curve, turnouts and bridges, etc in Pilot Section 1 and the vehicle vibration acceleration values are big according to the results of vibration measurement in Pilot Section 2.

We proposed the Pilot Section by the formal letter which was agreed by the Myanmar side, and the Myanmar side wanted to start the track maintenance practice in Pilot Section 2 earlier than that in the Pilot Section 1 because Pilot Section 2 has very bad track conditions.

After that, there was a request of early start of track maintenance practice in the section from 12km200m to 14km550m between Toekyaungkalay Sta. and Ywathargyi Sta. from Myanmar side on 11th December. Thereby, the order of track maintenance practice in the Pilot Section was changed from 16th December.

### 3.2.4 Implementation of track maintenance (inspection, planning, work and control)

(1) Compilation of text book

To use for classroom education and practical training, we compiled a text book in three parts, each covering the fields of (1) safety of work, (2) track maintenance work and (3) track inspection.

We implemented practical training and maintenance work based on this text book and compile, (1) standards and (2) manuals, for track maintenance work, after modifying, adding or deleting contents of the text book based on review of track maintenance training.

(2) Classroom education and practices (seminars)

Before implementing actual track maintenance work on the Pilot Section, we had seminars on the particulars related to track maintenance such as inspection, planning and work for the workers to be assigned to the Pilot Section. This is the first classroom education and an important step to assess the level of local staff, which will significantly contribute to the work progress control in the future.

Before starting the maintenance work in the Pilot Section, we performed practical training on track maintenance (inspection and work) on non-commercial tracks.(Some are commercial tracks) As safety is one of the most important concerns for track maintenance workers, we also educate them on safety in practicing track maintenance work, with (1) wearing protectors and other protective equipment and (2) deployment of security guards (train watchmen) subject to prior negotiation with MR. However, we proposed at least wearing protective shoes, helmets and safety vests.

Regarding classroom education and practical exercises, we selected an inspector and three to four works from each gang; implemented education in the classroom in the morning and practical exercises using working tools in the afternoon, for about one month in consideration of the combinations of work category and associated job and the number of object trainees. As a part of base line survey, track irregularities (5 items), train vibration accelerations (Vertical and lateral ), average speed in the Pilot Section were measured.

(3) Implementation of prior measurement and surveys of the Pilot Section

Before implementing track maintenance work for tracks used for commercial services in the Pilot Section, we measured track levels (transit measurement at curves) to calculate the amount of rail lift and the volume of ballast for the total length of the Pilot Section. Furthermore, we patrolled the total length to (1) visually checked the conditions of track structure/materials and (2) surveyed the workload required and the volume of materials in each 100 m-segment to draw up a working plan.

(4) Implementation of inspection, planning and work in the Pilot Section

Based on the working plan for each 100 m-segment compiled according to the results of prior measurement and surveys, we implemented in turn education and training for the inspector and workers of each track maintenance gang. In the course of this education/training for a particular gang until the track maintenance work in the range of track section in its charge completes, inspectors and workers for other gangs are expected to observe, witness and help the work in progress when necessary in order to make these gang-wise separated operations yield an extended effect over the whole Pilot Section.

For this education/training, In principle, we use the intervals between trains during the daytime. Based on the experience in practical training, time-consuming work will be shifted to the time zone when tracks are not used for commercial purposes.

See the items 1) to 11) below for the scheduled track inspection and maintenance work.

The contents which we are implementing now for technology transfer of track maintenance include the following.

1) Ballast compacting work (use of hand tie-tampers, beaters or shovels)

①Inspection of track irregularities and conditions

② Correction of track irregularities

2) Ballast sieving

① Inspection of ballast

② Execution of work

3) Rail renewal work

① Inspection of rail

②Rail renewal work

4) Rail joint work (rework on rail clearance (rail joint clearance), correction of rail joint depression)

①Inspection of rail joint

②Clearance correcting work

③ Fail joint correcting work

5) Track realignment work

① Inspection of track displacement

② Irregular alignment correcting work

6) Turnout maintenance work

① Inspection of turnout

② Repair and renewal of turnouts

7) Inspection and maintenance of bridge sections

① Inspection

② Maintenance work

8) Correction of track gauge

① Inspection

② Correction work

9) Welding of rails (preparation of long-rails and a measure to strengthen rail joints)

10) Improvement of formation

① Inspection of ballast and roadbed

②Although a standard width of formation is specified in Myanmar, we found through site surveys that sufficient widths are not maintained. To fully exert the effect of aforementioned ballast compacting work, we guide MR to expand the width of formation where it is insufficient.

11) Control and evaluation of track conditions

### 3.2.5 Education/training

In Myanmar, a rainy season starts every year at the end of May. As the track maintenance work in a rainy season is apprehended to adversely affect track beds, we will primarily implement education/training from the end of May to October, 2014.

(1) Seminars to improve track maintenance technologies

We assess the level of track maintenance technologies of MR employees and compile appropriate text books. Thereafter, we hold seminars to improve track maintenance technologies for those participated in the maintenance of pilot section (approximately 20 members) three times: at the start of track maintenance OJT, after completion of track maintenance and at the final summarization of track maintenance OJT.

(2) Education/training in Japan

We implement a two-week education/training program twice in Japan each for approximately 11 trainees including some MTT operators, in which education/training on track technologies (centering on lectures and practical training) will be performed under the cooperation of JR East and Japan Railway Track Consultants, at the Integrated Education/Training Center (Shin-Shirakawa), JR East, and at the Overseas Human Resources and Industry Development

Association (HIDA). MTT operators are included in the above program to prepare for introduction of MTTs into track maintenance in the future.

We practice actual work at the side tracks, and observe the nighttime work to use MTTs in the suburbs of Tokyo.

We discuss the detailed contents of curriculum so as to reflect the level of MR engineers, and also discuss with MR about suitable timing of training in Japan.

### 3.2.6 Summarization of the points of improvement and reflecting them in the track maintenance manuals/standards

We summarize the points of reflection through the whole of maintenance work and compile the maintenance manuals to meet the present status of the track maintenance in Myanmar in consideration of the local organizations, working conditions and climates. The essentials of maintenance manuals will be easy to use, while including the steps of work and handling of machines/materials for track maintenance.

### 3.2.7 Final summarization and seminars

In closing the above technical transfer course on track maintenance work, we will open seminars for the trainees participated in the program and track maintenance members for other sections selected through consultation with MR. As this is the final step for MR employees to receive technology transfer, which is expected to evolve as a model shop to every section of the country in the future, we will avail ourselves of this opportunity to totally wipe unknowns out of MR members regarding the whole of track maintenance work.

### 3.2.8 Major issues to be tackled with, good schemes for better implementation, lessons obtained through implementation

To implement the Project more smoothly, some JICA track experts were added to the original JICA experts.

## 4. Project implementation Organization

### 4.1 Structure of project implementation Organization

Based on R/D, a project implementation Organization was organized as shown in Fig. 4.1.

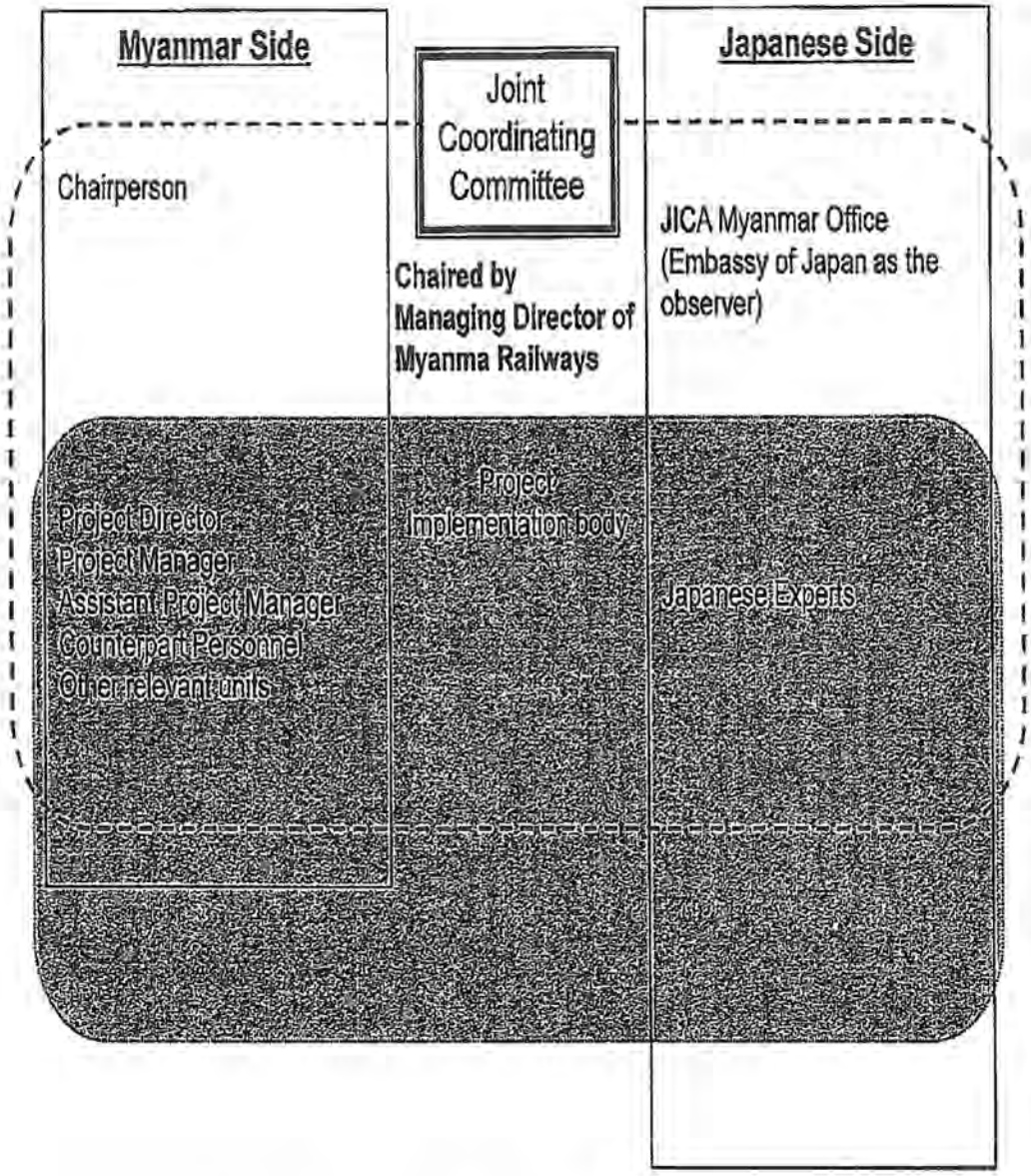



Fig. 4.1: Structure of project implementation Organization

This project is promoted as a scheme of "technical cooperation". Implementation organization consists of (1) Myanma Railways (MR) supported by the Ministry of Rail Transportation on the Myanmar side and (2) JICA and a tripartite consortium (JV) composed of Japan International Consultants for Transportation Co., Ltd. , Oriental Consultants Co., Ltd. , and Sumitomo Corporation. To ensure smooth implementation of the whole project, the Joint Coordinating Committee (JCC) was established as referred to later in 4.4.

### 4.2 Implementation body on the Myanmar side

MR plays a central role on the Myanmar side. To correspond to Japanese experts, a Counterpart Team was organized for this project. See Table 4.1. Project Director commands the general affairs and implementation of the project, while Project Manager manages the projects and directs technical affairs.

During the implementation of the Project, several experts locating at MR Headquarters at Nay Pyi Taw were added to the Counterpart Team, so that the analysis of accidents, low service level and discussion of countermeasures could be effectively executed under the cooperation of MR experts and JICA experts.

Namely the following experts were added to the Counterpart Team as shown in Table4.1.

(1) Track maintenance U Than Htay, DGM(Civil)

(2) Signal/ Telecommunications U Han Nyant, AGM(S&T)

(3) Rolling Stock U Thet Lwin, DGM (Rolling stock)

(4) Train Operation U Htiay Myint Aung, AGM (Operation)

(5) Structure U Tin Win, DGM(Civil)

### 4.3 Implementation body on the Japan side

The JICA experts selected from the above tripartite consortium guide/advise the personnel on the Myanmar side and offer recommendations where necessary for the project. See Table 4.1 for the list of the expert members.

During the implementation of the Project, the following replacement of Japanese experts was made due to inevitable circumstances.

(1) Signals/ Telecommunications from Kiichi Takemura to Ryuhei Mitani
(since October 25, 2013)

(2) Track Maintenance from Kazuhiko Murao to Masato Wakatsuki
(since October 28, 2013)

### 4.4 Establishment of Joint Coordinating Committee (JCC) and Its Functions

JCC is the committee to confirm the progress of the Project, discuss important matters and make decisions for the better implementation of the Project.

Managing Director of MR is the chairperson of the JCC. The members are listed in Table 4.2.

Corresponding to the replacement of Japanese experts as mentioned in the section 4.3, the JCC members on Japanese side were replaced as shown below.

(1) Signal/ Telecommunication from Kiichi Takemura to Ryuhei Mitani

(2) Track Maintenance from Kazuhiko Murao to Masato Wakatsuki

Originally it was planned to be held at least twice a year and when necessary arises.

However on the request of Myanmar side, it is planned to be held around once every 3 months.

Table 4.1 Administrative and Counterpart Personnel for the Project

| Fields | Myanma Railways | Japanese Side (JICA Expert Team) |
|---|---|---|
| Project Director | U Saw Valentine,General Manager (Technical & Admin.support) | Sadaaki KURODA(Leader) |
| Project Manager | U Tin Soe ,General Manager (civil) | Nobuyuki MATSUO (Duputy Leader) |
| Railway Policy/OM Improvement | U Kyaw Kyaw Myo Assistant General Manager(operating) | Hiroshi KOMATSU |
| Track Maintenance | U Maung Maung Than ,AGM (Civil) U Than Htay(DGM) Civil | Masato WAKATSUKI Kiyoshi MIYAMOTO |
| Procurement of Equipment &Materials | U Win Htein DGM( Supply) | Yuichi TANIGUCHI |
| Signalling&Telecommunications | U Myint Lwin,Assistant Engineer(S&T) U Han Nyunt ,AGM(S&T) | Ryuhei MITANI |
| Rolling Stock | U San Myint (Train Operation) U Thet Lwin,DGM(Rolling Stock) | Makoto ISHIKAWA |
| Train Operation | U zaw Pe Sein (Divisional Traffic Manager) U Htay Myint Aung,AGM(operating) | (Hideharu IGAGASHI) |
| Structure | U Tin Win ,DGM(Civil) | Mitsuru TAKAMI (Coordination) |

Table 4.2 JCC Personnel

| Chairman U Thurein Win Managing Director of Myanma Railways | | | |
|---|---|---|---|
| Myanmer Side | | Japanese Side | |
| Name | Position (Major) | Name | Position (Major) |
| U Saw Valentine | General Manager (Technical & Admin Support) | Sadaaki KURODA | Leader of Japanese Expert Team (Track maintenance) |
| U Myint Wai | General Manager (Operating) for analyzing accidents | Nobuyuki MATSUO | Duputy Leader (Maintenance planning) |
| U Aung Win | General Manager (Mechanical & Electrical) for rolling stocks | Hiroshi KOMATSU | Railway Administration and Management Expert |
| U Tin Soe | Project Manager, General Manager (Civil) | Yuichi TANIGUCHI | Procurement of Equipment and Materials Expert |
| U Than Htay | Assistant Project Manager, Deputy General Manager (Civil) | Ryuhei MITANI | Signalling and Telecommunications Expert |
| U Khin Maung Thein | Assistant Project Manager, Deputy General Manager (Signalling & Telecommunications) | Makoto ISHIKAWA | Rolling Stock Expert |
| U Min Aung | Counterpart Personnel, Assistant Engineer (Civil) | Masato WAKATSUKI | Track Maintenance Expert |
| U Myint Lwin | Counterpart Personnel, Assistant Engineer (Signalling &Telecommunications) | Kiyoshi MIYAMOTO | Earth Roadbed Expert |
| Daw Thi Thi Nwe | Assistant General Manager (Finanace) | Mitsuru TAKAMI | Coordinating Expert |
| Htaung Sian Kan | Deputy General Manager (Admin) | (Hideharu IGAGASHI) | Operation Expert |
| | | Mituso HIGASHI | Railway Management Adviser |
| | | | Representative of JICA |
| | | | Representative of JICA |
| | | | Representative of Embassy of Japan : Observer |

The first JCC was held on Aug. 28th, 2013 for authorization of Inception Report, and the 2nd JCC, originally planned to be held on Nov. 28th or 29th, 2013, but postponed with due consideration of various situations of MR, is being held on 27th February, 2014 at Nay Pyi Taw.

### 4.5 Establishment of Working Group for Service and Safety Improvement

In the Record of Discussion(R/D) agreed between Managing Director of MR, U Thurein Win and Chief Representative, Myanmar office of JICA, on May 28th ,2013, Appendix 1, Ⅱ .OUTLINE of the Project, 5.Activities(1-5) reads as follows: [To draw the improvement plan of railway facilities through discussion with Working Group for Service and Safety Improvement(tentative name)]

In this regards, MR and JICA Expert Team have established Working Group as shown in Table 4.3.

### 4.6 Major issues to be tackled with, good schemes for better implementation of the project and lessons obtained through implementation.

Regarding the safety and service improvement project based on analysis of accidents and low service level, the MR Head Office located at Nay Pyi Taw has the initiative to the implementation of the project. Accordingly the additional experts of track maintenance, rolling stock, signal/ telecom, structure maintenance and operation belonging to the MR Head Office were added to the counterpart team of MR.

Table 4.3 " Member of Working Group for Service and Safety Improvement"

| Fields | Myanma Railways | Japanese Side (JICA Expert Team) |
|---|---|---|
| Project Director | U Saw Valentine,General Manager (Technical & Admin.support) | Sadaaki KURODA(Leader) |
| Project Manager | U Tin Soe ,General Manager (civil) | Nobuyuki MATSUO (Duputy Leader) |
| Railway Policy/OM Improvement | U Kyaw Kyaw Myo Assistant General Manager(operating) | Hiroshi KOMATSU |
| Track | U Than Htay DGM (Civil) | Masato WAKATSUKI Kiyoshi MIYAMOTO |
| Signalling&Telecommunications | U Han Nyunt ,AGM (S&T) | Ryuhei MITANI |
| Rolling Stock | U Thet Lwin,DGM(Rolling Stock) | Makoto ISHIKAWA |
| Train Operation | U Htay Myint Aung ,AGM(Operating) | (Hideharu IGAGASHI) |
| Structure | U Tin Win ,DGM(Civil) | Mitsuru TAKAMI (Coordination) |

# 5 Interim Reporting of Progress of the Project

## 5.1 Recommendation of technical standards relating to administrative and maintenance aspect and drawing up railway facilities improvement plan to improve service and safety level.

### 5.1.1 Survey of the present status and establishment of an organization to collect information

(1) With respect to an organization to collect information, the counterpart team was established as shown in Table4.1

(2) Collection of relevant information relating to train operation and rolling stock.

Two experts visited MR headquarters and three rolling stocks workshops for facts finding in August and September, 2013.

①Interviews

At Headquarters, they interviewed the deputy Directors, Operating and Mechanicals, as follows.

a) Organization and Correspondence in case of railway accidents

b) Accidents report and Countermeasures

c) Train Operation Methods and Driving Crews' Training and Treatments

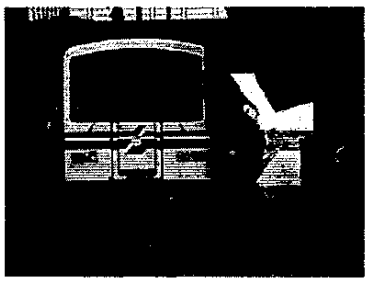
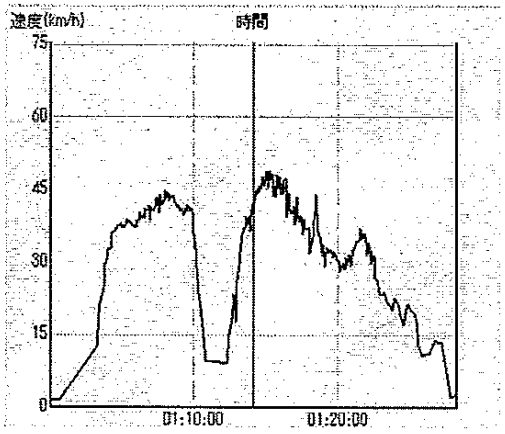
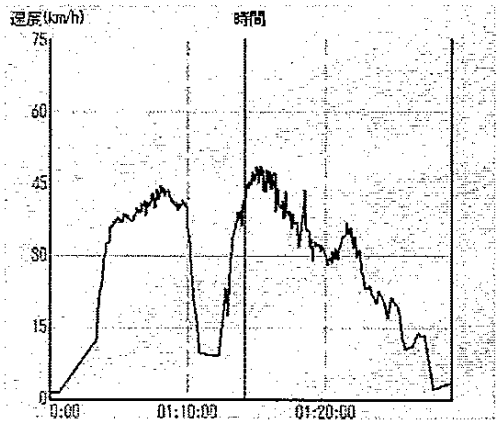
d) Restrict condition of sanction speed

e) Others

Also they introduced Japanese Railways current situations, for example national railway implementations, finance, and so on.

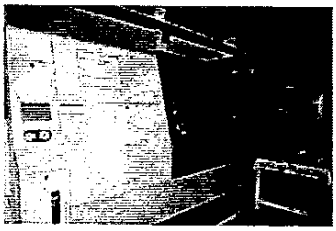
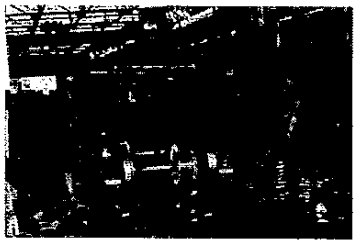
When experts boarded on MR trains between Naypyidaw Station and Pinmana Station two times, they measured Time-Velocity by GPS Logger.

Table5-1: Comparison of Train

| September 4th, AM 8:00-8:32 | September 6th, 17:00-17:30 |
|---|---|
| -Locomotive(2000Hp,DEL) hauling six passenger couches Train | -DMU(adapting air suspension bogies ) |
|  |  |
|  |  |

②Surveillance of Rolling stocks Maintenance Workshops

Table 5-2: Maintenance Workshops

| Insein Locomotive Workshop | Ywataung Locomotive Workshop | Myitnge Carriage and wagons Workshop |
|---|---|---|
| On September 2nd | On September 3rd | On September 3rd |
|  |  |  |
|  |  |  |

(3) Present status of safety and service level of MR

Based on the answers to the Questionnaire from the JICA expert team to MR, the paper "Present Situation of Safety and Service Level of MR" was prepared, which is attached as Appendix 8-1.

### 5.1.2 Guidance and familiarization of analysis technique of the causes of accidents and low service

(1) Compilation of text book

Expert team completed Text book and filed a training program in middle of next February. Table of contents is as follows,

Text book Contents

Forewords (MR side and Japanese side)

1. Safety
   1.1 Introduction of Prevention and Research organization in the world railway
   1.2 Past accidents and Countermeasures
      1.2.1 Collision
      1.2.2 Derailment
      1.2.3 Level crossing
      1.2.4 Natural Disasters
      1.2.5 Train Fire

2. Bottom up of Service Level
   2.1 Speed-up
   2.2 Prevention for Level Crossing Accident
   2.3 Punctuality
   2.4 Conformability
   2.5 Customer Satisfaction

Afterword

(2) Studying and learning with the textbook, and
(3) Summarization of cause analysis and countermeasures (workshop)

With respect to the subsections (2) and (3), the document "Procedure of Training Program of Cause Analysis of Accidents / Low Service Level and Establishment of Countermeasures" was prepared, which is attached as Appendix 8-2,

(4) Interview Survey
In order to investigate the customer's evaluation of MR's passenger services, the interview survey was programmed of which details are shown in the document" guidelines for investigation on customer's Satisfaction Level, attached as Appendix 8-3

### 5.1.3 Recommendation on technical standards for service and safety, and

### 5.1.4 Drawing up short-, medium-, and long-term railway improvement items

These two subjects of the sections 5.1.3 and 5.1.4, will be carried out in the period from June 2014 to Feb 2015, based on the results of implementation of the training program,

### 5.1.5 Education / training in Japan

This is scheduled to be held in October, 2014.
Concrete program and selection of 11 participants of MR will be finalized according to agreement between MR and JICA Expert Team.

### 5.1.6 Extent of achievement of target, major issues to be tackled with, good schemes for better implementation, lessons obtained through implementation

(1)Extent of achievement
As described in the Appendix8-2, the training program consists of
① Presentation by JICA experts of introduction of Japanese and European accidents, establishments of suitable countermeasure to prevent similar accidents, and how to improve service level, ②workshop where MR experts make presentation about MR's accidents and low service level, their causes, and establishment of measures to prevent the occurrence of similar accidents, and to improve their passenger services, and ③ practical training how to make use of train vibration measurements for improving safety and service level.
This training program will be completed on Feb 28th, 2014.
Further interview survey will be conducted from March 3rd to 7th, in order to identify the passenger's evaluation of MR passenger transport services.
Still more, JICA experts should make recommendation on technical standards of MR relating to safety and service level, and draw up short-, medium-, and long- term railway facilities improvement plan for safety and service of railway operation.

In this regard, it can be said that the target of this subprogram has been achieved halfway,

(2) Major issues to be tackled with, good schemes for better implementation, lessons obtained through implementation

1) Good schemes applied for better implementation

(a) Close contact between two subprojects

As given in the Inception Report, the Project consists of two subprograms:(1) Recommendation of technical standards relating to administrative and maintenance aspect and drawing up railway facilities plan to improve service and safe level, and (2) technology transfer of track maintenance technology to improve the level of service and safety through implementation of the Pilot Project.

These two subprograms should be executed under close contact so that they can mutually complement each other, because both the subprojects include the class room lecture on how to improve track and track maintenance from the viewpoint of ensuring safety and good service level.

(b) Preparation of textbook and presentation by JICA experts

①In adopting the examples of accidents analysis and service level improvement in the textbook, the following two points were duly taken into consideration.

a) the events likely to occur in MR

b) the items to be tackled with to cope with the furture traffic increase in MR

②Presentation of Japanese experiences

a) Not the newest technology, but the practical technologies able to be applied to the coming development of MR were introduced.

b) Calculation procedures were presented so that MR Experts can apply these calculation procedures to quantitative analysis of accidents or low service level.

c) Case study of analysis of derailment was presented so that MR experts could have interests in quantitative analysis of accidents.

(c) Workshop

In programming the workshop contained in the training program, it was so arranged that in the workshop MR experts make presentation of ① cause analysis of accidents and low service of MR themselves, ② countermeasures to prevent the similar accidents and low services, and ③ the procedure/ systems /organization of MR for ensuring safe and good service railway transport.

Through these activities, it is expected that MR experts' management capability of tackling with improvement of safe and service level could be raised up.

Furthermore it can be expected that through this workshop, JICA experts can deepen their understanding of the actual situation of MR relating to ensuring safe and good service railway operation, which would be a good basis for JICA experts to make recommendation on technical standards relating to safety and good services, and to draw up short-, medium-, and long- term facilities improvement plan to be executed in the next stage.

2) Major issues to be tackled with

(a) Technical standards

In improving the technical standards, not only the review of the items of the various standards, but also the explanatory sentences describing why such standard rules or criteria should be specified must be fully prepared.

(b) In the workshop, it is desirable that not only MR accidents and low service level but also Japanese similar ones would be analysed from the various viewpoints through discussion.

(c) The items which MR would have interests were investigated beforehand so that they could be reflected on the contents of the textbook appropriately. This effort should be encouraged.

## 5.2 Technology transfer of track maintenance technology to improve the level of service and safety through implementation of the Pilot Project

### 5.2.1 Drawing up a technical transfer plan

The system of track maintenance work currently in practice in Myanmar is a version of the old-fashioned system implemented in the past in Japan. Through this Project, track maintenance workers of MR receive education/training of basic track maintenance works, while aiming at a mechanized maintenance system to use large-scale maintenance machines in the future. This means a conversion from the current gang system to a larger sized maintenance depot system or a re-construction of maintenance system. Bearing in mind this long-term vision, we are preparing a plan for technology transfer focused on the track maintenance OJT for two years. See Table 4.2 for the schedule and record of technology transfer.

### 5.2.2 Selection /procurement of equipments/tools

Since there were equipments and tools which were not used in Japan among 74 kinds of them provided by JICA, arrival from Japan was delayed. But all the equipments and tools arrived in Yangon in mid-February. They are used by MR track maintenance workers now.

### 5.2.3 Selection of Pilot Section

Japan side proposed the pilot section consisting of Pilot Section 1 and Pilot Section 2 at the 1st JCC. This is selected by the reason that there are many types of tracks and structures such as straight line, curve, turnouts and bridges, etc in Pilot Section 1 and the vehicle vibration acceleration values are big according to the results of vibration measurement in Pilot Section 2.

We proposed the Pilot Section by the formal letter which was agreed by the Myanmar side, and the Myanmar side wanted to start the track maintenance practice in Pilot Section 2 earlier than that in the Pilot Section 1 because Pilot Section 2 has very bad track conditions.

After that, there was a request of early start of track maintenance practice in the section from 12km200m to 14km550m between Toekyaungkalay Sta. and Ywathargyi Sta. from Myanmar side on 11th December. Thereby, the order of track maintenance practice in the Pilot Section was changed from 16th December.

### 5.2.4 Implementation of track maintenance work (inspection, planning, work, control)

**(1) Compilation of textbook**

To use for classroom education and practical training, we compile a text book consisting of three parts, each of them covering the fields of (1) safety of work, (2) track maintenance work and (3) track inspection respectively.

We implement practical training and maintenance work based on this text book and compile (1) standards and (2) manuals for track maintenance work, after modifying, adding or deleting contents of the text book based on review of track maintenance training.

**(2) Classroom education and practical training (seminar)**

Before implementing actual track maintenance work in the Pilot Section, we had seminars on the particulars related to track maintenance such as inspection, planning and work for the workers in the Training room at Yangon Sta. on 23th October in 2013. This was the first classroom education and an important step to assess the level of local staff, which significantly contribute to the work progress control in the future. Before starting the maintenance work in the Pilot Section, we performed practical training on track maintenance (inspection and work) on yard tracks on 24th October in 2013. As safety is one of the most important concerns for track maintenance workers, we proposed at least wearing protective shoes, helmets and safety vests.

We divided 32 persons selected by MR into 4 group (A,B,C,D) and appointed a leader in charge of each group. There is one person in charge of the whole MR workers.
We implemented classroom education using Powerpoint of track maintenance work. We implemented practical training of track maintenance of which menus include rails exchange, site correction of sleepers and rectification of track irregularities, etc for 4 group. After hand tietampers, generators and jacks which were donated by JITI arrived in Yangon, we implemented classroom and practical training of lifting up of track for its strengthening based on results of survey on 19th-21th December in 2013.

**(3) Prior measurement and survey at the Pilot Section**

Before implementing track maintenance work for tracks used for commercial services in the Pilot Section, we hit temporary piles and measured track levels. Because of bad climate, we surveyed only some parts of the Pilot Section, but now we are surveying the remaining parts in parallel to working. We prepared a track maintenance plan per 100m unit amount of work and equipments/tools. Before the arrival of equipmemts/tools from Japan, we mainly executed only elementary kinds of track maintenance work (Spot surfacing, mending alignment and site correction of sleepers and supplement of ballasts).

**(4) Implementation of work**

We implemented track maintenance as below.

・26km200m to 27km035m (Up Line) ( From 28th October to 13th December in 2013)
・12km200m to 13km450m(Down Line) (From 16th December to Now)

We have implemented continuous tamping for lifting up track level from 9th January. Further we have implemented measuring of gauge, cross level, longitudinal level and horizontal alignment with measuring equipments on the commercial line and have given training of level surveying.

Records of work are as follows.

| Kind of work | Unit | 12k200m～13k450m | 26k200m～27k035m |
|---|---|---|---|
| Continuous Tamping | m | 826.5 | 254 |
| Spot Surfacing | m | 45.3 | 1,111 |
| Subtotal | m | 1279.5 | 1,365 |
| Spot Surfacing using ballast chipping at the joint | Nos. | 0 | 53 |
| Insert of sleepers cut into four pieces at the joint | Nos. | 0 | 8 |
| Positioning of sleepers | Nos. | 239 | 161 |
| Exchange sleepers | Nos. | 84 | 38 |
| Insert sleepers | Nos. | 9 | 22 |
| Remove sleepers | Nos. | 1 | 3 |
| Subtotal | Nos. | 95 | 63 |
| Rectification alignment | m | 552 | 915 |
| Supplement and arrangement of ballasts | m | 1535.5 | 1,128.5 |

**(Reference) Results of train vibration acceleration**

| Kind of Vibration | Items | 12k200m～13k450m | | 26k200m～27k035m | |
|---|---|---|---|---|---|
| | | Before 11/9 | After 2/8 | Before 10/23 | After 1/11 |
| Right And Left | Number of location More than 0.25g | 26 | 41 | 27 | 0 |
| | Average | 0.06 g | 0.05g | 0.04 g | 0.04 g |
| | Standard Deviation | 0.05 g | 0.04g | 0.03 g | 0.04 g |
| Up and Down | Number of location More than 0.25g | 999 | 0 | 11,501 | 2,261 |
| | Average | 0.07 g | 0.04g | 0.18 g | 0.12 g |
| | Standard Deviation | 0.06 g | 0.03g | 0.13 g | 0.10 g |
| Train Speed | | 28 km/h | 20 km/h | 34 km/h | 55 km/h |

### 5.2.5 Education/ training in Japan

This is scheduled to be held around June, 2014.

Concrete program and selection of 22 participants (11×2 times) of MR will be finalized according to agreement between MR and JICA Expert Team.

### 5.2.6 Summarization of the points of improvement and reflecting them in the track maintenance manuals/ standards

### 5.2.7 Final summarization and seminars

We are implementing technical transfer now. These two subjects of the sections 5.2.6, and 5.2.7 will be carried out in the period by April 2015, based on the results of implementation of the training program.

### 5.2.8 Extent of achievement of target, major issues to be tackled with, good schemes for better implementation, lessons obtained thorough implementation

We were considering about the schedule of rainy season and dry season. Temperature in Myanmar is very high beyond expectation. So we cannot help working in the morning. Now the training usually begins at 8 AM and finish 12 AM. It is getting hotter and hotter toward to April. We are thinking that we should begin training earlier in the morning.

## 6. Recommendation Addressed to Achievement of Overall Goal

### 6.1 Recommendation of technical standards relating to administrative and maintenance aspect and drawing up railway facilities improvement plan to improve service and safety level

The overall goal and the project purpose are given in the section 2.1 of Inception Report (IC/R):

(1) Service and safety level of MR is improved and,

(2) Administration and maintenance ability is improved for enhancement of service and safety of MR.

In order to achieve the above overall goal and the project purpose, we are now going through the following steps.

[Step 1]: Identification of present status of safety and service level of MR

[Step 2]: Compilation of text book which contains the analysis of causes of various accidents having occurred mainly in Japan, and establishment of suitable countermeasures against accident prevention along with the suitable measures for improvement of service level both practiced in Japan Railways.

[Step 3]: Discussion of the above text book in the class room, and holding the workshop. In the workshop, MR experts present the recent actual events of accidents and low service levels of MR, analyse their causes and establish the suitable countermeasures; these presentation by MR experts will be discussed by both JICA experts and MR experts. Along with the discussion of the text book and execution of the workshop, technology transfer of rolling stock vibration measurement and data analysis which will be the basis for improvement of service and safety level, and interview survey of the customer's satisfaction level about MR's passenger transport will be conducted.

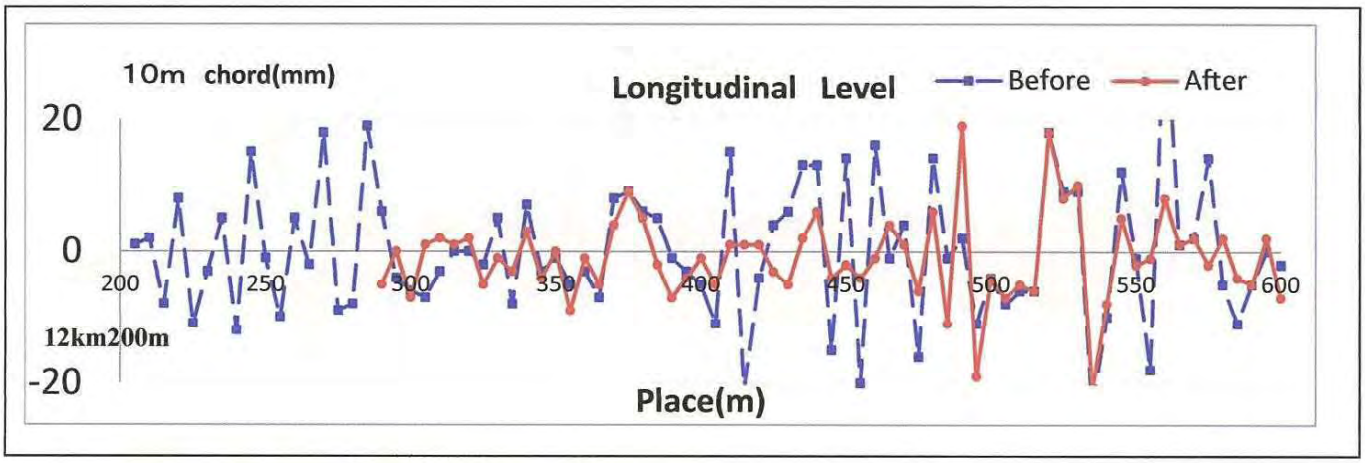
[Step 4]: Based on the results of the Step 3, recommendation on technical standards relating to administration and maintenance aspect to improve the safety and service level of MR will be proposed by JICA experts, which should be fully examined by the MR experts.
Further, railway facilities improvement plan for enhancement of safe and service level of MR should be prepared through discussion with the Working Group established for this purpose.

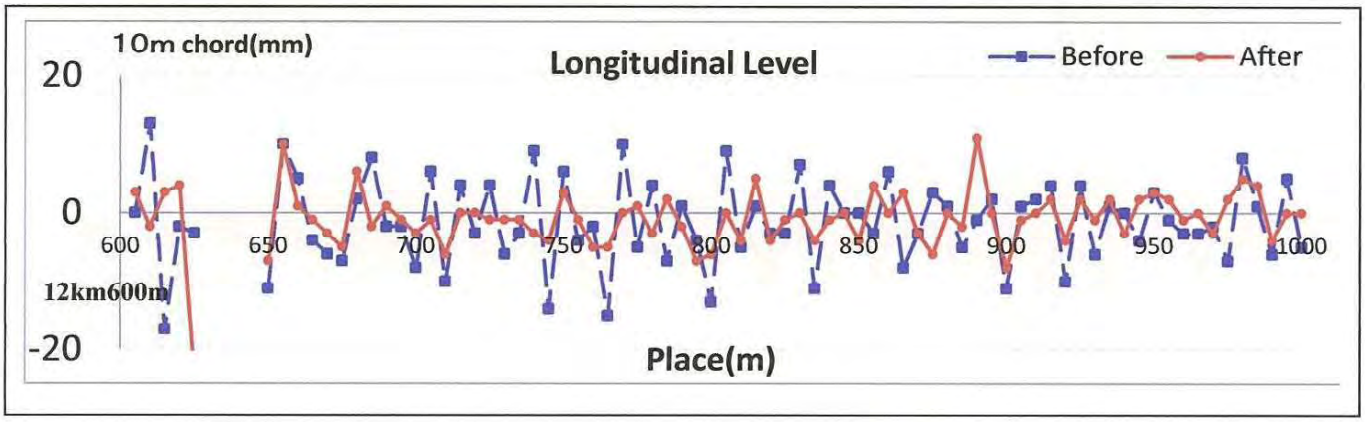
We are now in the middle of Step 3. Although we are still in the middle of the whole activities for achieving the overall goal and project purpose, we would dare to present the following suggestion for effective achievement of the overall goal and the project purpose.
Relevant technology transfer relating to improvement of safety and service level of railway could be achieved only though mutual and substantial discussion between MR experts and JICA experts to be held in the process of Step 3 and Step 4. In this context, we w
ould like to stress that technology transfer involves efforts in two directions.

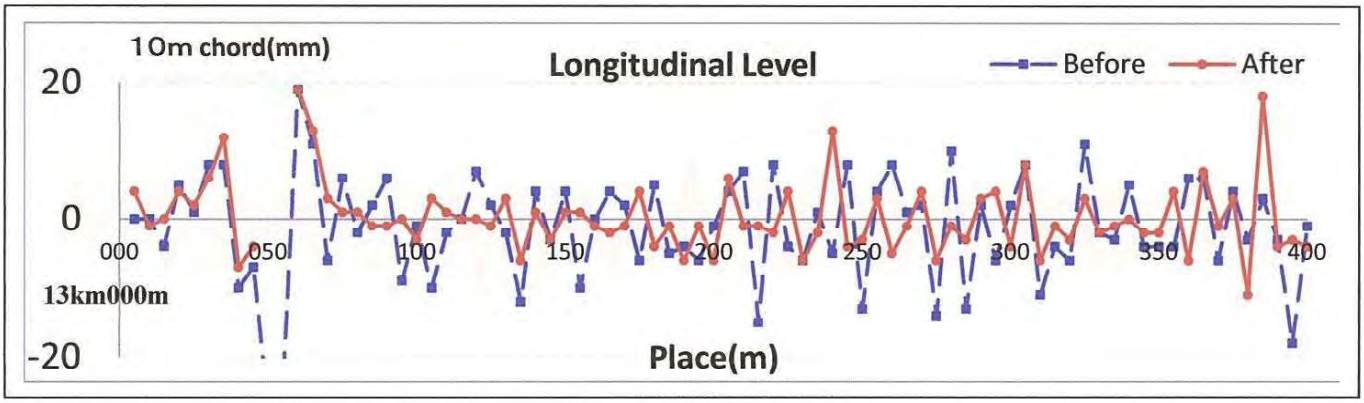
Effort in one direction is that of transmitting the experiences of Japanese Railways (JR) from JICA experts to MR experts.
Effort in another direction is that of response of MR experts to transmission of JR's experiences by JICA experts.
These effects in two directions should be realized through mutual and substantial discussion.
It is our suggestion that Step 3 and 4 should be executed through mutual and substantial discussion among MR experts and JICA experts.

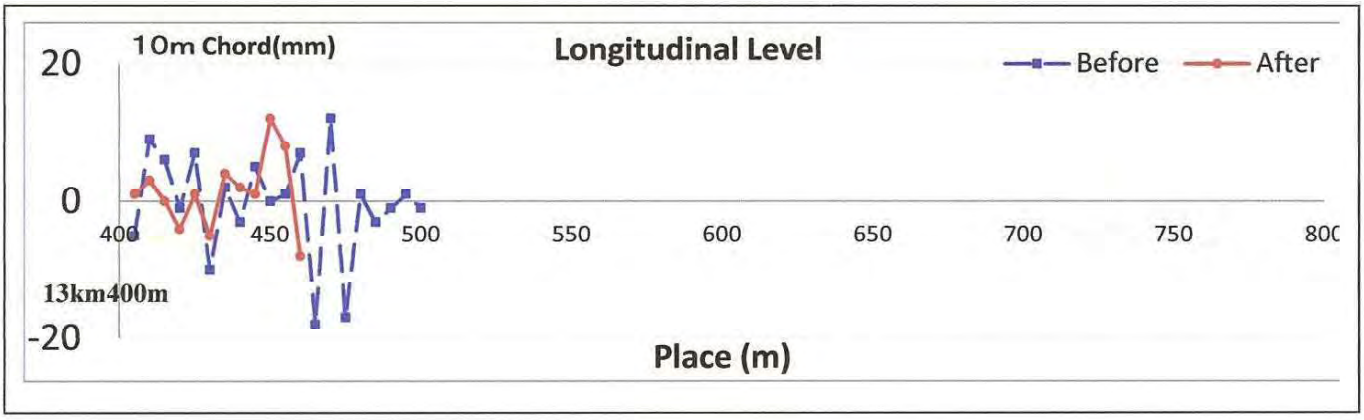
### 6.2 Technology transfer of track maintenance technology to improve the level of service and safety through implementation of the Pilot Project

The overall goal and the project purpose are the same as the sub project given in the section 6.1.
We are measuring values of some kinds of track irregularities and train vibration for evaluation of track maintenance before and after working on the commercial line.
Track irregularities measured by 10m chord include horizontal alignment and longitudinal level, and we compared the measurement values before and after the track maintenance work. Measurement of train vibration is in the vertical and lateral directions and was made in the working section once two weeks.



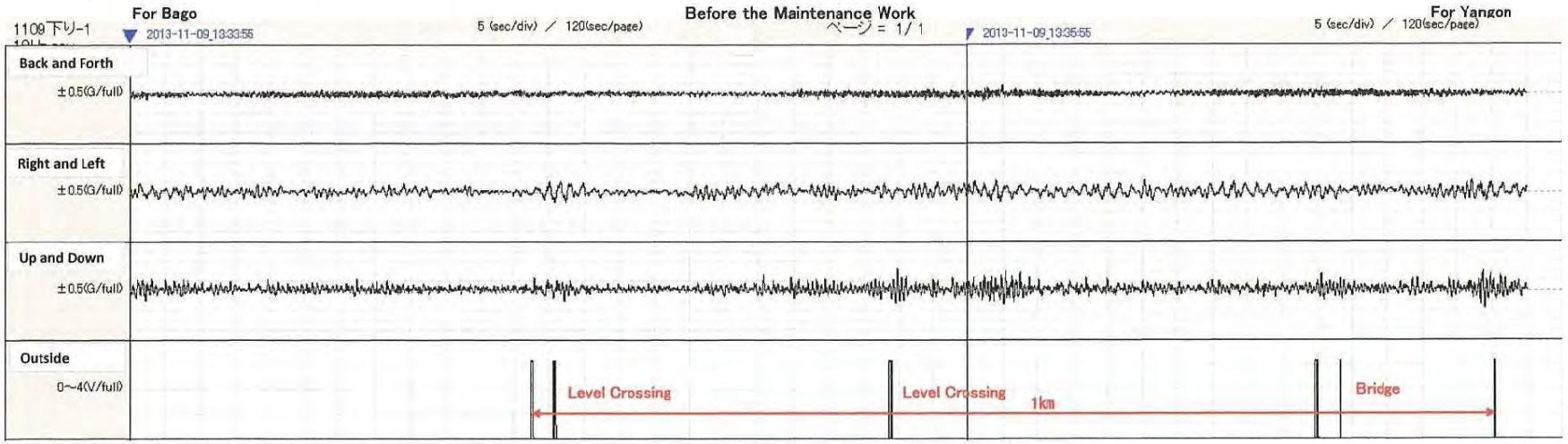




**Down Line 12k200m～13k450m,**

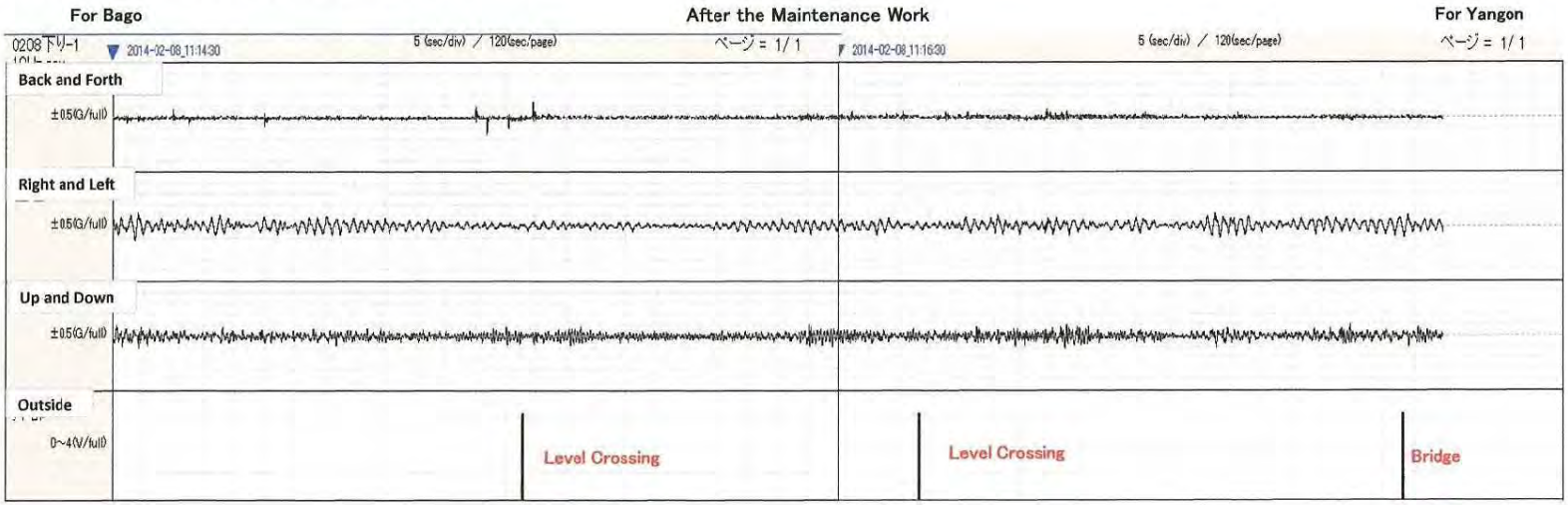
**Comparison of Longitudinal Level Before and After the Maintenance work**

Comparison of Vehicle Vibration Acceleration Before and After the Track Maintenance Work (Down Line 12k200m～13k500m)

2013/11/9 Down Line Speed 28km/h、Horizontal axis 1scale :5seconds (39m)




2014/2/8 Down Line Speed 20km/h、Horizontal axis 1scale:5seconds(28m)



## 7. Implementation Plan for the Next Stage

### 7.1 Recommendation of technical standards relating to administrative and maintenance aspect and drawing up railway facilities improvement plan to improve service and safety level

As described in the section 6.1, we are now in the middle of Step 3.
We will complete the Step 3 by March 7, 2014.
From now on we will continue our activities according to Table 3.1 as given below.

(1) Recommendation on technical standards for service and safety, and drawing up railway facilities improvement plan

After the completion of Step 3 mentioned in the section 6.1, JICA experts will 1) propose recommendation on technical standards for safety and improvement of service level, and 2) prepare railway facilities improvement plan through discussion with Working Group for Service and Safety Improvement, based on the results obtained thorough discussion in Step 3, around September 2014. These proposal and improvement plan should be thoroughly confirmed by MR experts. Then the finalizing discussion on these proposal and improvement plan is planned to be held around December, 2014.

(2) Education in Japan

Around October 2014, 11 trainees relating to management, operation, and maintenance in safety and service level improvement aspects will be invited to Japan for two weeks. Concrete proposals should be subject to determination through consultation with MR.

### 7.2 Technology transfer of track maintenance technology to improve the level of service and safety through implementation of the Pilot Project

74 kinds of equipments/tools from Japan have already arrived in Myanmar. But we haven't used all equipments/tools yet. We are planning to use all equipments/tools in the remaining training schedule. We are thinking that for effective technology transfer of track maintenance, all equipments /tools provided by JICA should be used by MR workers and we are arranging the training program so that they should draw up track maintenance plan by themselves. In order to ensure safe and smooth train operation on the track, MR should allocate more maintenance budget.

## Appendix

## Appendix-1 PDM

### 1.1 Latest version

The original PDM is given as Annex 1 of Record of Discussion (R/D) signed on March 25, 2013 between the Managing Director of MR and General Manager of JICA Office in Myanmar.

It was modified as given in Table 6.1 of Chapter 6 of the Inception Report, which is shown below.

### 1.2 Essence of modification of original PDM

Essence of modification is given in below.

Mainly the description of 「Objectively Verifiable Indicators」 and 「Means of Verification」 corresponding to 「Overall Goal 」 and 「Project Purpose」 are modified. The modified descriptions are shown in Table 6-1. The reasons for modification are given as follows.

(1) Overall Goal : Objectively Verifiable Indicators

① Number of annual accidents

Because (a) the Pilot Section is rather short, only 20km, accordingly rehabilitation of track is limited in length, (b) the rehabilitation/modernization of various railway facilities on the Yangon-Mandalay line is not made clear, accordingly it may be difficult to show how much the accidents caused by the deteriorated railway facilities can be reduced, and (c) number of accidents fluctuates considerably year to year mainly due to weather conditions, quantitative expression for reduction of accidents is avoided.

② 「Reduction of Number of Limited Speed Locations」, 「Improvement of Journey Speed」, 「Improvement of Punctuality of Train Operation」

Without the modernization of signaling systems, it may be difficult to raise the train speed, while ensuring the train operation safety. Accordingly 「Reduction of Number of Limited Speed Locations」, 「Improvement of Journey Speed 」, and 「Improvement of Punctuality of Train Operation」 are adopted as evaluation items, and also quantitative expressions are avoided.

(2) 「Overall Goal : Means of Verification」,
「Project purpose : Objectively Verifiable Indicators」, 「Project Purpose : Means of Verification」

The meanings are not changed, but the description is modified as given in Table 6-1.

(3) Others : Counterpart Training in Japan

Number of trainees is increased.

- Railway Institutional Management Improvement : 11persons×2weeks
- Track Maintenance : 11persons ×2×2weeks

# Table 6-1 Modification of PDM (Incepition Report)

Annex 1
PDM

Project Design Matrix
The Project on Improvement of Service and Safety of Railway
Excuting Agency:Myanma Railway(MR) ,Ministry of Rail Transportation

Project Implementation Period : 2013 to 2015
Project Site: Yangon (24months)

| Narrative Summary | Objectively Verifiable Indicators | Means of Verification | Important Assumption |
|---|---|---|---|
| Overall Goal<br>Service and safety level of Myanma Railways is improved. | ①Number of annual accidents on Yangon-Mandalay line decreases compared with the pesent and past records.<br>②Number of speed ristricted locations on Yangon-Mandalay line decreases compared with their present number.<br>③Journey speed on Yangon-Mandalay line increases compared with the present journey speed.<br>④Punctuality of express passenger trains on Yangen-Mandalay line is improved compared with the present situation.<br>⑤Satisfaction level of clients is enhanced.<br>⑥Number of passenger | ·Statistics on safety<br>·Roporting of accidents cause analysis and discussion of countermeasures are executed.<br>·Satistics on operation<br>·Interview/questionnaires to clients<br>·Satistics on operation | |
| Project Purpose<br>Administration and maintenance ability is improved for the enhancement of sevice and safety of Myanma Railways. | ①Accident cause analysis and countermeasures to prevent the similar accidents, and means to improve service levels are established and executed ,and inherited by MR<br>②Administrative and managerial capacity of track maintenance is improved and improved level is kept by MR | ·Reflection on organization,management/ operation rules,facilities renewal plans<br>·Utilization,modification of administration management manuals<br>·Actual results of maintenance execution, such as the record of maintenance | ·Administration staff members are not relocated drastically<br>·Technical staff members are not relocated drastically |
| Output | | | |
| 1. Issues are clarified for the enhancement of service and safety in the administration and maintenance process, and the improvement plan is drawn. | 1-1 System for collecting information of track, rolling stock, signal and communication, and operation is established.<br>1-2 Safety issues are listed based on the investigation and analysis of cause of accident.<br>1-3 Service issues are listed.<br>1-4 Service and safety improvement plan is drawn so as to tackle the issues. | 1-1 Related management document(s) of System for collecting information<br>1-2 Listed issues<br>1-3 Listed issues<br>1-4 Service and safety improvement plan | ·The Government support to the Myanma Railways, especially financial support is secured. |
| 2. Technical capability is improved through emergency track maintenance to improve the level of sevice and safety. | 2-1 Technical transfers are made effectively at each measure (targeted numbers of technical staff 30 persons).<br>2-2 Working manual of emergency track maintenance is prepared.<br>2-3 Proper equipment and materials are procured both qualitatively and quantitatively.<br>2-4 Counterpart personnel acuired necessary proficiency through seminars(3 times), trainings(3 times) for technical improvement on the rail maintenance and others. | 2-1 Record of technical transfers<br>2-2 Set of Working manual<br>2-3 Inventory list of equipment and materials<br>2-4 Record of seminar and training | |

# Table 6-1 (continued) (Inception Report)

Annex 1

| Activities | Input (Japanese side) | Input (Myanmar side) | Preconditions |
|---|---|---|---|
| **1. Preparation of Railway Service and Safety Improvement Plan**<br>1-1 To conduct current situation survey regarding track, rolling stock, signal and communication, and operation, and establish system for collecting information.<br>1-2 To promote familiarization on the investigation and analysis method of accident cause based on the comprehensive factors of track, rolling stock, signal and communication, and operation.<br>1-3 To coinduct the investigation and analysis mentioned above.<br>1-4 To provide recommendation based on above analysis on necessary technical standards to improve service and safety level.<br>1-5 To draw the improvement plan of railway facilities through discussion with the "Working Group for service and safety imprivement(tentative name) "<br>**2. Enhancement of Technical Capabilities of Track Maintenance**<br>2-1 To draw the technology transfer plan.<br>2-2 To procure the necessary equipment and materials.<br>2-3 To conduct emergency track maintenance.<br>2-4 To summarize betterment point(s) obtained during emergency track maintenance operation, and to feedback to the successive measures.<br>2-5 To draw the working manual of emergency track maintenance.<br>2-6 To conduct seminars, trainings for technical improvement on the rail maintenance and others. | **1. Dispatch of Japanese Experts**<br>Fields of Experts(several person)<br>-Railway OM improvement<br>-Technical Standards<br>-Track Maintenance<br>-Procurement of Equipment and Materials/Project Coordination<br><br>**2.Counterpart training in Japan**<br>-Railway Institutional Management Improvement: 11person ×2weeks<br><br>-Track Maintenance:<br>22person (11p×2×2weeks)<br><br>**3.Equipment**<br>Necessary handy equipment of emergency track maintenance, such as Tie Tamper.<br><br>**4.Expense**<br>-For research, travelling, training, the other activities for Japanese experts | **1. Assignment of Counterpart**<br>-Project Drector: 1person<br>-Project Manager: 1person<br>-Railway Polocy/OM Improvement: 1person<br>-Rail Maintenance: 1person<br>-Procurement of Equipment and Materials: 1person<br>-Others: As approproate<br><br>**2.Provision of facilities for the Project implementation:**<br>-Project office (in the Myanmar Railways, Lower Myanma Regional Office)<br>-Working tools and furniture for Project Office<br>-Internet connection in the Project office<br><br>**3.Joint Coordination Committee(JCC)**<br>-Establishment of JCC<br><br>**4.Expense**<br>-Local cost for personnel<br>-Cost for office rent and quipment.<br>-Expense for the pilot project,such as gravels,sleepers,rail materials and others.<br>-Other expenses:<br>For research,travelling,training,the other activities for counterpart personnel<br><br>**5.Others**<br>-Status guarantees of Japanese experts, ID card for access into the Myanma Railways properties.<br>-Access to the necessary statistical data and related information<br>-Other necessary local cost | Natural Disaster does not hit the railway facilities fatally. |

**Appendix-2** **Flow Chart of Project Implementation**

**As shown in Fig.2.1 of the main text.**

**Appendix-3** **Detailed Implementation Plan**

**As shown in Table 3.1, 3.2 of the main text.**

**Appendix-5** **Records of Training in Japan**

**As shown in the section 3.1.6 and 3.2.5(2)**

**①Railway Institutional management Program**

**11persons×2weeks, next October**

**②Track maintenance**

**11persons×2weeks ×Twice (Total 22 persons), next June**

**Appendix-6** **Records of Procurement of required equipments/tools**

**As shown in Table 3.3 of the main text.**

# Appendix-4 Records of JICA experts dispatching

| Assignment | Name | Belongs | 2013 | | | | | | | | | | | | 2014 | | | | | | | | | | | | 2015 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | |
| Leader/ Track maintenance | Sadaaki KURODA | JIC | 6/25 | 7/10 | | 8/25 | 9/8 | 10/20 | 11/3 | 1/12 | 1/18 | 2/8 | (3/10) | (5/16) | (5/30) | | | (8/20) | (9/3) | (10/15) | (10/31) | (11/15) | (12/1) | | (2/16) | (3/4) | | | |
| Deputy leader/ Maintenance Planning | Nobuyuki MATSUO | JIC | 6/25 | 7/10 | 7/23 | 7/28 | 8/25 | 10/26 | 11/11 | 12/31 | 1/26 | 2/5 | 2/16 | (3/31) | (5/4) | (6/17) | | (7/25) | (9/7) | (10/15) | (11/15) | | (12/20) | (1/20) | | | | | |
| Operation Maintenance | Hiroshi KOMATSU | JIC | 6/25 | 7/13 | | 8/21 | 9/7 | 9/9 | 10/6 | 10/20 | 11/20 | 11/25 | 12/25 | 12/30 | 1/29 | 2/6 | (3/1) | (3/18) | (5/8) | (6/14) | (7/28) | (8/20) | (10/18) | (11/5) | (12/24) | (1/18) | (3/13) | | | |
| Procurement of equipment and material | Yuuichi TANIGUCHI | Sumitomo | | | 8/5 | 8/26 | 8/6 | 9/3 | 10/6 | 10/24 | 10/8 | 11/2 | 11/7・8・20-22・28-30 | 1/7・9-11 | | | | | | (10/1) | (10/30) | | | | | | | | |
| Signalling and Telecommunications | Ryuuhei MITANI | JIC | | | | | 9/2 | 9/8 | | | | 2/8 | (3/2) | | | | | | (9/1) | (9/15) | | | (1/5) | (1/19) | | | | | |
| Rolling Stock | Makoto ISHIKAWA | OC | | | | | 8/25 | 9/8 | | | | 2/8 | (3/10) | | | | | | (9/1) | (9/7) | | | (1/12) | (1/18) | | | | | |
| Track Maintenance | Masato WAKATSUKI | JIC | | | | | | 9/29 10/20 | 10/12 10/27 | 11/3 | 11/24 | 1/19 | 2/9 | (3/9) | (3/23) | (4/14) | (6/12) | | | (10/20) | (11/9) | | (1/5) | (2/18) | | | | | |
| Earth road bed | Kiyoshi MIYAMOTO | OC | | | | | 8/28 | | | | | 2/2 | (3/2) | | | | | | (9/1) | (9/12) | | | (1/5) | (1/22) | | | | | |
| Train operation | Hidaharu IGARASHI | JIC | | | | | 8/25 | 9/8 | | | | 2/8 | (3/10) | | | | | | (9/1) | (9/7) | | | (1/12) | (1/18) | | | | | |
| Coordination | Mitsuru TAKAMI | JIC | | 6/25 | 7/13 | 8/19 | 10/6 | | | | | | (3/20) | (4/5) | | | | | | | | | | (3/2) | (4/5) | | | | |
| Track Maintenance(2) | Hisayoshi MITSUI | NSG | | | | | | 9/29 10/22 | 10/13 11/17 | 12/22 | 1/4 | Planning | | | | | | | | | | | | | | | | | |
| Track Maintenance(3) | Shigenori TANAKA | NSG | | | | | | | 11/17 | 12/1 | | | | | | | | | | | | | | | | | | | |
| Track Maintenance(4) | Takashi ITO | NSG | | | | | | 10/20 | 11/3 | 12/1 | 12/22 | | | | | | | | | | | | | | | | | | |
| Railway Advisor | Mitsuo HIGASHI | JR East/JIC | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Appendix-7

# Minutes of Discussion

## 1st JCC for " The Project on Improvement of Service and Safety of Railway in Myanmar"

**1. DATE** 28 August, 2013 10:00am~12:00am

**2. PLACE** Meeting Room of Myanma Railway Head Quarter

**3. ATTENDANTS**

**3.1 Myanmar side**

**Myanma Railways**

| | |
|---|---|
| GM (Inspection) | Mr. Ba Myint |
| GM (Operating) | Mr.MyintWai |
| Deputy GM (Mechanical) | Mr. Thet Lwin |
| Deputy GM (Goods) | Mr. Thura Aung Myo Myint |
| Deputy GM (Civil) | Mr. Maung Maung Thwin |
| Deputy GM (Planning) | Mr.Htaung Sian Kan |

**3.2 Japan side**

**JICA** Transportation and ICT Division 1
Transportation and ICT Group
Economic Infrastructure Department Mr. K.Imia (Adviser), Mr.T.Chokki
JICA Southeast Asia Division 4
Southeast Asia and Pacific Department Mr.T.Kon(Adviser), Mr. A. Fukuyama
JICA Myanmar Office Mr. M.Morikawa(Project Fomulation Adviser)
JICA Expert Team Dr.S.Kuroda(Leader:Track maintenance),
Mr.N.Matsuo(Sub-leader:Maintenance Planning),
Mr.H.Komatsu(Operation maintenance),
Mr.Y.Taniguchi(Procurement of equipment and material),
Mr.K.Miyamoto(Track maintenance 2),
Mr.Ishikawa(Rolling Stock),
Mr.H.Igarashi(Train Operation),
Mr.M.Takami(Coordination),
JICA Railway management
Adviser Mr.M.Higashi
Observer JICA Study Team (MYT-PLAN) Mr.J.Shibata(Project Manager),
Mr.I.Numata(Train Operation)
Sumitomo Corporation Asia Pte.Ltd.NayPyi Taw Office
Mr.M.Yamato(General Manager)
**Interpreter** Mr.YeTunOo

**4. SUBJECT** Explanation and Discussion of Inception Report(IC/R)

**5. HANDOUTS** Inception Report(IC/R)

Power Point document for explaining Inception Report

Three kinds of letters

- JICA Expert Team Schedule until October
- Selection of the Pilot Section
- Additional Questionnaire

List of members of JICA Expert Team with face photos

**6. GREETING S BY JICA**

Before the start of explanation and discussion of IC/R, Mr.Chokki of JICA Headquarters gave an opening address and at the same time delivered the following comment and request for the Project.

(1). This Project is not a Yen loan project, but a technical cooperation project aiming at technology transfer.

(2). We should be grateful, if MR could kindly arrange smooth import of related equipments/tools from Japan, and prepare track materials such as rail, ballast etc.,necessaryfor track maintenance OJT in proper timing.

**7. MAJOR SUBJECTS**

**7.1 Presentation of IC/R**

IC/R was presented and explained by Dr.Kuroda , leader of JICA Expert Team, and it was accepted by MR in principle.

**7.2 The following three letters were explained by Dr.Kuroda.**

(1) The letter proposing the Pilot Section and requesting confirmation of it by MR

(2) The letter describing the working schedule of JICA experts in August, September and October and requesting the arrangements necessary for JICA experts activities.

(3) The letter requesting provision of relevant information requested by the additional Questionnaire.

**7.3 Major Points of discussion**

(1) **MR** : ① MR will be responsible for clearance of necessary equipments/tools to be provided by Japan side for the Project.

: ② MR has already prepared necessary track materials to be used for on-the-job training of track maintenance. JICA experts should make checking the ballast whether right size or not before start the project.

: ③ Working schedule of JICA experts in August, September and October has already been confirmed. MR will suitably deal with it.

(2) MR When was the vibration of vehicle running on the proposed Pilot Section measured?

**JICA Expert** : It was measured in March, 2013.

**MR :** In the period from March to August, any specific renewal work has not been executed, accordingly the measurement in March does not raise any specific problems.

(3) **MR:** JICA Expert Team is proposing the Pilot Section, and is requesting MR to confirm the proposal. Are there any possibilities to modify the proposal?

**JICA Expert:** Pilot Section is selected with due consideration on the kinds of track maintenance work technology to be transferred to MR staff. Difference of opinions between MR and JICA Expert Team , if any , can be adjusted in the first week of September , during which preparatory work such as driving in the posts is carried out.

**MR:** We would like to have the discussion in the first week of September on the location of the Pilot Section. JICA experts and MR staff will survey the proposed Pilot section together using the rail car.
At that time, please check the size of ballast.

**JICAExpert:** Please provide us with the specification of ballast.

**MR:** We will do.

**(4) MR:** Does proposed Pilot Section include both the up line and the down line?

**JICA Expert:** It includes both lines.

**(5) MR:** How many trainees will be involved in job training of pilot project?

**JICA Expert:** Members of gangs are planned to be trained.
Number of trainees will be about 30. With respect to details, we would like to discuss with MR. We are also planning to make use of the training center of MR.

**(6) MR:** Is welding work technology included in the kinds of maintenance work to be transferred to MR staff? We would like to get training of welding technology.

**JICA Expert:** Yes, it is included. Thermit welding is used by MR, so if the quality of Thermit welding used by MR has some problems, we will investigate the problems and make recommendations.

**(7 ) MR:** In the period of 1st week of September during which discussion on the location of the Pilot Section will be held , we would like to request JICA experts to examine the equipments/tools possessed by MR gangs.

**JICA Expert:** Yes, we do. As one countermeasure to improve rail joint portion, we would like to propose one design of fishplate of rail joint.

**(8) MR:** With respect to equipments /tools to be imported from Japan, tax and import license fee exemptions can be assured. Schedule of technology transfer of track maintenance has already been informed to the relevant track maintenance organizations. The answers to the Additional Questionnaire are being prepared and will be completed soon.

**(9) MR:** Which rail will be used in the pilot project, new or existing rails?

**JICA Expert:** It will be confirmed while implement the project.

**Nay Pyi Taw**

**Sept 5, 2013**

U Thurein Win
Managing Director
Myanma Railways

Dr. S.Kuroda
Leader of JICA Expert Team

Appendix 8-1

## Present Situations of Safety and Service Level of MR

1. Accidents (Safety Level)

1.1 Classification of Main accidents in MR

i) Collisions (including side collisions)
ii) Averted collisions (nearly collision such as neglect of signal)
iii) Level crossing accident
iv) Trains parting
v) Derailments between sections
vi) Derailments in station yards

1.2 Present Situations of accident in MR

(1) Number of accidents by kinds (per 1 million train-km)

1) Train-km

Train-kms of passenger trains and freight trains during the 5 years from 2008/2009 to 2012/2013are shown in Table 1.1-1.

Table 1.1-1 Train-kms of Yangon – Mandalay Line (unit = 1 million train-km)
(April – March)

| Year | 2008/2009 | 2009/2010 | 2010/2011 | 2011/2012 | 2012/2013 |
|---|---|---|---|---|---|
| Passenger train | 2.743062 | 2.764224 | 2.750661 | 2.757071 | 2.761762 |
| Freight train | 0.868153 | 0.864458 | 0.893531 | 1.309607 | 1.259473 |
| Total | 3.611215 | 3.628282 | 3.644192 | 4.066678 | 4.021235 |

2) Number of accident

Number of accidents by kinds and number of accidents per 1 million train-km for 2008/2009 to 2012/2013 are shown in Table 1.1-2

Table 1.1-2 Number of accidents by kinds (April – March)

| Year / Accidents by kinds | 2008/2009 | 2009/2010 | 2010/2011 | 2011/2012 | 2012/2013 |
|---|---|---|---|---|---|
| Train Collision | 1 | 1 | 1 | 1 | |
| Averted Train Collision | 2 | | | | |
| Accident on Level crossing | 7 | 10 | 4 | 16 | 11 |
| Train Parting | 82 | 32 | 45 | 41 | 7 |
| Derailment within Station | 62 | 39 | 33 | 51 | 30 |

| | | | | | |
|---|---|---|---|---|---|
| Yard | | | | | |
| Derailment between stations | 33 | 37 | 15 | 9 | 21 |
| Total | 187 | 119 | 98 | 118 | 69 |
| No. of accident par 1 million train-km | 51.783 | 32.794 | 26.892 | 29.016 | 17.159 |

(2) Analysis of Causes of Accidents

Frequency of accidents by kind of causes and by kind of accidents
(2012.4 - 2013.3)

| Kind of accident | Cause | Frequency | total |
|---|---|---|---|
| derailment | spread gauge | * * * * * * | 6 |
| | unbalance of cross level | * * * * * * * * * * * * * * * * * * * * * | 21 |
| | driver fault | * * * * * * * | 7 |
| | thin flange | * * | 2 |
| | unfix of tongue | * | 1 |
| | improper set of point | * * * | 3 |
| | axle coil broken | * * * * * | 5 |
| | side bearer nut broken | * * | 2 |
| | coil bracket broken | * | 1 |
| | perish of sleeper | * * | 2 |
| | crossing nose break | * * | 2 |
| | coil pin broken | * | 1 |
| | sinkage of track | * | 1 |
| | side bearer decfect | * * | 2 |
| | master plate broken | * | 1 |
| | low joint of track | * | 1 |
| | less center pivot oil | * | 1 |
| | pointmen fault | * * * * * | 5 |
| | unmatched of rail | * | 1 |
| | booster coil broken | * * * | 3 |
| | spread of axle | * | 1 |
| | capping of point | * | 1 |
| | | | 70 |
| train parting | defective of lock lifter | * | 1 |
| | defective of knuckle | * | 1 |
| | defective of coupling | * * | 2 |
| | low joint of track | * * * | 3 |
| | defective of center pivot pin | * | 1 |
| | weakness of suspension coil | * | 1 |
| | | | 9 |
| level crossing | careless of car driver | * * * * * * * * * * * | 11 |
| | | | 90 |

Note: * indicates that this accident was caused not by a single cause but jointly with another cause.

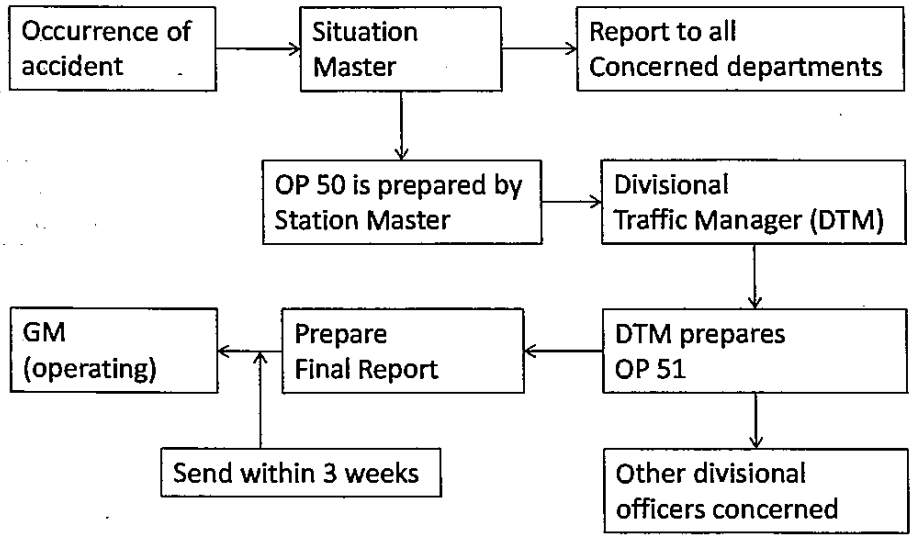
1. With respect to derailment, gauge enlargement, cross level irregularity (twist), improper set of point are the major causes relating to track.
   Relating to vehicle, axle coil broken, booster coil broken are the major causes.
   Relating to handling procedure, driver fault and pointmen fault are the major causes.
2. With respect to train parting, low joint of track and defective of coupling are the major causes.
3. With respect to level crossing accidents, careless of car drivers are causes of all accidents.

(3) Details of Some accidents

Details of Accident No. 40, No.54

| No. | The Date of Occurrence | Location of Occurrence | Kind of Accident | Estimated Cause | Major Damages | Countermeasures Taken |
|---|---|---|---|---|---|---|
| 1 | 4.10.2012 (No. 40) | Yepale – Hanza 11 Up | Train Parting | Weakness of suspension coil<br><br>Low Joint of track due to the weakness of packing under the sleeper at rail joint | A little | Replaced the coil springs which have standard stiffness, At every periodical overhaul, all the coil springs are checked for the standard stiffness. Coupler and underframe heights are checked.<br>Uplift of rail joint and well packing under the sleeper. Civil department have the insufficient of employees problem. |
| 2 | 29.12.2012 (No.54) | Minsu – Kywese 23 UP | Derailment | Bolster Coil Broken.<br><br>Underblance of cross level due to the weakness of packing under the sleepers | Empty | As the prompt response, the coach was checked, not only the body, but also the bearings. The defects were corrected. If the coach is fit to run, it is put into service, If it is required, it is dispatched to workshop for further checking.<br>Recheck the level of adjacent rails. Repaired the cross level of track and well packing under the sleeper. Civil department have the insufficient of employees problem. |

1.3 Record and reporting of accidents




Questions: OP 50 is for minor accidents.

How about for major accidents?

1.4 Examples of OP50, OP51 and Final Report in English

1.5 MR has the following General rules, subsidiary rules, working manuals, operation manuals regarding train operation and accident.

- General Rules Part I & II together with Subsidiary Rules of Burma Railways
  Chapter III Working for Trains General
  Chapter IV Accidents

1.6 Organization and system in MR to handle with establishment of countermeasures for prevention of accidents or improvement of service level.

1.6.1 Operating department performs the following function for prevention of accidents.

(1) To issue the general rules, subsidiary rules and instructions when required.

(2) To analyse the trends of accidents and suggest remedial measures.

(3) To carefully study the Accident Enquiring Report and follow up the execution of recommendations.

(4) To monitor the progress of safety work by respective divisions.

(5) To provide safety equipment according to rules and instructions.

(6) To ensure training and eye test for staff relating to safety of train operation.

1.6.2 Others

(1) Accident cause analysis and countermeasures

Anti-accident team led by GM (Operating) has to investigate accident causes, identify the problem, and establish prevention measures. The team carries out detail action and assigned the relevant work to respective division.

(2) Concerning train accident, train delay, speed restriction and abnormal train vibration, the station master shall send all concerned messages to the section control centers and the central control center. The central control center shall send information to Managing Director and General Manager (operating) at head office.

(3) There is a general instruction regarding train operation control against the severe weather conditions (heavy rain fall, strong wind etc.). However there is no specific train operation control against the heavy rain fall or strong wind expressed quantitatively.

2. Service Level

2.1 Delay of train operation

2.1.1 Definition and classification of train delay

All trains which do not arrive at stations at the time specified in Time Table is defined as "delayed train". (Train diagram includes substantial amount of surplus time) Ddelay of train is classified as follows.

(a) 1 to 10 minutes (Group A)
(b) 11 to 30 minutes (Group B)
(c) 31minutes to 1 hour (Group C)
(d) 1 hour to 3 hours (Group D)

(e) Over 3 hours (Group E)

(f) Train cancellation (Group F)

2.1.2 Present situations of delay of express trains at terminals (Yangon, Mandalay, Nay Pyi Taw) on Yangon – Mandalay Line

Delay time of train (only for express passenger trains)

Number of delayed trains, punctuality of train operation, distribution of delay time of express passenger trains at terminals (Yangon、Mandalay、Nay Pyi Taw) are shown in Table 1.1-3

Table 1.1-3 Delay of trains (2012.8～2013.7)

| Section | Distance (km) | Number of operated train (A) | Number of delayed train (B) | Punctuality (1-B/A) % | Delay time | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1～10 min. (C) | 10～30 min. (D) | 30 min.～1h (E) | 1h～3h (F) | more than 3h (G) | Average value (*) |
| Yangon - Mandalay or Mandalay - Yangon | 620 | 2184 | 688 (1496) (**) | 68 | 6 | 197 | 259 | 193 | 33 | 65 min./ train |
| Yangon - Nay Pyi Taw or Nay Pyi Taw - Yangon | 375 | 1454 | 102 (1352) (**) | 93 | — | 62 | 7 | 28 | 5 | 57 min./ train |

(*) Calculation method of average value

Assuming the average of (C) as 5minutes, that of (D) as 20 minutes, that of (E) as 45 minutes, that of (F) as 2h, and that of (G) as 3h, the average value was calculated.

(**) Number of punctual trains

2.1.3 Analysis of causes of train delay

## Causes of Delay

(Epress Train on Yangon-Mandaly Line April 2012/ March 2013)

| No. | Cause | No. of occurrence | Remark |
|---|---|---|---|
| 1 | Coach damage | 26 | |
| 2 | Locomotive damage | 9 | |
| 3 | Pilot | 6 | |
| 4 | Locomotive filled water | 2 | |
| 5 | Lovomotive exchange | 1 | |
| 6 | Wait for other train accident | 1 | |
| 7 | Electrical cut off | 1 | |
| 8 | Wait for other train | 1 | |
| 9 | Attched by coaches | 1 | |
| 10 | Point damage | 1 | |
| | Total | 49 | |

1 Coach damages are dominant causes of express train on Yangon-Mandalay Line
2 Locomotive damages and pilot damages rank as the 2nd and 3rd largest causes of train delay

2.1.4 Example of details of some delay

(Delay No.9 and No.20)

| No. | Date | Train No. | Station (Major Stations Only) | Delayed Time | Cause of Delay | Countermeasures Taken |
|---|---|---|---|---|---|---|
| 1 | 31.7.2012 (No.9) | 6 DN | Thazi | 1:17 | Coach Damages<br>BDTEZ-12214<br>Wheel No.5 & 6<br>Roller Bearing Seized | Remove the damaged coach from train set and continued trip. The damaged wheels set were replaced with new ones by Thazi C&W Exaimers.The wheel sets have been inspected at Myitnge Workshop. Ultrasonic flaw detecting was done on each wheel set. Radial clearance of bearing is checked after fitting the roller bearing on joumal of axle. The temperature of axleboxes of all coaches are monitored at the end terminal. |
| 2 | 30.8.2012 (No.20) | 12 DN | Taungoo | 6:30 | Locomotive Damages<br>Taungoo – Thaungdaingone<br>Mile Post 165/7-8<br>Locomotive No.DF-1318<br>Traction Motor No. (6)<br>Ball Bearing Seized | Replaced with another locomotive and continued trip. The damaged traction motor was removed in Taungoo Shed and sent to Insein Locomotive Workshop. Inspections will done and the bearing was refitted. After fitting, the bearing is checked fro proper fitting and functioning |

Civil Engineering Department

Yangon – Mandalay Line, delay of Express Passenger Trains (2012 – 2013)

Item No. 9, 31.7.2012, 6DN, Thazi, (Details of Delay No.9)

Cause of train delay responsible by Civil Engineering Department and counter measurement

| Item | Cause of Delay | | Time | Coutner measurement |
|---|---|---|---|---|
| 1 a | Permanent caution | 3 Nos | 00':06" | cannnot able |
| b | Caution of bridge repairing | 1 Nos | 00':05" | reparing of bridge as quick as possible |
| c | Mobile team's track repairing work | 5 Nos | 00':39" | repairing of track as quick as possible |
| 2 | Due to the coach damage | | 01':17" | |

2.1.5 Compensation to passengers due to delay

Myanma Railways doesn't make any compensation to passengers for delay. According to the instruction of Commercial Department, sometimes Myanma Railways refund to passenger who bought ticket, for train cancellation by accident, coach damage and weather etc.

2.1.6 Current time table of Yangon – Mandalay express passenger trains

Express passenger train of Yangon – Mandalay line in 2012/2013.

| 4DN | 6DN | 12DN | 32DN | 8DN | Statin | 7Up | 31UP | 3Up | 5UP | 11Up |
|---|---|---|---|---|---|---|---|---|---|---|
| 0915 | 0630 | 2230 | 1800 | 0530 | Yangon | 2030 | 0800 | 1700 | 1500 | 0600 |
| 0713 | 0428 | 2022 | 1558 | 0337 | Bago | 2226 | 0956 | 1856 | 1651 | 0756 |
| 0710 | 0425 | 2019 | 1555 | 0334 | | 2229 | 0959 | 1859 | 1654 | 0759 |
| 0217 | 2357 | 1527 | 1102 | 2251 | Taungoo | 0315 | 1448 | 2354 | 2125 | 1254 |
| 0207 | 2347 | 1517 | 1059 | 2248 | | 0318 | 1451 | 0004 | 2135 | 1304 |
| 2319 | 2059 | 1219 | 0800 | 2000 | Naypyitaw | 0600 | 1800 | 0240 | 0010 | 1549 |
| 2316 | 2056 | 1216 | | | | | | 0243 | 0013 | 1552 |
| 2001 | 1756 | 0906 | - | - | Thazi | - | - | 0554 | 0309 | 1858 |
| 1958 | 1753 | 0903 | | | | | | 0557 | 0312 | 1901 |
| 1700 | 1500 | 0600 | - | - | Mandalay | - | - | 0915 | 0630 | 2230 |

2.2 Sanction speed by sections, location of restricted speed, journey speed

2.2.1 Sanction speed and restricted speed

Sanction speeds by sections and the locations of speed restriction which were informed by MR in August, 2013 are shown in Table 1.1-4.

Sanction speeds by sections are determined jointly by Operating Dept and Civil Engineering dept. Major factors deciding the sanction speeds by sections are defective of track, and defective of facing points.

Table 1.1-4 Section Speed and Speed Restriction on Yangon- Mandalay Line

(2013-2014)

| Station | Dist km | accumulated distance | ection Speed | | Reason of speed Restriction |
|---|---|---|---|---|---|
| | | | Up | Down | |
| Yangon | 0 | | 16 km/h | 16 km/h | Due to Diamond crossing and crossing of Circular Railway Line and Main Line Auto Signal |
| Pazundaung | 1.6 | 1.6 | 40 km/h | 40 km/h | |
| Thingangyun | 5.5 | 7.1 | 64 km/h | 64 km/h | |
| Kawche | 35 | 42.1 | 72 km/h | 64 km/h | |
| Payagyi | 49 | 91.1 | 64 km/h | 64 km/h | |
| Thaungdainggon | 167 | 258.1 | 56 km/h | 56 km/h | |
| | | | 32 km/h | | Br. No. 263 Using gunletted track on single truss |
| Taungoo | 7 | 265.1 | 8 km/h | | Mile 181/1-2 Br. No. 290 up At Bed Block Crack |
| | | | 56 km/h | 56 km/h | |
| | | | | 8 km/h | Mile 166/7-5 DN: Fibre cable Earth Work |
| Thagaya | 47 | 312.1 | 67 km/h | 67 km/h | |
| Yeni | 17.5 | 329.6 | 64 km/h | 64 km/h | |
| Ywadaw | 37.4 | 367 | 48 km/h | 48 km/h | |
| Kyidaunggan | 8.35 | 375.35 | | 40 km/h | Mile 250/20-6 DN: Poor Track Condition |
| | | | 64 km/h | 48 km/h | |
| Yamethin | 62.5 | 437.85 | 68 km/h | 48 km/h | |
| Shweda | 12.3 | 450.15 | 48 km/h | 48 km/h | |
| Pyawbwe | 8.35 | 458.5 | 48 km/h | 68 km/h | |
| Nwarhtoo | 23.4 | 481.9 | 64 km/h | 68 km/h | |
| Hanza | 21 | 502.9 | 68 km/h | 64 km/h | |
| Samon | 21.4 | 524.3 | 64 km/h | 68 km/h | |
| Thabyedaung | 11.5 | 535.8 | 68 km/h | 68 km/h | |
| Kume Road | 8.35 | 544.15 | 68 km/h | 64 km/h | |
| Myohaung | 65.6 | 609.75 | 48 km/h | 24 km/h | Br. No. 829 Using gunletted track on single truss |
| | | | 48 km/h | 48 km/h | |
| Mandalay | 4.3 | 614.05 | | | |

2.3 Journey speeds

Journey speed of Yangon – Mandalay express passenger trains calculated based on the time table on that line in 2012/2013 are shown in Table 1.1-5.

Table 1.1-5 Journey speed of express passenger train Yangon – Mandalay Line

| Section | Train No. | Travel time (A) | Running distance (km) (B) | Jourey speed (km/h) (B/A) | Average value |
|---|---|---|---|---|---|
| Yangon - Mandalay | 4DN | 16h 15min | 620.4 | 38.2 | 38.6 |
| | 6DN | 15h 30min | | 40 | |
| | 12DN | 16h 30min | | 37.6 | |
| | 3UP | 16h 15min | | 38.2 | |
| | 5UP | 15h 30min | | 40 | |
| | 11UP | 16h 30min | | 37.6 | |
| Yangon - Nay Pyi Taw | 32DN | 10h 00min | 374.9 | 37.5 | 38.5 |
| | 8DN | 9h 30min | | 39.5 | |
| | 7UP | 9h 30min | | 39.5 | |
| | 31UP | 10h 00min | | 37.5 | |

2.4 Satisfaction level of passengers

Based on the annex "Guideline for Interview Survey", interview survey will be carried out, and the results will be suitably analyzed.

2.5 Annual passengers number

Total number of passengers on Yangon – Mandalay Line during the 5 years from 2008/2009～2012/2013are shown in Table 1.1-7.

Table 1.1-7 Total number of passengers on Yangon – Mandalay Line

| Year | 2008/2009 | 2009/2010 | 2010/2011 | 2011/2012 | 2012/2013 |
|---|---|---|---|---|---|
| No. of Passengers (1000) | 11,930 | 11,877 | 12,203 | 13,600 | 9,035 |

2.6 Riding comfort

MR has never measured train vibrations. Track irregularities are measured by track geometry measuring trolley

Question: Kindly explain details of track geometry measuring trolley.

2.7 Various matters relating to service level

(1) Regarding train delays, with respect to reporting to the headquarters, analysis of causes, identification of problems and countermeasures, every division and head office of MR hold operating meeting daily. Officers of all concerned department must attend with particulars of

action take by concerned department. The operating department of MR is in charge of these matters.

(2) Many speed restrictions are caused by track problems. At present Yangon – Mandalay track line ahs been substituted by PC sleepers and damaged turnout are being renewed. But there is a need to fill the ballast as per specification. Another major cause of speed restriction is due to bridges. Some bridges are constructed in pre-war and some foundations are under repair. To delete the speed restriction, Civil Engineering Department is trying to repair the track and bridges according to the budget allowance. All of speed restrictions and countermeasures are recorded in all concerned departments.

(3) Regarding improvement of riding comfort (reduction of train vibration, cleaning inside of passenger cabin), with respect to reporting to the headquarters, clarification of causes of vibration, identification of problems, establishment of countermeasures, Civil Engineering and Mechanical Department of MR have to be responsible. Civil Engineering Depot is in charge of the matter in total.

(4) To improve railway facilities of Yangon – Mandalay line in 2013 – 2014 and in 2014 – 2015, MR laid down the following plan , in order to shorten travel time of express passenger train between Yangon and Mandalay.

- Removing of short rail having joints.
- Replacing of ballast and adjusting rail gap.
- Welding of short rails.
- Changing and repairing point and crossing.
- Sand blanketing for bed soil formation.
- Heavy repair from section to section.

One hour will be shortened by that pain.

Appendix 8-2

**Procedure of Training Program of Cause Analysis of Accidents/ Low Service Level and Establishment of Countermeasures Project on Improvement of Service and Safety of Railway in Myanmar**

1. **Purpose:**

As one of the activities of technical supporting project, namely "Project on Improvement of Service and Safety of Railway in Myanmar", Training Program, of which purpose is to guide MR staff to and make them be familiarized about the technique to analyse the cause of accidents and low service levels, and establishment of countermeasures, will be held jointly by the MR and JICA. Also through the Workshops to be held as one part of Training Program, a sustainable clue to approach and solve the problem of MR will be found.

2. **Participants:**

Approximately 20 experts of managers level (Track maintenance, Civil works, Signaling, Rolling stocks and Train Operation) of Divisions or Head office in MR and divided into 4 groups of 5 people.

3. **Place :**

Designated by MR

4. **Timing and tentative schedule:**

From the middle of February to the beginning of March, 2014. Refer to the attached schedule table.

The whole training program consists of there parts. The first part is class room lecture of the text book prepared by JICA experts. The second one is workshop. The third one is training of vibration measurement of rolling stock. Detailes of each part is explained below.

Further it should be mentioned that interview survey to investigate the customer's satisfaction level of MR's passenger transport will be conducted following the training program.

5. **Procedures of Training Program**

Training program will be carried out from Feb.10 to Feb.28.

The first day of training program (Feb. 10) will be allotted for the opening ceremony, introduction of participants (MR and JICA experts), and orientation of the whole training program. The first day will also include the presentation of analysis of the present situation of

safety and service level of MR by JICA expert.

Class room lecture of the text book will be held form Feb.11 to Feb. 21 between 9:00 – 12:00 in the morning. Workshop will be held from Feb. 11 to Feb.24, mainly between 14:00 – 16:00 in the afternoon. Training of rolling stock vibration measurement will be implemented from Feb. 25 to Feb. 2 8 . The afternoon of the last day of the training program (Feb. 28), will be allotted for the closing ceremony.

**5.1 Class room lecture of text book**

JICA experts explain, based on the text book, about the past accidents and countermeasures in the world mainly in Japan (for examples, derailment, train collision, level crossing, natural disaster and so on), and introduce the measures for improvement of the service level (for examples, increasing train speed, punctuality, riding comfortabilities, train protections and so on). The text book contents are as follows.

<Text book Contents>

Forewords (MR side and Japanese side)

1. Safety
   - 1.1 Introduction of Accidents Prevention and Research organization in the world railway
   - 1.2 Past accidents and Countermeasures
     - 1.2.1 Collision
     - 1.2.2 Derailment
     - 1.2.3 Level crossing
     - 1.2.4 Natural Disasters
     - 1.2.5 Train Fire
2. Bottom up of Service Level
   - 2.1 Speed-up
   - 2.2 Prevention for Level Crossing Accident
   - 2.3 Punctuality
   - 2.4 Comfortability
   - 2.5 Customer Satisfaction

Afterword

It should be stressed that the lecture given by the JICA experts should be fully discussed among MR experts and JICA experts.

## 5.2 Workshops

(1) The purpose of the workshop

The purpose of the workshop is to make MR experts be familiarized with analysis of causes of accidents and low service levels and establishment of countermeasures through making MR staff themselves analyse the causes of actual accidents or low service levels of MR and making themselves establish suitable countermeasures.

In this regard, 16 items relating to accidents and low service levels (train delay and speed restrictions) will be selected from the actual MR's events in 2012/ 2013, and MR experts by themselves try to analyse the causes and to establish the appropriate countermeasures. 16 items to be selected are as follows.

a. Accidents: 10 items

-Derailment (on main line and siding track), each 3 items

-Level crossing, 2 items

-Train separation, 2 items

These 10 items should be selected from Table 1 Yangon – Mandalay line train accidents (2012 – 2013)

b. Service improvement (Train Delay): 3 items

These 3 items should be selected from Table 2 Yangon – Mandalay station Express Passenger Train Delay (2012/ 2013), with due consideration on kind of causes and magnitude of delay time.

c. Service improvement (Speed Limited): 3 items

3 speed restriction locations should be selected from Table 3 Section speed and Speed Restriction on Yangon – Mandalay Line (2012/ 2013).

(2) Presentation of reports by MR experts and discussion

16 items mentioned in (1) above, will be allotted to 4 groups evenly, namely 4 items per one group, and each group will prepare 4 reports for 4 items allocated to him namely one report for each item respectively. The report should describe the outlines of each item, causes analysed and countermeasures established as much as in detail.

In preparing the report, Format A should be used for the report of accident items, Format B for train delay, and Format C for speed restriction.

Each group should present the 4 reports in charge one by one (one report for half of the afternoon,namely about one hour). In presentation of the report, full discussion is expected between the presentators and the remaining MR experts and JCA experts

(3) On the Feb. 21, MR experts (any group) are requested to report the current situations of procedure/ systems/ organizations of reporting (from the field to the Head Quarter), cause analysis (accidents and low service level), establishment of countermeasures, practiced in MR. These matters should be fully discussed among MR experts and JICA experts.

(4) Presentation by MR experts about the following:

"Improvement of technical standards, relating to administration and maintenance aspect to improve safe and service level of MR"

As given in the Inception Report, JICA experts should make a recommendation on technical standards relating to administrative and maintenance aspect to improve safe and service level of MR.

In order for JICA experts to fulfill their duty, their recommendation on technical standards should be prepared with due consideration on MR experts' opinions and ideas.

In this context, if MR experts by themselves try to make some recommendation on the current technical standards of MR, these opinions and ideas will effectively contribute to JICA experts fulfillment of duty. At the same time, such effort by MR experts by themselves will contribute to raising up their administrative and maintenance capability for ensuring safe and good service level of MR.

In this regard on the last day of the workshop namely on Feb. 24, MR's experts (any group) are requested to present a report containing

"Recommendation on technical standards of MR relating to administrative and maintenance aspect to improve the safe and service level of MR"

(5) Closing ceremony

In the afternoon of Feb. 28, closing ceremony will be held, where certificates of completion of training program will be handed over to each participant of MR, and speaches from MR side and JICA side will be delivered.

### 5.3 Practices for Measurements of Train Vibrations

Targeted for several participants in charge of Track maintenance, rolling stocks and someone interested, JICA experts will instruct measurement and analysis of actual Train Vibrations on Feb. 25, 26 ,27 and 28th. Practices will be implemented by using the device [UHA-3 Type ]. Practices will include 1 ) how to use the device to measure the vibration and how to analyses the measured data, 2) measurement of actual MR's express train, and 3) analysis of the measured data.

## 6. Investigation on Customer Satisfaction Level

After implementation of the training program, interview survey to investigate customers

satisfaction level of MR's passenger train will be carried out from March 3 (preparing meeting) to March 7. The details of the procedure for interview survey are described in the document "Guideline for Investigation on Customers Satisfaction Level"

Table: Tentative Schedule

| Date | Hour | Contents | Note |
|---|---|---|---|
| Mon. 10 Feb. | AM | Opening Ceremony<br>-Greeting from MR side and Japanese Side<br>-Introduction of MR Participants and JICA Experts<br>Orientation | |
| | PM | Orientation continued as required<br>Analysis of the Present Situation of Safety and Service Level of MR<br>Lectured by Dr. S. Kuroda | |
| Tue. 11 Feb | AM | Derailment Accident in Japan and Discussion on Derailment:<br>Lectured by Mr. KURODA | |
| | | Derailment Accident in Japan :<br>Lectured by Mr. MIYAMOTO | |
| | PM | Workshops: Derailment 2 items | |
| Wed. 12 Feb | | National holiday | |
| Thu. 13 Feb | AM | Rolling stocks accident : Lectured by Mr. ISHIKAWA<br>Level crossing accidents : Lectured by Mr. MITANI | |
| | PM | Workshops: Derailment 2 items | |
| Fri. 14 Feb | AM | Natural disasters :<br>Lectured by Mr. TAKAMI | |
| | PM | Workshops: Level Crossing 2 items | |
| Sat. 15 Feb | | Holiday | |
| Sun. 16 Feb | | Holiday | |

| Date | Hour | Contents | Note |
|---|---|---|---|
| Mon. 17 Feb. | AM | Brake systems on rolling stocks<br>Lectured by Mr. ISHIKAWA | |
| | | Train Protection System<br>Lectured by Mr. MITANI | |
| | PM | Workshops: Train separation 2 items | |
| Tue. 18 Feb | AM | Prevention for Accidents<br>Lectured by Mr. IGARASHI | |
| | | Measures for speed up on Track side:<br>Lectured by Mr. KURODA | |
| | PM | Workshops: Train delay 2 items | |
| Wed. 19 Feb | AM | Measures for Punctualities on track side :<br>Lectured by Mr. MIYAMOTO | |
| | | Measures for Riding Comfortabilities on track side:<br>Lectured by Mr. MIYAMOTO | |
| | PM | Workshops: Train delay 1 item and Speed limited 1 item | |
| Thu. 20 Feb | AM | Measures for Riding Comfortabilities on rolling stocks side: :<br>Lectured by Mr. ISHIKAWA | |
| | | Maintenance of Long Rail :<br>Lectured by Mr. MIYAMOTO | |
| | PM | Workshops: Speed limited 2 items | |
| Fri. 21 Feb | AM | Workshops: Currents situations of Procedure/ system/ organization for reporting, cause analysis and establishment of countermeasures of MR | |
| | PM | General Discussion | |
| Sat. 22 Feb | | Holiday | |
| Sun. 23 Feb | | Holiday | |

| Date | Hour | Contents | Note |
|---|---|---|---|
| Mon. 24 Feb. | AM | Workshops: Improvement of Technical Standards relating to administrative and maintenance aspect to improve the service and safety of MR | |
| | PM | Turnout: Lectured by Mr. MIYAMOTO | |
| Tue. 25 Feb | | General Discussion | |
| Wed. 26 Feb | AM | General Discussion | |
| | PM. | Practice for Measurements of Train Vibrations<br>(Lecture on measurement and data analysis) | |
| Thu. 27 Feb | AM | Joint Coordinating Committee:<br>Practice for Measurements of Train Vibrations<br>(Practical measurement of vibration) | |
| | PM. | Practices for Measurements of Train Vibrations<br>(Practical measurement of vibration) | |
| Fri. 28 Feb | AM | Practices for Measurements of Train Vibrations<br>(Analysis of measured data) | |
| | PM | Closing ceremony<br>-Hand over the Certification,<br>-Greeting from MR side and Japanese Side | |
| Sat. 1<br>Sun. 2<br>Mar | | Holiday | |
| Mon. 3 Mar | AM | 10:00<br>Interview survey preparation meeting | |
| Tue. 4 Mar | | Interview survey | |
| Wed. 5 Mar | | Interview survey | |
| Thu. 6 Mar | | Interview survey | |
| Fri. 7 Mar | | Interview survey | |

Table 1 Yangon-Mandalay line Train of Accident(2012/2013)

| No | The date of occurrence | Location of occurrence | kind of accident | Estimated Cause | Major Damages | Countermeasures taken |
|---|---|---|---|---|---|---|
| 1 | 5.4.2012 | Penewgon-Tawgywe | Train Parting | Defective of knuckle | empty | Mechanical |
| 2 | 6.4.2012 | Yamethin Station Yard | Derailment | Spread gauge | empty | Civil |
| 3 | 11.4.2012 | Taungoo Station Yard | Derailment | Unbalance of cross level and Human Error(Driver fault) | A little | Mechanical+Civil |
| 4 | 11.4.2012 | Yangon Station Yard | Derailment | Thin flange and unfix of tongue | empty | Operating+Mechanical |
| 5 | 16.4.2012 | Magyibin-Tatkon | Derailment | Unbalance of cross level | empty | Civil |
| 6 | 21.4.2012 | Taungoo-Kyedaw | Level Crossing Accident | Careless of car driver | A little damage of Loco | Other |
| 7 | 22.4.2012 | Nyaunglebin-Tawwi | Derailment | Unbalance of cross level | A little | Civil |
| 8 | 25.4.20123 | Inngyinkan-Shweda | Level Crossing Accident | Careless of car driver | A little | Other |
| 9 | 26.4.2012 | Pyawbwe-Shweda | Level Crossing Accident | Careless of car driver | A little | Other |
| 10 | 27.4.2012 | Thategon-Kyauktaga | Derailment | Unbalance of cross level | empty | Civil |
| 11 | 30.4.2012 | Ywapale-Hanza | Train Parting | Defective of Lock lifter | empty | Mechanical |
| 12 | 30.4.2012 | Naypyitaw Station Yard | Derailment | improper Set of Point | empty | Operating |
| 13 | 1.5.2012 | Yangon Station Yard | Derailment | Axle Coil broken | A little | Mechanical |
| 14 | 16.5.2012 | Nyaungyan Station Yard | Derailment | Side bearer nut broken | A little | Mechanical |
| 15 | 16.5.2012 | Kyedaw Kyungon | Derailment | Axle Coil broken | A little | Mechanical |
| 16 | 19.5.2012 | Dabein Tongyi | Derailment | Side bearer nut broken | A little | Mechanical |
| 17 | 27.5.2012 | Swa-Thagaya | Derailment | Unbalance of cross level and Coil bracket broken | A little | Mechanical+Civil |
| 18 | 24.5.2012 | Penewgon-Tawgyweinn | Derailment | Perishing of sleeper and Axle Coil Broken | A little | Mechanical+Civil |
| 19 | 31.5.2012 | Yangon Station Yard | Derailment | Unbalance of cross level | empty | Civil |
| 20 | 31.5.2012 | Airportsiding-Kyungon | Derailment | Spread gauge | empty | Civil |
| 21 | 13.6.2012 | Pyinmana Station Yard | Derailment | Crossing nose broken | A little | Civil |
| 22 | 17.6.2012 | Pyinmana Station Yard | Level Crossing Accident | Careless of car driver | A little | Other |

| | | | | | | |
|---|---|---|---|---|---|---|
| 23 | 19.6.2012 | Shanyaw Nyaung Yanug | Derailment | Unbalance of cross level and Coil pin broken | A little | Mechanical+Civil |
| 24 | 21.6.2012 | Ywathaegyi-ledaung gau | Train Parting | Defective of coupling | empty | Mechanical |
| 25 | 2.7.2012 | Ywataw-Pyinmana | Level Crossing Accident | Careless of car driver | A little | Other |
| 26 | 21.7.2012 | Beli-kyauksae | Level Crossing Accident | Careless of car driver | A little | Other |
| 27 | 25.7.2012 | Pyawbwe-Shweda | Derailment | Unbalance of cross level | empty | Civil |
| 28 | 30.7.2012 | Sanyar-Nyaungyan | Derailment | Unbalance of cross level | empty | Civil |
| 29 | 13.8.2012 | Mandalay Station Yard | Derailment | Thin flange of wheel | empty | Mechanical |
| 30 | 18.8.2012 | Myohla-Yeni | Train Parting | Low joint track | empty | Civil |
| 31 | 18.8.2012 | Yeni Station Yard | Derailment | Unbalance of cross level | empty | Mechanical |
| 32 | 20.8.2012 | Kyungon-Yedashe | Derailment | sinkage of track | empty | Mechanical |
| 33 | 21.8.2012 | Bandwegon-Oktwin | Train Parting | Defective of centre pivot pin | A little | Mechanical |
| 34 | 27.8.2012 | Thingangyon-Toegyaungale | Derailment | Spread gauge | empty | Civil |
| 35 | 1.9.2012 | Ywataw Station Yard | Derailment | Careless of Locomotive driver | A little | Mechanical |
| 36 | 10.9.2012 | BeLin Station Yard | Derailment | Unbalance of cross level and defective of side bearer | empty | Mechanical+Civil |
| 37 | 11.9.2012 | Thingangyun Station Yard | Derailment | Careless of Locomotive driver | empty | Mechanical |
| 38 | 19.9.2012 | Konyi Station Yard | Derailment | Unbalance of cross level | empty | Civil |
| 39 | 22.9.2012 | Yaungoo-Kyedaw | Level Crossing Accident | Careless of car driver | A little damage of Loco | Other |
| 40 | 4.10.2012 | Yepale-Hanza | Train Parting | Low joint and weakness of suspension coil | A little | Mechanical+Civil |
| 41 | 6.10.2012 | Thategon Station Yard | Derailment | Perishing of sleeper and spread gauge | A little | Civil |
| 42 | 9.10.2012 | Thaungdaingon-Taungoo | Derailment | Unbalance of cross level and master plate broken | A little | Mechanical+Civil |
| 43 | 10.10.2012 | Pyinmanar Station Yard | Derailment | Low joint of track and defective of side bearer | empty | Mechanical+Civil |
| 44 | 10.10.2012 | Pyiwin-Pyinman | Derailment | Unbalance of cross level and less centre pivot oil | empty | Mechanical+Civil |
| 45 | 17.10.2012 | Yangon Station Yard | Derailment | improper set of points and lack of track | A little | Operating+Civil |

| | | | | | | |
|---|---|---|---|---|---|---|
| 46 | 18.10.2012 | Zeyawadi Station Yard | Derailment | Lack of point men and locomotive driver | empty | Operating+Mechanical |
| 47 | 12.12.2012 | Tawa-Tyaktan | Derailment | Unbalance of cross level | empty | Mechanical+Civil |
| 48 | 17.12.2012 | Yeni Station yard | Derailment | Careless of locomotive driver | A little | Mechanical |
| 49 | 20.11.2012 | Swa-Thagaya | Level Crossing Accident | Careless of car driver | A little | Other |
| 50 | 22.11.2012 | Myohaung Station Yard | Derailment | Unmatched of rail | empty | Civil |
| 51 | 10.12.2012 | Bago Station Yard | Derailment | Unbalance of cross level and improper set of point and lock | A little | Operating+Civil |
| 52 | 11.12.2012 | Ywadaw-Pyinmanar | Level Crossing Accident | Careless of car driver | A little | Other |
| 53 | 18.12.2012 | Pyawbwe-Shweda | Derailment | Axle Coil broken and Unbalance of cross level | empty | Mechanical+Civil |
| 54 | 29.12.2012 | Minsu-Kywese | Derailment | Booster Coil Broken and Unbalance of cross level | A little | Mechanical+Civil |
| 55 | 2.12.2013 | Pyawbwe-Shweda | Derailment | Unbalance of cross level | empty | Civil |
| 56 | 8.1.2013 | Pyawvbwe-Shanywa | Derailment | Spread gauge | empty | Civil |
| 57 | 16.1.2013 | Ledaunggan-Dabein | Train Parting | Low joint of track and unbalance of coupler | empty | Mechanical+Civil |
| 58 | 21.1.2012 | Thazi Station Yard | Derailment | Lack of point men and locomotive driver | empty | Mechanical+Operating |
| 59 | 22.1.2013 | Pyawbwe Station Yard | Derailment | Lack of point men and locomotive driver | empty | Mechanical+Operating |
| 60 | 30.1.2013 | Thedaw Station Yard | Derailment | spread Axle and Unbalance of cross level | empty | Mechanical+Civil |
| 61 | 10.2.2013 | Ywathargyi-Toegyaunggale | Level Crossing Accident | Careless of car driver | A little | Other |
| 62 | 15.2.2013 | Thedaw Station Yard | Derailment | Booster Coil Broken and Unbalance of cross level | A little | Mechanical+Civil |
| 63 | 15.2.2013 | Shewmyo Station Yard | Derailment | Booster Coil Broken | A little | Mechanical |
| 64 | 18.2.2013 | Yedashe Station Yard | Derailment | Axle Coil broken and defective of Crossing nose | A little | Mechanical+Civil |
| 65 | 25.2.2013 | Yaugon Station Yard | Derailment | Lack of point men | empty | Operating |
| 66 | 8.3.2013 | Dabein Station Yard | Derailment | Lack of point men | empty | Operating |
| 67 | 8.3.2013 | Pyinmana-Ywataw | Level Crossing Accident | Careless of car driver | A little | Other |
| 68 | 26.3.2013 | Kyedaw-Taungoo | Derailment | capping of points | empty | Operating |
| 69 | 29.3.2013 | Kyaungon Station Yard | Derailment | Spread gauge | empty | Civil |

Table2 Yangon-Mandalay Station Express Passenger Trains Delay(2012/2013)

| No | Date | Train No | Station(Major stations only) | Delayed Munutes | | Countermeasures taken |
|---|---|---|---|---|---|---|
| 1 | 28.6.12 | 6DN | Bago | 28 | Coach damages | Mechanical |
| 2 | 1.7.12 | 5UP | Yangon | 30 | Locomotive damages | Mechanical |
| 3 | 5.7.12 | 11UP | Yangon | 45 | Coach damages | Mechanical |
| 4 | 17.7.12 | 6DN | Taungoo | 10 | Coach damages | Civil & Mechanical |
| 5 | 22.7.12 | 5UP | Taungoo | 24 | Coach damages | Civil & Mechanical |
| 6 | 26.7.12 | 112UP | Taungoo | 3 | Pilot | Civil & Signal |
| 7 | 30.7.12 | 12DN | Mandalay | 10 | Locomotive damages | Mechanical |
| 8 | 30.7.12 | 4DN | Mandalay | 35 | Coach damages | Civil & Mechanical |
| 9 | 31.7.12 | 6DN | Thazi | 01:17 | Coach damages | Civil & Mechanical |
| 10 | 6.8.12 | 6DN | Taungoo | 4 | Coach damages | Civil & Mechanical |
| 11 | 6.8.12 | 6DN | Naypyitaw | 32 | Coach damages | Civil & Mechanical |
| 12 | 8.8.12 | 6DN | Taungoo | 10 | Coach damages | Civil & Mechanical |
| 13 | 14.8.12 | 3UP | Taungoo | 9 | Locomotive Filled water | Mechanical |
| 14 | 14.8.12 | 4DN | Thazi | 11 | Locomotive damages | Civil & Mechanical |
| 15 | 23.8.12 | 4DN | Mandalay | 01:00 | Coach damages | Civil & Mechanical |
| 16 | 26.8.12 | 5UP | Thazi | 25 | Coach damages | Civil & Mechanical |
| 17 | 27.8.12 | 12DN | Naypyitaw | 5 | Coach damages | Civil & Signal |
| 18 | 29.8.12 | 5UP | Taungoo | 10 | Coach damages | Civil & Mechanical |
| 19 | 29.8.12 | 4DN | Mandalay | 15 | Coach damages | Civil & Mechanical |
| 20 | 30.8.12 | 12DN | Taungoo | 06:30 | Locomotive damages | Mechanical |
| 21 | 3.9.12 | 5UP | Bago | 13 | Coach damages | Civil & Mechanical |
| 22 | 3.9.12 | 6DN | Taungoo | 12 | Coach damages | Civil & Mechanical |
| 23 | 5.9.12 | 4DN | Mandalay | 30 | Coach damages | Civil & Mechanical |
| 24 | 10.9.12 | 5UP | Thazi | 8 | Coach damages | Civil & Mechanical |
| 25 | 24.9.12 | 5UP | Yangon | 10 | Locomotive damages | Mechanical |

| | | | | | | |
|---|---|---|---|---|---|---|
| 26 | 9.10.12 | 4DN | Mandalay | 1:15 | Locomotive damages | Civil & Mechanical |
| 27 | 18.12.12 | 12DN | Taungoo | 45 | Coach damages | Civil & Mechanical |
| 28 | 6.1.13 | 4DN | Taungoo | 12 | Locomotive Filled water | Mechanical |
| 29 | 12.1.13 | 6DN | Taungoo | 24 | Coach damages | Civil & Mechanical |
| 30 | 17.1.13 | 11UP | Bago | 14 | Locomotive damages | Mechanical |
| 31 | 17.1.13 | 11UP | Thazi | 6 | Pilot | Signal |
| 32 | 28.1.13 | 3UP | Bago | 15 | Coach damages | Civil & Mechanical |
| 33 | 31.1.13 | 4DN | Taungoo | 3 | Locomotive Exchange | Mechanical |
| 34 | 3.2.13 | 3UP | Taungoo | 9 | Coach damages | Mechanical |
| 35 | 7.2.13 | 5UP | Thazi | 9 | Pilot | Civil & Mechanical |
| 36 | 10.2.13 | 12DN | Mandalay | 40 | Locomotive damages | Mechanical |
| 37 | 10.2.132 | 3UP | Taungoo | 4 | Pilot | Civil & Mechanical |
| 38 | 14.2.13 | 3UP | Thazi | 25 | Wait for other train accident | Other |
| 39 | 17.2.13 | 4DN | Taungoo | 10 | Coach damages | Mechanical |
| 40 | 21.2.13 | 6DN | Taungoo | 8 | Coach damages | Mechanical |
| 41 | 25.2.13 | 5UP | Thazi | 3 | Pilot | Signal |
| 42 | 28.2.13 | 11UP | Taungoo | 4 | Pilot | |
| 43 | 5.3.13 | 11UP | Mandalay | 01:14 | Locomotive damages and Slow down | Mechanical |
| 44 | 10.3.13 | 11UP | Taungoo | 4 | Electrical cut off | Signal |
| 45 | 10.3.13 | 6DN | Taungoo | 59 | Coach damages | Civil & Mechanical |
| 46 | 11.3.13 | 5UP | Naypyitaw | 9 | Coach damages | Civil & Mechanical |
| 47 | 12.3.13 | 6DN | Bago | 8 | Wait for other train | Civil |
| 48 | 12.3.13 | 4DN | Yangon | 18 | Point damage | Signal |
| 49 | 27.3.13 | 11UP | Yangon | 01:10 | Attached by coaches | Mechanical |

## Table Section Speed and Speed Restriction on Yangon – Mandalay Line

(2013-2014)

| Station | Dist km | accumulated distance | ection Speed | | | | Reason of speed Restriction |
|---|---|---|---|---|---|---|---|
| | | | Up | | Down | | |
| Yangon | 0 | | 16 km/h | | 16 km/h | | Due to Diamond crossing and crossing of Circular Railway Line and Main Line Auto Signal |
| Pazundaung | 1.6 | 1.6 | 40 km/h | | 40 km/h | | |
| Thingangyun | 5.5 | 7.1 | 64 km/h | | 64 km/h | | |
| Kawche | 35 | 42.1 | 72 km/h | | 64 km/h | | |
| Payagyi | 49 | 91.1 | 64 km/h | | 64 km/h | | |
| Thaungdainggon | 167 | 258.1 | 56 km/h | | 56 km/h | | |
| | | | | 32 km/h | | | Br. No. 263 Using gunletted track on single truss |
| Taungoo | 7 | 265.1 | 8 km/h | | 56 km/h | | Mile 181/1-2 Br. No. 290 up At Bed Block Crack |
| | | | 56 km/h | | 8 km/h | | Mile 166/7-5 DN: Fibre cable Earth Work |
| Thagaya | 47 | 312.1 | 67 km/h | | 67 km/h | | |
| Yeni | 17.5 | 329.6 | 64 km/h | | 64 km/h | | |
| Ywadaw | 37.4 | 367 | 48 km/h | | 48 km/h | | |
| Kyidaunggan | 8.35 | 375.35 | 64 km/h | | 40 km/h | | Mile 250/20-6 DN: Poor Track Condition |
| Yamethin | 62.5 | 437.85 | 68 km/h | | 48 km/h | | |
| Shweda | 12.3 | 450.15 | 48 km/h | | 48 km/h | | |
| Pyawbwe | 8.35 | 458.5 | 48 km/h | | 68 km/h | | |
| Nwarhtoo | 23.4 | 481.9 | 64 km/h | | 68 km/h | | |
| Hanza | 21 | 502.9 | 68 km/h | | 64 km/h | | |
| Samon | 21.4 | 524.3 | 64 km/h | | 68 km/h | | |
| Thabyedaung | 11.5 | 535.8 | 68 km/h | | 68 km/h | | |
| Kume Road | 8.35 | 544.15 | 68 km/h | | 64 km/h | | |
| Myohaung | 65.6 | 609.75 | 48 km/h | | 24 km/h | | Br. No. 829 Using gunletted track on single truss |
| | | | 48 km/h | | 48 km/h | | |
| Mandalay | 4.3 | 614.05 | | | | | |

Format A

Format : Accident Analysis

| | | | | |
|---|---|---|---|---|
| Category | | | | |
| Date Time | | Location | | |
| Damage | Canceled Train | | Delayed Train | |
| | Injured | | Dead | |
| | Damage of rolling stock | | Damages of others | |
| Train Components | | | | |
| Outline | | | | |
| Cause Analysis | | | | |
| Counter Measures established | | | | |

Format B

Format : Service Improvement Analysis (Train delay)

| | | | |
|---|---|---|---|
| Category | | Date: | Train No.: |
| Location (Station) | | Delayed minutes: | |
| Outline | | | |
| Cause analysis | | | |
| Solutions established | | | |

Format C

Format : Service Improvement Analysis (Speed Restriction)

| | | |
|---|---|---|
| Location | Up Line | Accumulated distance from Yangon (km) |
| | Down Line | Accumulated distance from Yangon (km) |
| Restricted speed | Up Line | (km/h) |
| | Down Line | (km/h) |
| Reason for speed restriction | Up Line | |
| | Down Line | |
| Countermeasures for releasing speed restriction | Up Line | |
| | Down Line | |

Training Program of Cause Analysis of Accidents/Low Service Level and Establishment of Countermeasures:

"PROJECT ON IMPROVEMENT OF SERVICE AND SAFETY OF RAILWAY IN MYANMAR "

List of Participants:

| Group | Name | Department | Location | remark |
|---|---|---|---|---|
| A | Mr. Than Htay | Deputy General Manager/Civil | Head Quarter | |
| | Mr. Aye Ko | Assistant Mechanical Engineer | Head Quarter | |
| | Mr. Tinh Lwin Htun | Assistant Engineer / Civil | Division (11) | Replaced Mr.San Ngwe Assistant Engineer/Civil Division(5) Since Feb.13 |
| | Mr. Myo Tint | Assistant Traffic Manager | Division (4) | |
| | Mr. Htun Wai | Assistant Engineer (Signaling & Telecommunication) | Head Qnarter | |
| B | Mr. Htein Win | Assistant General Manager/Operating | Division (5) | |
| | Mr. Hla Htut | Divisional Engineer (Signaling & Telecommunication) | Division (6,8,9) Yangon | |
| | Mr. Thein Myint | Assistant Mechanical Engineer | Head Quarter | |
| | Mr. Lwan Thu | Divisional Engineer / Civil | Division (5) | |
| | Mr. Aye Thein | Assistant Traffic Manager | Division (2) | Absent all classes |
| C | Mr. Min Pan Aung | Divisional Engineer ((Signaling & Telecommunication) | Division (3) | |
| | Mr. Naing Zaw Oo | Divisional Traffic Manager | Division (10) | |
| | Mr. Than Win | Assistant Mechanical Engineer | Division (2) | |
| | Mr. Myint Lwin | Assistant Mechanical Engineer | Division (4) | |
| | Mr. Tin Moe | Assistant Engineer / Civil | Head Quarter | |
| D | Mr. Min Min Htway | Divisional Traffic Manager | Division (10) | |
| | Mr. Soe Thein Aung | Divisional Engineer ((Signaling & Telecommunication) | Division (5,11) Taungoo | |
| | Mr. San Thar Aung | Divisional Traffic Manager | Head Quarter | |
| | Mr. Ye Kyaw Htwe | Assistant Mechanical Engineer | Division (5) | |
| | Mr. Aye Nyein Swe | Assistant Engineer / Civil | Division (3) | |

## Guideline for Investigation on Customer Satisfaction Level

**1. Purpose:**

According to the Inception Report agreed upon between U Thurein Win, Managing Director of MR and Mr. S, Kuroda, Leader of JICA Expert Team in the 1st JCC held on Aug, 28 ,2013 at Nay Pyi Taw, interview survey will be conducted as one of the activities of technical supporting project " Project on Improvement of Service and Safety of Railway in Myanmar" to identify the current satisfaction level of customers with respect to passenger services of MR. Guidance will be given to the counterpart with respect to the way of analysis and way of doing the questionnaire survey.

**2. Timing of investigation:**

(1) Preparation meeting : March 3rd, 2014

(2) Interview survey: March 4, 5, 6, 7th, 2014

**3. Section of investigation :**

Between Yangon Station and Mandalay Station on Yangon-Mandalay Trunk Line

**4. Targeted Object and methods for investigation:**

Targeted for Myanma Railway passenger, except foreign travelers, and interviewing on the running trains. In case of a group trip, only one passenger of the group will be interviewed.

**5. Sampling number:**

Targeted 3 kinds of train and class, "Express Upper", "Express Ordinary" and "Local", and at least 120 passengers will be sampled for each train kind/class.

Table1 : 5. Sampling number

| Train kind/class | Sampling number/Train | Train number /day | days | Total number |
|---|---|---|---|---|
| Express (Upper) | 20 | 3 | 2 | 120 |
| Express (Ordinary) | 20 | 3 | 2 | 120 |
| Local | 30 | 2 | 2 | 120 |

**6. Details of conduction of interview survey**

(1) Establishment of Interview Survey Teams

Six interview survey teams will be established as shown in Table 1.

(2) Preparation meeting will be held at 10:00 AM on March 3rd, 2014 at MR Head Quarters at Nay Pyi Taw .All members of interview survey teams should participate in the meeting.

(3) Interview survey will be conducted on March 4, 5, 6 and 7th, according to Table 1, using the

Questionnaire attached.

## TABLE(1) :Assignment of Interview Team

(Draft)

| | | 1st day | 2nd day | 3rd day | 4th day | Train travel time |
|---|---|---|---|---|---|---|
| Express Train | | 12DN | 31UP | | | 9~16h |
| | | A,B | A,B | | | |
| Upper class (20) passengers/train | | 11UP | 32DN | | | 9~16h |
| | | C,D | C,D | | | |
| Ordinary class (20)passengers/train | | 32DN | 11UP | | | 9~16h |
| | | E,F | E,F | | | |
| Total (40) passengers/train | | | | | | |
| Local Train | No.1(14DN) | | | (B-Y) | (B-Y) | 3h |
| | | | | A,B,C,D | A,B,C,D | |
| (30)passengers/train | No.2(13UP) | | | (Y-B) | (Y-B) | 3h |
| | | | | A,B,C,D | A,B,C,D | |

A,B,C,D,E,F are interview teams, each consisting of one interviewer and one assistant.

**Interview time : 3~4 passengers /1 hour**

7. **Questionnaire item:**

   Refer to Attached Sheets

8. **Analyzing Methods:**

   (1) Subjective evaluation items (Q1~16) are scored and the difference of evaluation by train kind and passenger class will be analyzed

   (2) The survey items (Q17~19) are for investigating the fundamental properties of passengers such as gender, age, purpose of travel and occupation.

Please answer the following questions about the Myanma Railway passenger Services.

Q 1 About riding comfortability.

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q 2 About Train speed

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q 3 About Train Delay

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q 4 About Cleanness in Train Cabin

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q 5 About Cleanness in Train Restroom

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q 6 About Comfortability of Train Seat

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q 7 About Attitude of Train staff (Guard)

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q8 About Ticket booking at Station

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q9 About waiting facilities at Station

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q10 About Cleanness in Station Restroom

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q11 About Attitude of Station staff

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q12 About Train Departure Time Table

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q13 About Train Arrival Time Table

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q14 About Train Frequency

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q15 About Train Fare

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q16 Do you want to use Railway Service again?

| Little bit Want | | No Particular Opinion | | Rather Do Not Want | | Do Not Want |
|---|---|---|---|---|---|---|
| 4 | — | 3 | — | 2 | — | 1 |

Q17 What is the reason for choosing Railway ? (Multiple Choice is OK)

☐ Cheap Fare
☐ Railway Station Close to departure/arrival place
☐ A lot of luggage
☐ Other ( )

Q18 How often do you use the Railway service ?

☐ Almost every day
☐ 2 or 3 times every week
☐ 1 time every week
☐ 1 time every month
☐ 5 or 6 times annually
☐ 1 to 4 times annually
☐ For the first time

Q19 What kind of improvement do you want for Railway service? (Please put the priority order in the box)

☐ Punctuality
☐ Faster than Bus
☐ Less rattling and more comfortable
☐ No accident
☐ Cleanness in the Cabin

Q20 Please tell us about yourself。

☐ Male ☐ Female age _____s' years old

☐ Boarding section
From _____ Station to _____ Station

Purpose of trip

☐ Business ☐Leaving from/Returning to home ☐Sightseeing
☐ Other( )

Occupation

☐ Public officials ☐Company employee ☐Commerce or self-employed
☐ Farmer or fisher ☐ Students ☐other ( )

List of Member of Interview survey Teams

| TEAM | NAME | POST |
|---|---|---|
| (A) | 1.Mr.Than Shein Oo | Commercial Inspector (leader) |
| | 2.Mr. Khin Mg Htun | Travelling Ticket Inspector |
| (B) | 1.Mr.Thein Win | Commercial Inspector (leader) |
| | 2.Mr.Tin Lwin | Travelling Ticket Inspector |
| (C) | 1.Mr.Aung Naing Myint | Commercial Inspector (leader) |
| | 2.Mr.Kyi Shein | Travelling Ticket Inspector |
| (D) | 1.Mr.Tin Soe | Commercial Inspector (leader) |
| | 2.Mr.Soe Min | Travelling Ticket Inspector |
| (E) | 1.MR.Zaw Lin | Commercial Inspector (leader) |
| | 2.Mr.Myint Mg | Travelling Ticket Inspector |
| (F) | 1.Mr.Htun Pyae Aung | Commercial Inspector (leader) |
| | 2.Mr.Myint Oo | Travelling Ticket Inspector |

# The Project on Improvement of Service and Safety of Railway in Myanmar

Progress Report
February 27th, 2014 at Nay Pyi Taw

JICA EXPERT TEAM

Japan International Cooperation Agency



## Table of Content



Japan International Cooperation Agency

# 1. Project Summary

## 1.1 Project Background

Train operation Safety and Service levels are major issues for MR.

## 1.2 Circumstances having led to the project

According to the Record of Discussion signed on last March 25th in 2013, between Managing Director, Myanma Railways, and Chief Representative, Myanmar Office, JICA, agreement was reached upon the detailed contents .

## 1.3 Purpose of the Project

Administration and maintenance ability is improved for the enhancement of Service and Safety of Myanma Railways



# 2. Basic Plan of Project Implementation

## 2.1.1 Overall Goal and Project purpose

### Output 1

Based on accident analysis, issues are clarified for the enhancement of service and safety in the administration and maintenance process, and the improvement plan is drawn up.

### Output 2

Technology transfer of track maintenance technology through implementation of the Pilot Project

## 2.1.2 Implementation plan

We made implementaion plan to accomplish Output 1 and 2.

## 2.1.3 Project Section

Yangon – Bago Section. Pilot section about 20km

## 2.2 Flow Chart of Project Implementation

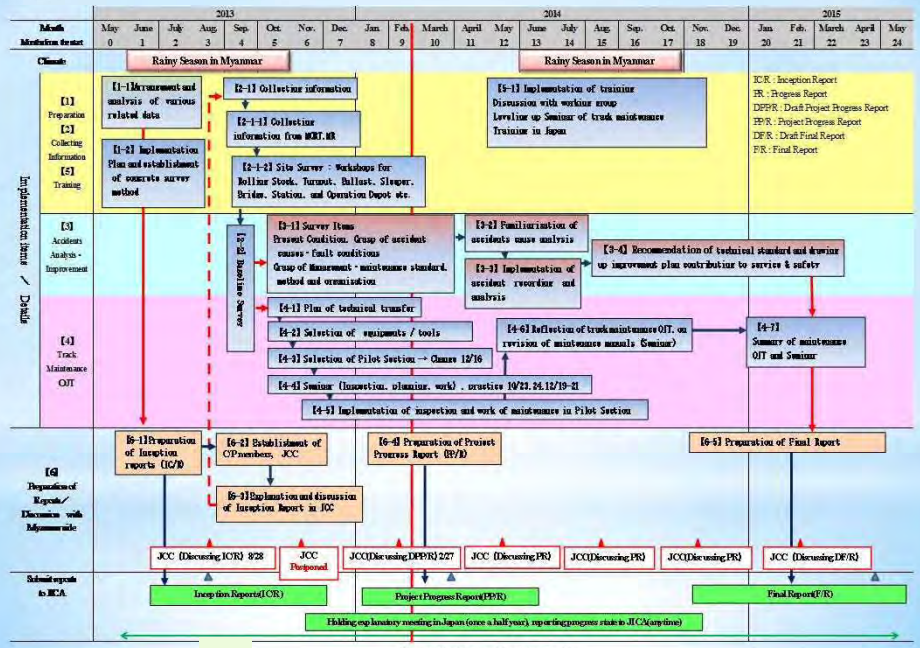



Figure 2-1 Project Implementation



# 3 Detailed Methods for the Project Implementation

## 3.1 Recommendation of technical standards relating to administrative and maintenance aspect and drawing up railway facilities improvement plan to improve service and safety level.

3.1.1 Preparation of a working plan

3.1.2 Survey of the present status and establishment of organization to collect information

3.1.3 Guidance and familiarization of the technique to analysis the present status and causes of accidents and poor services.

3.1.3-A Safety

3.1.3-B Service level

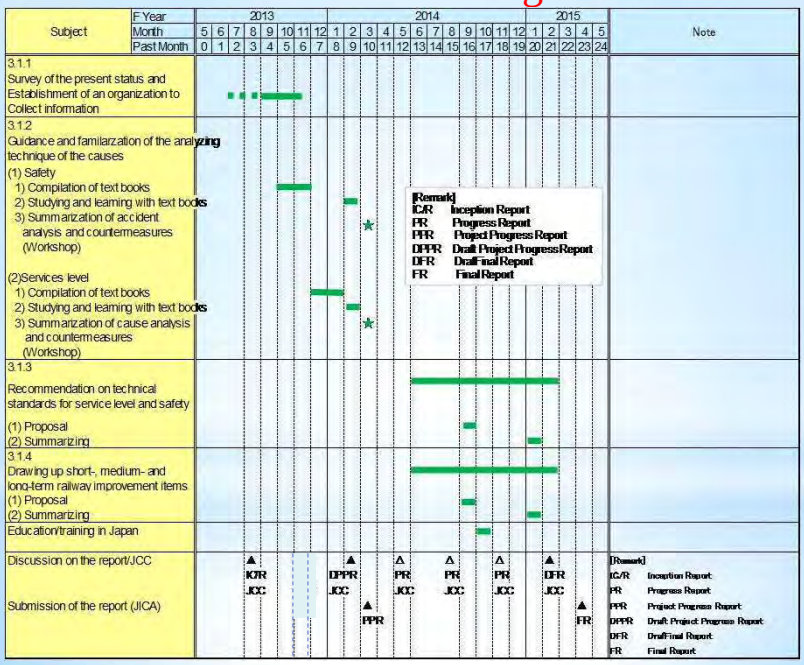
3.1.4 Recommendation on technical standards relating to administrative and maintenance aspect to improve the service level and safety

3.1.5 Drawing up of short- , medium- and long-term railway facilities improvement plan

3.1.6 Education/training in Japan

3.1.7 Major issues to be tackled with, good schemes for better implementation, lessons obtained through implementation

# Schedule of Working Plan



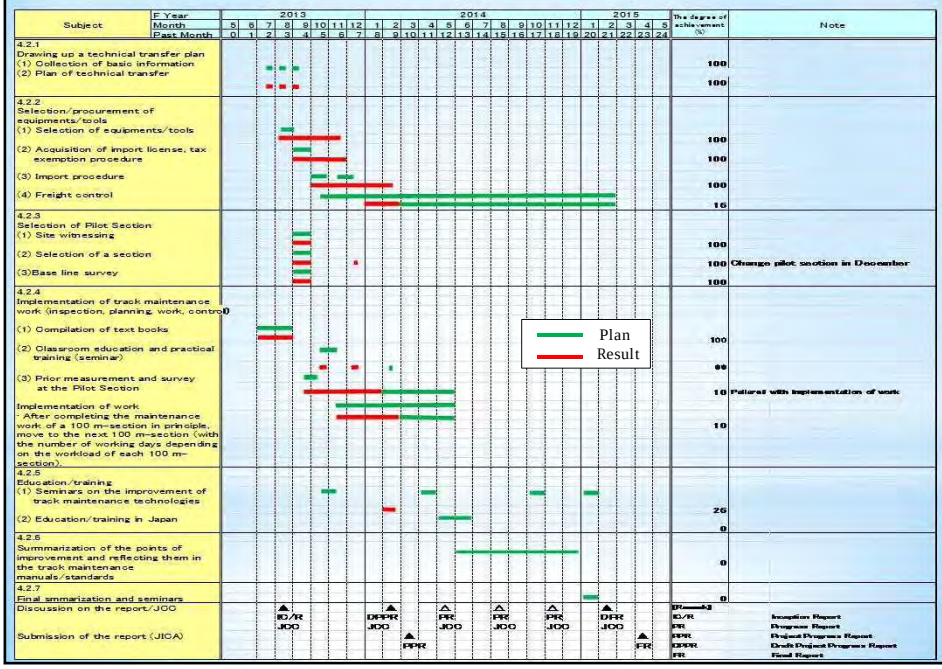



## 3.2 Technology Transfer of Track Maintenance Technology to improve the level of Service and Safety through Implementation of The Pilot Project

- 3.2.1 Drawing up a plan for technology transfer
- 3.2.2 Procurement of the required equipments / tools
- 3.2.3 Selection of the Pilot Section
- 3.2.4 Implementation of track maintenance (inspection, planning, work and control)
- 3.2.5 Education/Training
- 3.2.6 Summarization of the points of improvement and reflecting them in the track maintenance manuals/standards
- 3.2.7 Final summarization and seminars
- 3.2.8 Major issues to be tackled with, good schemes for better implementation, lessons obtained through implementation

Japan International Cooperation Agency

## Schedule of Track maintenance




9

## 4. Project implementation Organization

4.1 Structure of the implementation Organization

4.2 Implementation body on the Myanmar side

4.3 Implementation body on the Japan side

4.4 Establishment of Joint Coordinating Committee（JCC）and Its Functions

4.5 Establishment of Working Group for Service and Safety Improvement

4.6 Major issues to be tackled with, good schemes for better implementation of the project and lessons obtained through implementation.

Japan International Cooperation Agency

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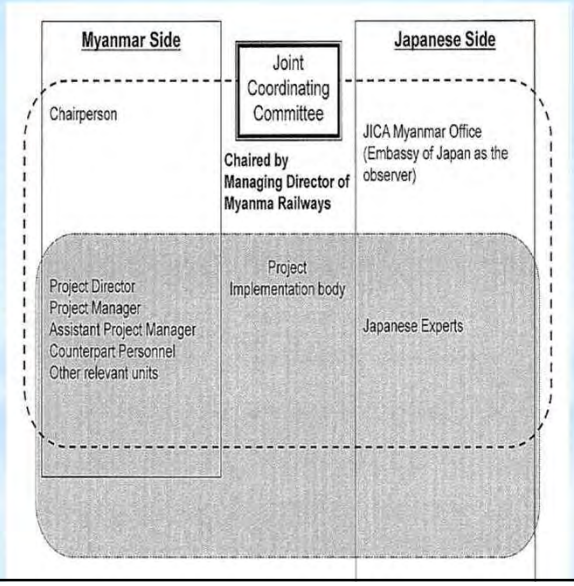
# Structure of project implementation Organization




11

Table 4.1 Administrative and Counterpart Personnel for the Project

| Fields | Myanma Railways | Japanese Side (JICA Expert Team) |
|---|---|---|
| Project Director | U Saw Valentine,General Manager (Technical & Admin.support) | Sadaaki KURODA(Leader) |
| Project Manager | U Tin Soe ,General Manager (civil) | Nobuyuki MATSUO (Duputy Leader) |
| Railway Policy/OM Improvement | U Kyaw Kyaw Myo Assistant General Manager(operating) | Hiroshi KOMATSU |
| Track Maintenance | U Maung Maung Than ,AGM (Civil) U Than Htay(DGM) Civil | Masato WAKATSUKI Kiyoshi MIYAMOTO |
| Procurement of Equipment &Materials | U Win Htein DGM( Supply) | Yuichi TANIGUCHI |
| Signalling&Telecommunications | U Myint Lwin,Assistant Engineer(S&T) U Han Nyunt ,AGM(S&T) | Ryuhei MITANI |
| Rolling Stock | U San Myint (Train Operation) U Thet Lwin,DGM(Rolling Stock) | Makoto ISHIKAWA |
| Train Operation | U zaw Pe Sein (Divisional Traffic Manager) U Htay Myint Aung,AGM(operating) | (Hideharu IGAGASHI) |
| Structure | U Tin Win ,DGM(Civil) | Mitsuru TAKAMI (Coordination) |

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# JCC personnel

| Chairman U Thurein Win　Managing Director of Myanma Railways | | | |
|---|---|---|---|
| Myanmer Side | | Japanese Side | |
| Name | Position (Major) | Name | Position (Major) |
| U Saw Valentine | General Manager (Technical & Admin Support) | Sadaaki KURODA | Leader of Japanese Expert Team (Track maintenance) |
| U Myint Wai | General Manager (Operating) for analyzing accidents | Nobuyuki MATSUO | Duputy Leader (Maintenance planning) |
| U Aung Win | General Manager (Mechanical & Electrical) for rolling stocks | Hiroshi　KOMATSU | Railway Administration and Management Expert |
| U Tin Soe | Project Manager, General Manager (Civil) | Yuichi TANIGUCHI | Procurement of Equipment and Materials Expert |
| U Than Htay | Assistant Project Manager, Deputy General Manager (Civil) | Ryuhei MITANI | Signalling and Telecommunications Expert |
| U Khin Maung Thein | Assistant Project Manager, Deputy General Manager (Signalling & Telecommunications) | Makoto ISHIKAWA | Rolling Stock Expert |
| U Min Aung | Counterpart Personnel, Assistant Engineer (Civil) | Masato WAKATSUKI | Track Maintenance Expert |
| U Myint Lwin | Counterpart Personnel, Assistant Engineer (Signalling &Telecommunications) | Kiyoshi MIYAMOTO | Earth Roadbed Expert |
| Daw Thi Thi Nwe | Assistant General Manager (Finanace) | Mitsuru TAKAMI | Coordinating Expert |
| Htaung Sian Kan | Deputy General Manager (Admin) | (Hideharu IGAGASHI) | Operation Expert |
| | | Mituso HIGASHI | Railway Management Adviser |
| | | | Representative of JICA |
| | | | Representative of JICA |
| | | | Representative of Embassy of Japan : Observer |

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# Member of Working Group for Service and Safety Improvement

| Fields | Myanma Railways | Japanese Side (JICA Expert Team) |
|---|---|---|
| Project Director | U Saw Valentine,General Manager (Technical & Admin.support) | Sadaaki KURODA(Leader) |
| Project Manager | U Tin Soe ,General Manager (civil) | Nobuyuki MATSUO (Duputy Leader) |
| Railway Policy/OM Improvement | U Kyaw Kyaw Myo Assistant General Manager(operating) | Hiroshi KOMATSU |
| Track | U Than Htay DGM (Civil) | Masato WAKATSUKI Kiyoshi MIYAMOTO |
| Signalling&Telecommunications | U Han Nyunt ,AGM (S&T) | Ryuhei MITANI |
| Rolling Stock | U Thet Lwin,DGM(Rolling Stock) | Makoto ISHIKAWA |
| Train Operation | U Htay Myint Aung ,AGM(Operating) | (Hideharu IGAGASHI) |
| Structure | U Tin Win ,DGM(Civil) | Mitsuru TAKAMI (Coordination) |

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# 5 Interim Reporting of Progress of the Project

## 5.1 Recommendation of technical standards relating to administrative and maintenance aspect and drawing up railway facilities improvement plan to improve service and safety level.

5.1.1 Survey of the present status and establishment of an organization to collect information

5.1.2 Guidance and familiarization of analysis technique of the causes of accidents and low service

5.1.3 Recommendation on technical standards for service and safety,

5.1.4 Drawing up short-, medium-, and long-term railway improvement items

5.1.5 Education / training in Japan

5.1.6 Extent of achievement of target, major issues to be tackled with, good schemes for better implementation, lessons obtained through implementation



## 5.1.1 Survey of the present status and establishment of an organization to collect information

Appendix8-1 present situation of Safety and Service Level of MR

1. Accident Analysis
   - Classification
   - Number of accidents by kinds
   - Analysis of Causes
   - Reporting System
   - Organization in charge of handling accidents and countermeasures

2. Service Level
   - Train delay analysis(magnitude, frequency, causes)
   - Sanction Speeds by section, restricted speed
   - Journey speed
   - Riding Comfort

## 5.1.2 Guidance and familiarization of analysis technique of the causes of accidents and low service

(1) Preparation of text book

(2) Executing of Training Program
- Introduction of Japanese Experiences by JICA Experts
- Workshop
- Training of Train vibration measurements

(3) Interview Survey

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Text book Contents

Forewords (MR side and Japanese side)

1. Safety
 1.1 Introduction of Prevention and Research organization in the world railway
 1.2 Past accidents and Countermeasures
  1.2.1 Collision
  1.2.2 Derailment
  1.2.3 Level crossing
  1.2.4 Natural Disasters
  1.2.5 Train Fire

2. Bottom up of Service Level
 2.1 Speed-up
 2.2 Prevention for Level Crossing Accident
 2.3 Punctuality
 2.4 Conformability
 2.5 Customer Satisfaction

Afterword

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# Training schedule ①

| Date | Hour | Contents | Note |
|---|---|---|---|
| Mon. 10 Feb. | AM | Opening Ceremony<br>-Greeting from MR side and Japanese Side<br>-Introduction of MR Participants and JICA Experts<br>Orientation | |
| | PM | Orientation continued as required<br>Analysis of the Present Situation of Safety and Service Level of MR<br>Lectured by Dr. S. Kuroda | |
| Tue. 11 Feb | AM | Derailment Accident in Japan and Discussion on Derailment:<br>Lectured by Mr. KURODA | |
| | | Derailment Accident in Japan :<br>Lectured by Mr. MIYAMOTO | |
| | PM | Workshops: Derailment 2 items | |
| Wed. 12 Feb | | National holiday | |
| Thu. 13 Feb | AM | Rolling stocks accident : Lectured by Mr. ISHIKAWA<br>Level crossing accidents : Lectured by Mr. MITANI | |
| | PM | Workshops: Derailment 2 items | |
| Fri. 14 Feb | AM | Natural disasters :<br>Lectured by Mr. TAKAMI | |
| | PM | Workshops: Level Crossing 2 items | |
| Sat. 15 Feb | | Holiday | |
| Sun. 16 Feb | | Holiday | |

| Date | Hour | Contents | Note |
|---|---|---|---|
| Mon. 17 Feb. | AM | Brake systems on rolling stocks<br>Lectured by Mr. ISHIKAWA | |
| | | Train Protection System<br>Lectured by Mr. MITANI | |
| | PM | Workshops: Train separation 2 items | |
| Tue. 18 Feb | AM | Prevention for Accidents<br>Lectured by Mr. IGARASHI | |
| | | Measures for speed up on Track side:<br>Lectured by Mr. KURODA | |
| | PM | Workshops: Train delay 2 items | |
| Wed. 19 Feb | AM | Measures for Punctualities on track side :<br>Lectured by Mr. MIYAMOTO | |
| | | Measures for Riding Comfortabilities on track side:<br>Lectured by Mr. MIYAMOTO | |
| | PM | Workshops: Train delay 1 item and Speed limited 1 item | |
| Thu. 20 Feb | AM | Measures for Riding Comfortabilities on rolling stocks side: :<br>Lectured by Mr. ISHIKAWA | |
| | | Maintenance of Long Rail :<br>Lectured by Mr. MIYAMOTO | |
| | PM | Workshops: Speed limited 2 items | |
| Fri. 21 Feb | AM | Workshops: Currents situations of Procedure/ system/ organization for reporting, cause analysis and establishment of countermeasures of MR | |
| | PM | General Discussion | |
| Sat. 22 Feb | | Holiday | |
| Sun. 23 Feb | | Holiday | |



# Training schedule ②

| Date | Hour | Contents | Note |
|---|---|---|---|
| Mon. 24 Feb. | AM | Workshops: Improvement of Technical Standards relating to administrative and maintenance aspect to improve the service and safety of MR | |
| | PM | Turnout: Lectured by Mr. MIYAMOTO | |
| Tue. 25 Feb | | General Discussion | |
| Wed. 26 Feb | AM | General Discussion | |
| | PM. | Practice for Measurements of Train Vibrations<br>(Lecture on measurement and data analysis) | |
| Thu. 27 Feb | AM | Joint Coordinating Committee:<br>Practice for Measurements of Train Vibrations<br>(Practical measurement of vibration) | |
| | PM. | Practices for Measurements of Train Vibrations<br>(Practical measurement of vibration) | |
| Fri. 28 Feb | AM | Practices for Measurements of Train Vibrations<br>(Analysis of measured data) | |
| | PM | Closing ceremony<br>-Hand over the Certification,<br>-Greeting from MR side and Japanese Side | |
| Sat. 1 Sun. 2 Mar | | Holiday | |
| Mon. 3 Mar | AM | 10:00<br>Interview survey preparation meeting | |
| Tue. 4 Mar | | Interview survey | |
| Wed. 5 Mar | | Interview survey | |
| Thu. 6 Mar | | Interview survey | |
| Fri. 7 Mar | | Interview survey | |

## Participants List

| Group | Name | Department | Location | remark |
|---|---|---|---|---|
| A | Mr. Than Htay | Deputy General Manager/Civil | Head Quarter | |
| | Mr. Aye Ko | Assistant Mechanical Engineer | Head Quarter | |
| | Mr. Tinh Lwin Htun | Assistant Engineer / Civil | Division (11) | Replaced Mr.San Ngwe Assistant Engineer/Civil Division(5) Since Feb.13 |
| | Mr. Myo Tint | Assistant Traffic Manager | Division (4) | |
| | Mr. Htun Wai | Assistant Engineer (Signaling & Telecommunication) | Head Quarter | |
| B | Mr. Htein Win | Assistant General Manager/Operating | Division (5) | |
| | Mr. Hla Htut | Divisional Engineer (Signaling & Telecommunication) | Division (6,8,9) Yangon | |
| | Mr. Thein Myint | Assistant Mechanical Engineer | Head Quarter | |
| | Mr. Lwan Thu | Divisional Engineer / Civil | Division (5) | |
| | Mr. Aye Thein | Assistant Traffic Manager | Division (2) | Absent all classes |
| C | Mr. Min Pan Aung | Divisional Engineer ((Signaling & Telecommunication) | Division (3) | |
| | Mr. Naing Zaw Oo | Divisional Traffic Manager | Division (10) | |
| | Mr. Than Win | Assistant Mechanical Engineer | Division (2) | |
| | Mr. Myint Lwin | Assistant Mechanical Engineer | Division (4) | |
| | Mr. Tin Moe | Assistant Engineer / Civil | Head Quarter | |
| D | Mr. Min Min Htway | Divisional Traffic Manager | Division (10) | |
| | Mr. Soe Thein Aung | Divisional Engineer ((Signaling & Telecommunication) | Division (5,11) Taungoo | |
| | Mr. San Thar Aung | Divisional Traffic Manager | Head Quarter | |
| | Mr. Ye Kyaw Htwe | Assistant Mechanical Engineer | Division (5) | |
| | Mr. Aye Nyein Swe | Assistant Engineer / Civil | Division (3) | |

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## Interview Survey

| Train kind/class | Sampling number/Train | Train number /day | days | Total number |
|---|---|---|---|---|
| Express（Upper） | 20 | 3 | 2 | 120 |
| Express（Ordinary） | 20 | 3 | 2 | 120 |
| Local | 30 | 2 | 2 | 120 |

| | | 1st day | 2nd day | 3rd day | 4th day | Train travel time |
|---|---|---|---|---|---|---|
| **Express Train** | | 12DN A,B | 31UP A,B | | | 9~16h |
| Upper class (20) passengers/train | | 11UP C,D | 32DN C,D | | | 9~16h |
| Ordinary class (20)passengers/train | | 32DN E,F | 11UP E,F | | | 9~16h |
| Total (40) passengers/train | | | | | | |
| **Local Train** | No.1(14DN) | | | (B-Y) A,B,C,D | (B-Y) A,B,C,D | 3h |
| (30)passengers/train | No.2(13UP) | | | (Y-B) A,B,C,D | (Y-B) A,B,C,D | 3h |

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Q 1 About riding comfortability.

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | – | 3 | – | 2 | – | 1 |

Q 2 About Train speed

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | – | 3 | – | 2 | – | 1 |

Q 3 About Train Delay

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | – | 3 | – | 2 | – | 1 |

Q 4 About Cleanness in Train Cabin

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | – | 3 | – | 2 | – | 1 |

Q 5 About Cleanness in Train Restroom

| No Particular Opinion | | Little bit Dissatisfaction | | Dissatisfaction | | Very Dissatisfaction |
|---|---|---|---|---|---|---|
| 4 | – | 3 | – | 2 | – | 1 |

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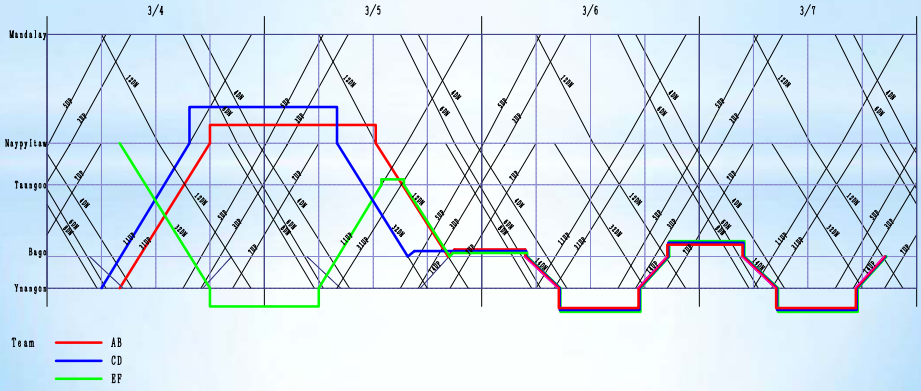
# Schedule of Interview Survey

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## Training of improving safety and service Level

25

## Video① Training of improvement safety and service level


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## 5.2 Technology transfer of track maintenance technology to improve the level of service and safety through implementation of the Pilot Project

5.2.1 Drawing up a technical transfer plan
5.2.2 Selection /procurement of equipments/tools
5.2.3 Selection of Pilot Section
5.2.4 Implementation of track maintenance work (inspection, planning, work, control)
5.2.5 Education/ training in Japan
5.2.6 Summarization of the points of improvement and reflecting them in the track maintenance manuals/ standards
5.2.7 Final summarization and seminars
5.2.8 Extent of achievement of target, major issues to be tackled with, good schemes for better implementation, lessons obtained thorough implementation



## List of the required equipments/tools

| No. | Item | Unit | Manufacturer |
|---|---|---|---|
| 1 | Analog standard gauge | 5 | KANEKO CO., LTD. |
| 2 | Instrument detection for track | 5 | GIDOU GIKEN |
| 3 | Mesuring instrument for rail wearing depthe | 2 | HARADA SEISAKUSYO |
| 4 | Gap gauge | 5 | TSUKO NAKAYAMA CO., LTD. |
| 5 | Taper gauge | 5 | KANEKO CO., LTD. |
| 6 | Thermometer for rail | 5 | KANEKO CO., LTD. |
| 7 | Square for rail | 5 | KANEKO CO., LTD. |
| 8 | Trackmaster | 1 | KANEKO CO., LTD. |
| 9 | Mesuring instrument for train swing | 1 | SHINYEI TECHNOLOGY CO.,LTD. |
| 10 | Cloth measuring tape (30 m) | 5 | YAMAYO SOKUTEKI CO., LTD. |
| 11 | Steel measuring tape (30 m) | 5 | YAMAYO SOKUTEKI CO., LTD. |
| 12 | Square | 5 | TETUYU KOGYO CO., LTD. |
| 13 | Slate pencil , Chalk | 4 | NIHON HAKUBOKU KOGYO CO., LTD. |
| 14 | Tie tamper | 1 | SHIBAURA ELRTEC CORPORATIO |
| 15 | Beater | 18 | ISHI TEKOU CO., LTD. |
| 16 | Shovel | 18 | TONBO KOGYO CO.,LTD. |
| 17 | Bar | 35 | ISHI TEKOU CO., LTD. |
| 18 | Spike hammer | 13 | ISHI TEKOU CO., LTD. |
| 19 | Panpuller | 18 | HOSEN KIKI SEIBI CO.,LTD. |
| 20 | Jack for rail | 40 | NICH CO., LTD. |
| 21 | Equipment for ballast tamping | 5 | HITACHI KENKI KAMINO CO., LTD. |
| 22 | Generator | 1 | SHIBAURA ELRTEC CORPORATIO |
| 23 | Generator | 5 | HONDA MOTOR CO., LTD. |
| 24 | Shovel | 9 | TONBO KOGYO CO.,LTD. |
| 25 | Dump shovel | 9 | KATOU SEISAKUSYO CO., LTD. |
| 26 | Shovel with blade divided into multiple | 9 | KATOU SEISAKUSYO CO., LTD. |
| 27 | Hoe with blade like nail of wild goose | 9 | KYOUWA CO., LTD. |
| 28 | Hand screen | 15 | IRIE KOUGYO CO., LTD. |
| 29 | Hoe with blade of traiangle | 9 | IRIE KOUGYO CO., LTD. |
| 30 | Wooden maul | 9 | KONDO KASHIZAI MOKOUSYO CO., LTD. |
| 31 | Basket made by bamboo or plastic | 9 | SEKISUI KAGAKU KOGYO CO., LTD. |
| 32 | Jack traverser | 10 | TOKO SANGYO CO., LTD. |
| 33 | Rail sawing machine | 3 | TETUYU KOGYO CO., LTD. |
| 34 | Rail boring machine | 3 | KOBORI TEKOUSYO CO., LTD. |
| 35 | Core cutter | 10 | KOBORI TEKOUSYO CO., LTD. |
| 36 | Rail bending machine | 1 | RIKEN KIKI CO., LTD. |
| 37 | Rail joint expandor | 1 | TETUYU KOGYO CO., LTD. |

| No. | Item | Unit | Manufacturer |
|---|---|---|---|
| 38 | Sleeper replacing machine | 1 | HOSEN KIKI SEIBI CO.,LTD. |
| 39 | Rail carrying machine | 9 | YOSHIKE KAKEN KIKI CO., LTD. |
| 40 | Rail carrying tongs | 9 | YOSHIKE KAKEN KIKI CO., LTD. |
| 41 | Shovel | 18 | TONBO KOGYO CO.,LTD. |
| 42 | Single open ended spanner | 9 | ISHI TEKOU CO., LTD. |
| 43 | Chisel | 5 | ISHI TEKOU CO., LTD. |
| 44 | Rail fork | 5 | NICH CO., LTD. |
| 45 | Disc grinder | 5 | HITACHI KOUKI HANBAI CO., LTD. |
| 46 | Power wrench | 5 | MAKITA CO., LTD. |
| 47 | Low joint maintenance machine | 1 | L. GEISMAR |
| 48 | Spanner for joint bolt | 9 | IIJIMA KIKOU CO., LTD. |
| 49 | Rail grinding machine | 1 | YOSHIKE KAKEN KIKI CO., LTD. |
| 50 | Swager for back bolt | 1 | NIPPON POP RIVETS AND FASTENERS LTD. |
| 51 | Hydraulic lining machine | 5 | TETUYU KOGYO CO., LTD. |
| 52 | Low roller | 7 | HOSEN KIKI SEIBI CO.,LTD. |
| 53 | Chisel with handle | 3 | ISHI TEKOU CO., LTD. |
| 54 | Spanner for bed plate / rail brace | 7 | IRIE KOUGYO CO., LTD. |
| 55 | Adz | 9 | ISHI TEKOU CO., LTD. |
| 56 | Hand hammmar | 9 | TORASUKO NAKAYAMA CO., LTD. |
| 57 | Spanner for huck bolt | 9 | IIJIMA KIKOU CO., LTD. |
| 58 | Engine Drilling Machine | 13 | NIKOU TANAKA ENJINYARING CO., LTD. |
| 59 | Drill 22mm | 13 | NIKOU TANAKA ENJINYARING CO., LTD. |
| 60 | Gouge | 9 | KAKUBU SANGYO |
| 61 | Electric saw | 5 | HITACHI KOUKI HANBAI CO., LTD. |
| 62 | Boring machine | 3 | MAKITA CO., LTD. |
| 63 | Sleeper carrying tongs | 9 | KATOU SEISAKUSYO CO., LTD. |
| 64 | Pad remover | 9 | ORURA CO., LTD. |
| 65 | Light track trolley | 5 | YOSHIKE KAKEN KIKI CO., LTD. |
| 66 | Gas cutting machine | 2 | YAMATO SANGYO CO.,LTD. |
| 67 | Rail lifting machine | 3 | TOKO SANGYO CO., LTD. |
| 68 | Spanner | 2 | TOPU KOGYO CO., LTD. |
| 69 | Track jack | 9 | TETUYU KOGYO CO., LTD. |
| 70 | Low elasticity pad | 20 | NIHON ESURAITO CO., LTD. |
| 71 | Track shim | 20 | TETUDOU YOUHIN CO., LTD. |
| 72 | Huck bolt | 40 | KONDO TEC CO., LTD. |
| 73 | Brushcutter | 4 | HONDA MOTOR CO., LTD. |
| 74 | Chip cutter for Brushcutter | 4 | HONDA MOTOR CO., LTD. |

## Record of Work

| Kind of work | Unit | 12k200m～13k450m | 26k200m～27k035m |
|---|---|---|---|
| Continuous Tamping | m | 826.5 | 254 |
| Spot Surfacing | m | 45.3 | 1,111 |
| Subtotal | m | 1279.5 | 1,365 |
| Spot Surfacing using ballast chipping at the joint | Nos. | 0 | 53 |
| Insert of sleepers cut into four pieces at the joint | Nos. | 0 | 8 |
| Positioning of sleepers | Nos. | 239 | 161 |
| Exchange sleepers | Nos. | 84 | 38 |
| Insert sleepers | Nos. | 9 | 22 |
| Remove sleepers | Nos. | 1 | 3 |
| Subtotal | Nos. | 95 | 63 |
| Rectification alignment | m | 552 | 915 |
| Supplement and arrangement of ballasts | m | 1535.5 | 1,128.5 |

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## Training of Track maintenance used by equipments of MR

Training on the commercial line

Track maintenance by man power

Tamping using by Hand Tie tamper of MR

Mesuearering

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## Training of Track maintenance of classroom(10/23), ceremony at Yangon Sta.(11/27)

Training of classroom using by text of Myanmar language

Practice on the track in Yangon Sta.


Donation Ceremony from JITI to MR

Demonstration of Hand Tie Tampers in Yangon Sta.

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## Training of track maintenance after the arrival of equipments from Japan

Explanation of Hand Tie Tamper

Track maintenance used by Hand Tie Tamper

Track maintenance used by jack

Track maintenance used by standard gauge

32

① Video of Morning role call

② Video of Hand Tie Tamper

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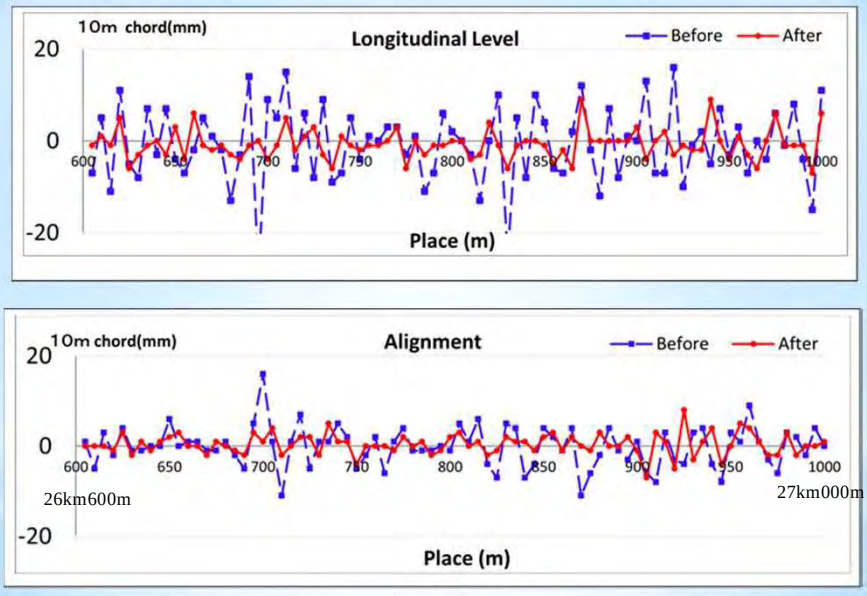


Up Line 26k600m～27k000m,
Comparison of Longitudinal Level and Alignment
Before and After the Maintenance work

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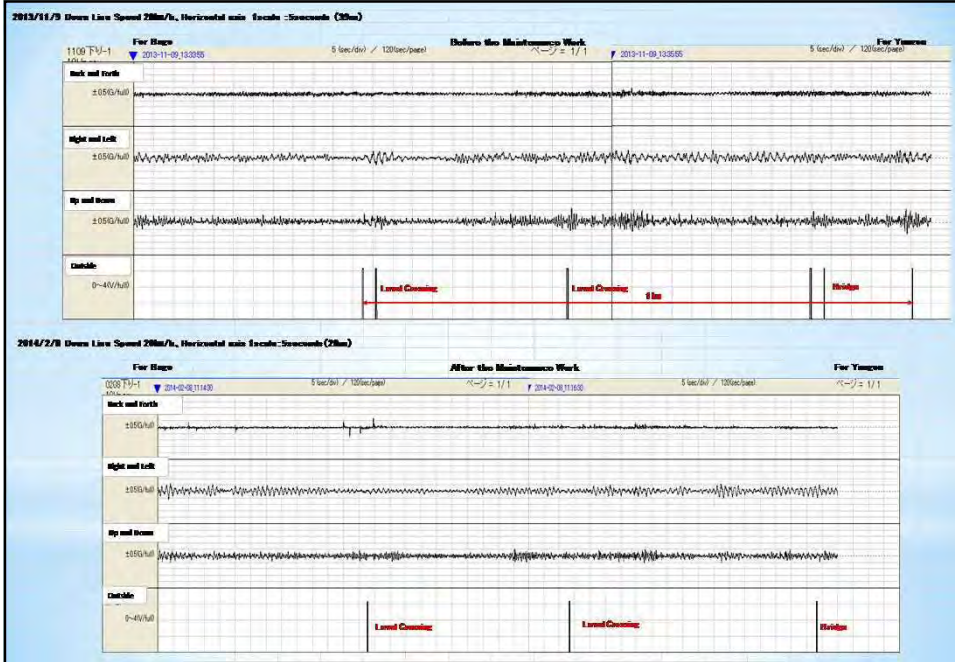


Comparison of Vehicle Vibration Acceleration Before and After the Track Maintenance Work
（Down Line　12k200m～13k500m）

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# 6　Recommendation Addressed to Achievement of Overall Goal

6.1 Recommendation of technical standards relating to administrative and maintenance aspect and drawing up railway facilities improvement plan to improve service and safety level

6.2 Technology transfer of track maintenance technology to improve the level of service and safety through implementation of the Pilot Project

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## 6.1 We would like to stress that technology transfer involves efforts in two directions.

Effort in one direction is that of transmitting the experiences of Japanese Railways (JR) from JICA experts to MR experts.
Effort in another direction is that of response of MR experts to transmission of JR's experiences by JICA experts.
These effects in two directions should be realized through mutual and substantial discussion.
It is our suggestion that Step 3 and 4 should be executed through mutual and substantial discussion among MR experts and JICA experts.

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## 6.2

The overall goal and the project purpose are the same as the sub project given in the section 6.1.
We are measuring values of some kinds of track irregularities and train vibration for evaluation of track maintenance before and after working on the commercial line.
Track irregularities measured by 10m chord include horizontal alignment and longitudinal level, and we compared the measurement values before and after the track maintenance work. Measurement of train vibration is in the vertical and lateral directions and was made in the working section once two weeks.

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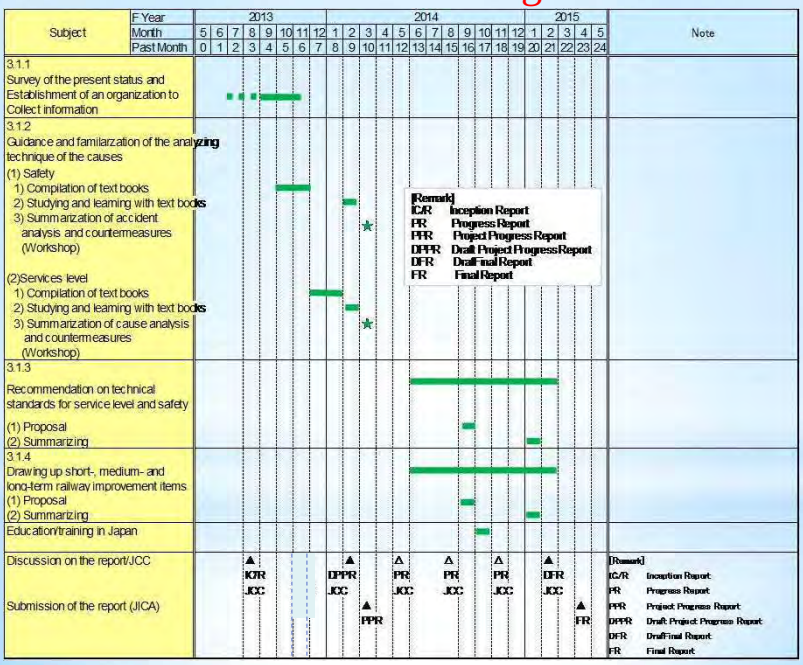
# 7． Implementation Plan for the Next Stage

7.1 Recommendation of technical standards relating to administrative and maintenance aspect and drawing up railway facilities improvement plan to improve service and safety level

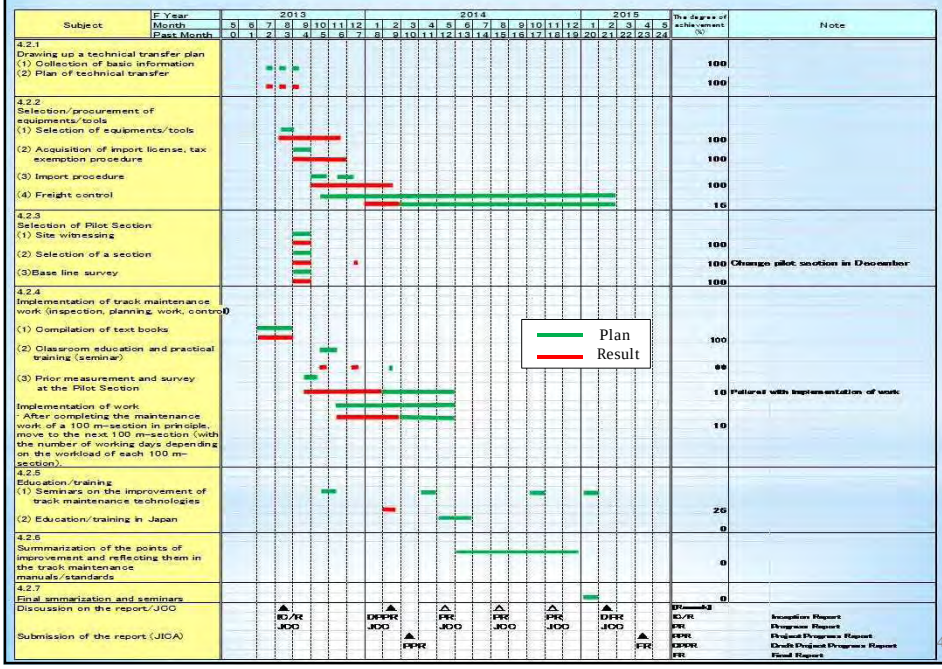
7.2 Technology transfer of track maintenance technology to improve the level of service and safety through implementation of the Pilot Project



# Schedule of Working Plan



## Schedule of Track maintenance

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Ask a favor of Myanma Railways from JICA Expert Team

We have two plans of Training in Japan.

① Railway institutional management

Implementation time Next October

Span For 2 Weeks

Numbers 11

②Training of track maintenance in Japan

(We will implement the same training twice)

Implementation time Next June

Span For 2 Weeks

Numbers 11×twice(Total:22)

Please elect 33 persons and proceed to get passport and visa.

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Thank you for your attention.