Japan International Cooperation Agency (JICA)
Syrian Arab Republic

No.

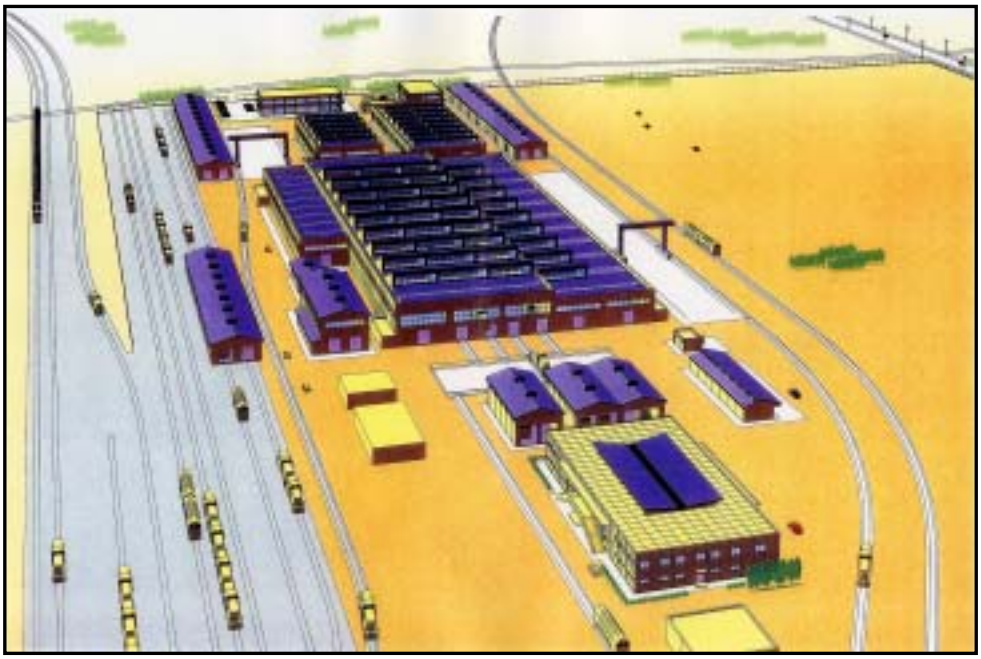
The Master Plan Study on The Development of Syrian Railways in The Syrian Arab Republic

Volume III

Feasibility Study on the Locomotive Workshop Modernization

Final Report

(Summary)



August, 2001

Japan Railway Technical Service (JARTS)
Yachiyo Engineering CO.,LTD(YEC)

SSF
JR
01-120 (3/6)

Exchange Rate of Currency

1US$=46Syrian Pounds

1US$=¥115

1 Syrian Pounds=¥2.5

January, 2001

PREFACE

In response to a request from the Government of the Syrian Arab Republic, the Government of Japan decided to conduct a Master Plan Study on the Development of Syrian Railways in the Syrian Arab Republic and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Dr. Sadaaki Kuroda of Japan Railway Technical Service, and consist of Japan Railway Technical Service and Yachiyo Engineering Co., Ltd. to the Syrian Arab Republic, 3 times between April 2000 and August 2001.

In addition, JICA set up an advisory committee headed by Mr. Hiroshi Saeki, Director, Environmental Office, Railway Bureau, Ministry of Transport (present Ministry of Land, Infrastructure and Transport) between April 2000 and August 2001, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the Syrian Arab Republic and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Syrian Arab Republic for their close cooperation extended to the Team.

August 2001

Kunihiko Saito
President
Japan International Cooperation Agency

August, 2001

Mr. Kunihiko SAITO
President
Japan International Cooperation Agency

Dear Sir,

Letter of Transmittal

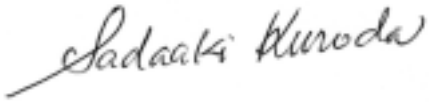
We have the pleasure of submitting herewith our Report for the Master Plan Study on the Development of Syrian Railways in the Syrian Arab Republic. The report describes the results of the Study carried out by Japan Railway Technical Service and Yachiyo Engineering Co. Ltd., as per the contract with Japan International Cooperation Agency.

The Study Team conducted field surveys three times during the period from April 2000 to August 2001. The Team held sufficient consultations with the Syrian governmental agencies concerned regarding the results of the field surveys and study activities in Japan, and drew up a master plan for the rehabilitation and modernization of the nationwide railway for the year 2020; phased rehabilitation and modernization plans for 2005 (short term), 2010 (medium term), and 2020 (long term); and two plans, as short-term urgent projects, on the rehabilitation and modernization of Tartous, Homs and Al-Sharqia section and on the locomotive workshop modernization. In close coordination with the Syrian side, the Team thereafter studied the feasibility of these plans from technical, environmental, economic, and financial aspects, and drew up this report.

From the standpoint of reinforcing the transport infrastructures necessary for the social and economic development of Syria, we would like to recommend the early implementation of the two projects: rehabilitation and modernization of the railway section between Tortous, Homs and Al-Sharqia; and locomotive workshop modernization.

We wish to express our sincere gratitude to the Japan International Cooperation Agency, the Ministry of Foreign Affairs, the Ministry of Land, Infrastructure and Transport, and the Japanese Embassy and JICA Office in Syria for the kind assistance and guidance extended to us in executing the Study.

Yours faithfully,



Sadaaki KURODA, Dr. Eng.
Leader
The Study Team for the Master Plan Study on the Development of Syrian Railways in the Syrian Arab Republic

Syria
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Caspian Sea
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Hamāh
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Damascus
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Dayr az Zawr
Tripoli
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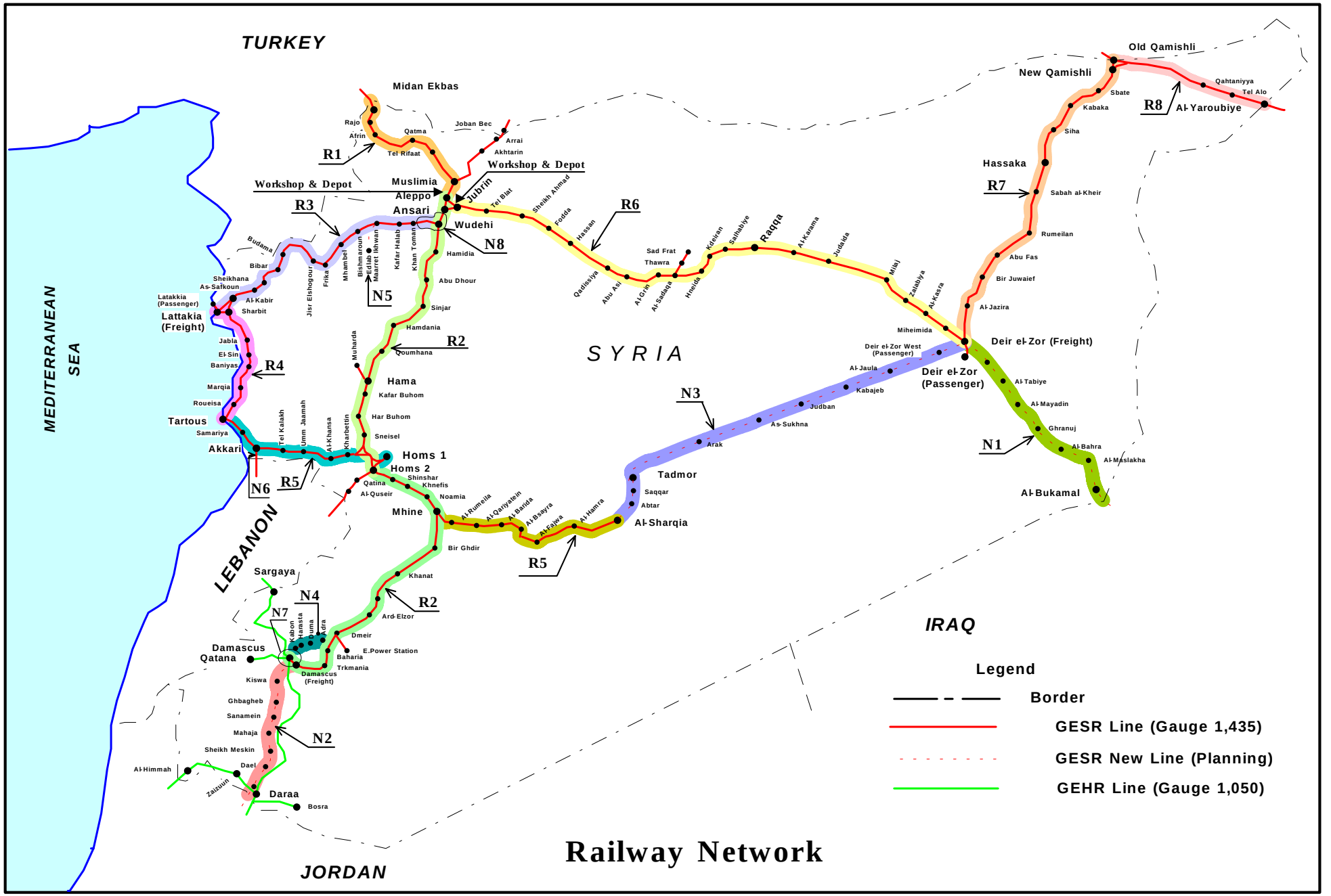
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Latakkia (Passenger)
Lattakia (Freight)
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Sharbit
Jisr Elshogour
Frika
Mhambel
Bishmaroun
Edlab
Maarret Ihwan
Kafar Halab
Khan Tomane
Hamidia
Abu Dhour
Sinjar
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Homs 2
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Abu Fas
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Legend
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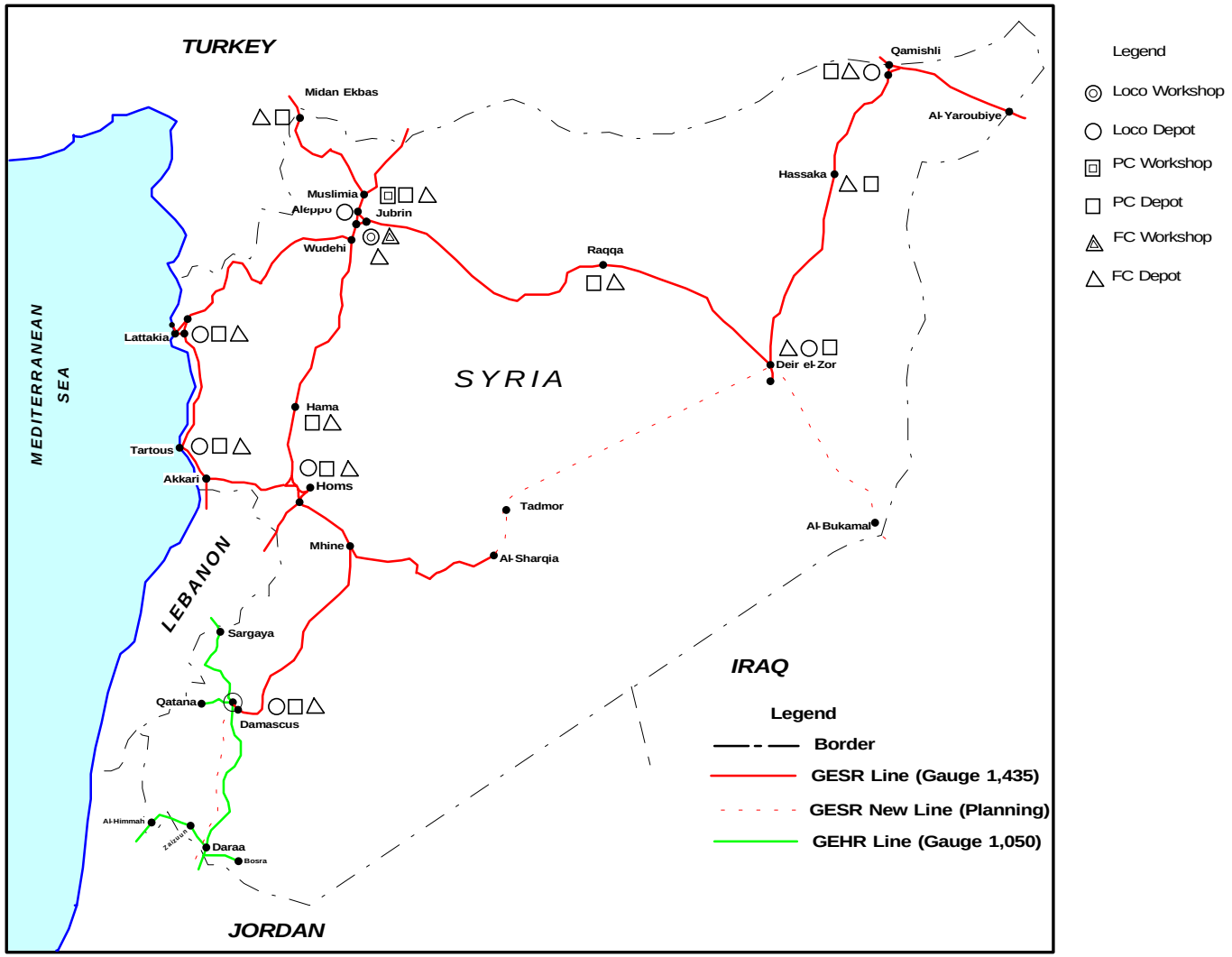
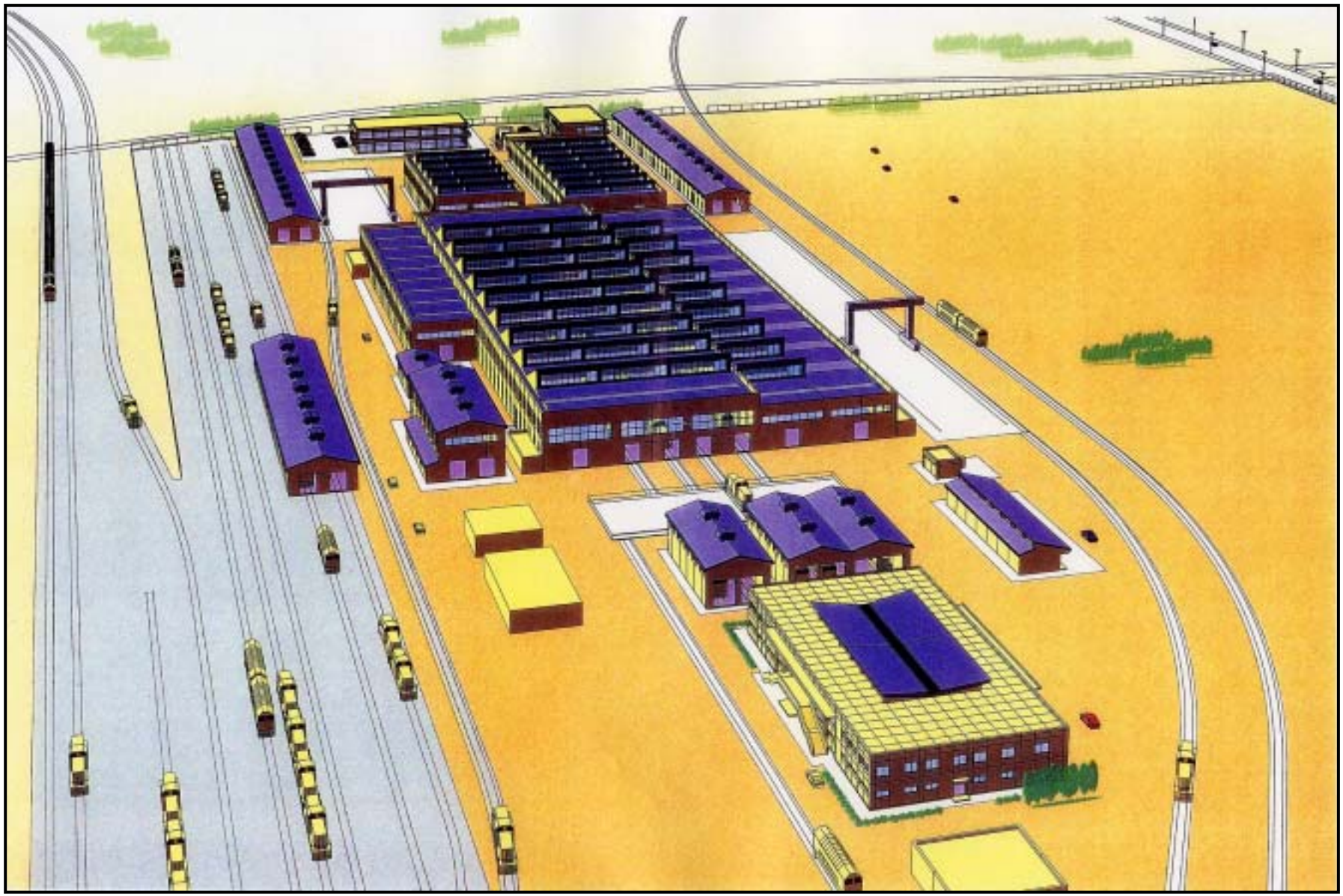
GESR Line (Gauge 1,435)
GESR New Line (Planning)
GEHR Line (Gauge 1,050)
Railway Network



Site of Workshop and Depot



Musulimia Workshop

The Master Plan Study on the Development of Syrian Railways
Volume Ⅲ

The Feasibility Study on the Locomotive Workshop Modernization (Executive Summary)

Study period : Apr,2000～Aug, 2001
Accepting Organization : Ministry of Transportation(MOT). General Establishment of Syrian Railways(GESR)

1. Purpose

Conduct the feasibility study on the modernization of the locomotive workshop, which is the short term urgent project included in the master plan study on the development of Syrian Railways. Technical transfer of the technique on rolling stock maintenance and production control was carried out through the execution of the project.

2. Method of Study

(1) In order to grasp the current situation of Jubrin locomotive workshop and the foundry shop of Aleppo passenger car workshop, conducted the additional site study besides the master plan study.

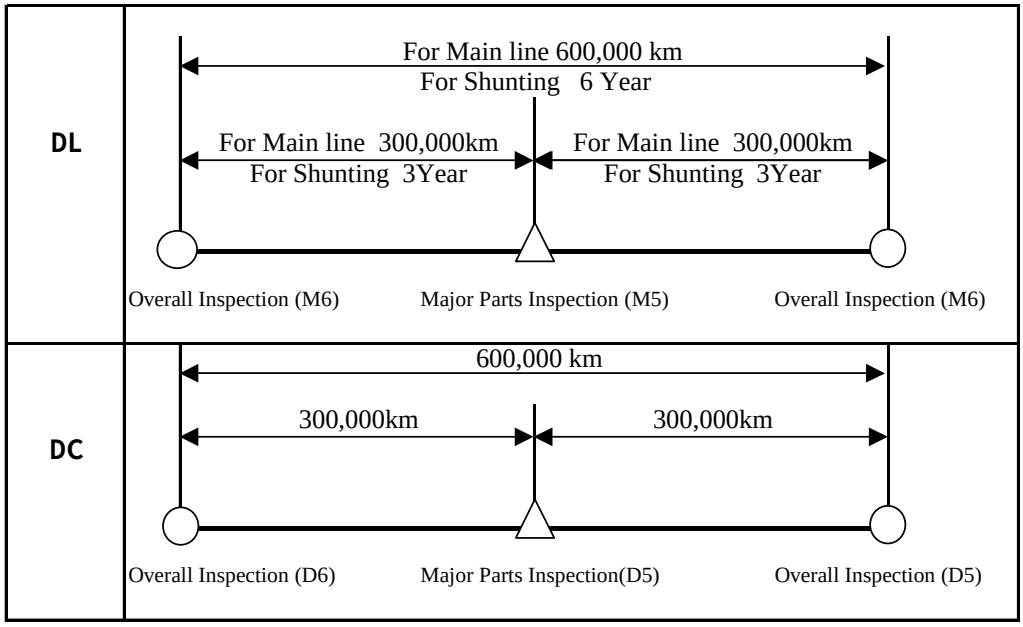
Based on these site study and results of master plan study, the feasibility study was carried out and the report was prepared under the guidance of JICA.

(2) The necessary number of rolling stock were estimated so as to meet the transport demand. In planning new works, the periodic inspection cycle, the standard process of the periodic inspection at workshop, and other fundamental matters were studied, based on the master plan study. They are as follows.

Table 2.1 Necessary number of rolling stock

	2005	2010	2015	2020
DL	116	151	221	321
DC	55	85	195	290
Total	171	236	416	611

Note : DL ------Diesel locomotive
DC-------Diesel railcar



Note ; M5,M6 ---Periodic inspection for DL D5,D6 ----Ditto for DC
In 2020, 300,000 km and 600,000 km will be extended to 450,000 km and 900,000 km respectively.

Fig 2.1 Periodic inspection cycle

Table 2.2 Standard process at workshop

(Actual work day)

	DL		DC	
	M5	M6	D5	D6
Staying period (day)	30	40	22	30

3. Outline of the project

3.1 Basic policy on locomotive workshop modernization

(1) JICA team examined two alternatives on the way of modernization, one is the expansion of Jubrin locomotive workshop, and the other is construction of new workshop. Two alternatives were compared with respect to their contents of construction, construction costs, GESR long term plan on rolling stock maintenance, etc.

As a result, the construction of new workshop was selected and the feasibility study on it was conducted.

In addition, at the new workshop, brake shoes for all rolling stock in GESR would be cast besides periodic inspection of DLs and DCs.

(2) Necessary number of DLs and DCs to be inspected was estimated, based on Table 2.1 and Fig 2.1, with some allowance for examination of building, facilities and equipment plan, and with severe one in a likely way for examination of rolling stock maintenance work. Casting quantity of brake shoes were assumed based on the current consumed ones and necessary number of rolling stock.

3.2 Main outline of the plan

(1) For the planning of buildings, facilities and equipment, 144 DLs and the same number of DCs were assumed to be maintained per year and 3,400 tons per year for brake shoes casting.

(2) For the examination of work volume, personnel, organization and so forth, the number of DLs and DCs to be inspected and casting quantity of brake shoes as shown in Table 3.2.1 and Table 3.2.2 were assumed.

Table 3.2.1 Yearly number of DLs and DCs to be inspected

		2006	2010	2015	2020
DL	Periodic inspection	44	55	66	107
	Temporary inspection	23	30	44	64
DC	Periodic inspection	22	34	89	122
	Temporary inspection	11	17	39	58
Total	Periodic inspection	66	89	155	229
	Temporary inspection	34	47	83	122

Reference : Max. maintenance capacity of Jubrin locomotive workshop (2000)
35 LDE2800s M5or M6 per year

Table 3.2.2 Quantity of brake shoes casting (t/year)

	2006	2010	2015	2020
Total	1,500	2,100	3,400	5,400

(3) Outline of new workshop scale

1) The new workshop will be built in the area of about 38 ha, adjacent to Muslimia station.

2) Main shop area, facilities and equipment for rolling stock maintenance and those attached to buildings are as shown in Table 3.2.3.

Table 3.2.3 Workshop building, facilities and equipment

	New workshop	(Reference) Jubrin locomotive workshop
Main shop area (m^2)	34,000	11,000
Facilities and equipment for rolling stock maintenance (Piece, set)	1,020	125
Casting capacity (ton /year)	3,400	-
Lightning protection (set)	1	-
Waste water treatment plant (set)	1	(-)
Incineration equipment (set)	1	-
Others	Omitted	

3) General layout for the new workshop

General layout for the new workshop is shown in Fig 3.2.1.

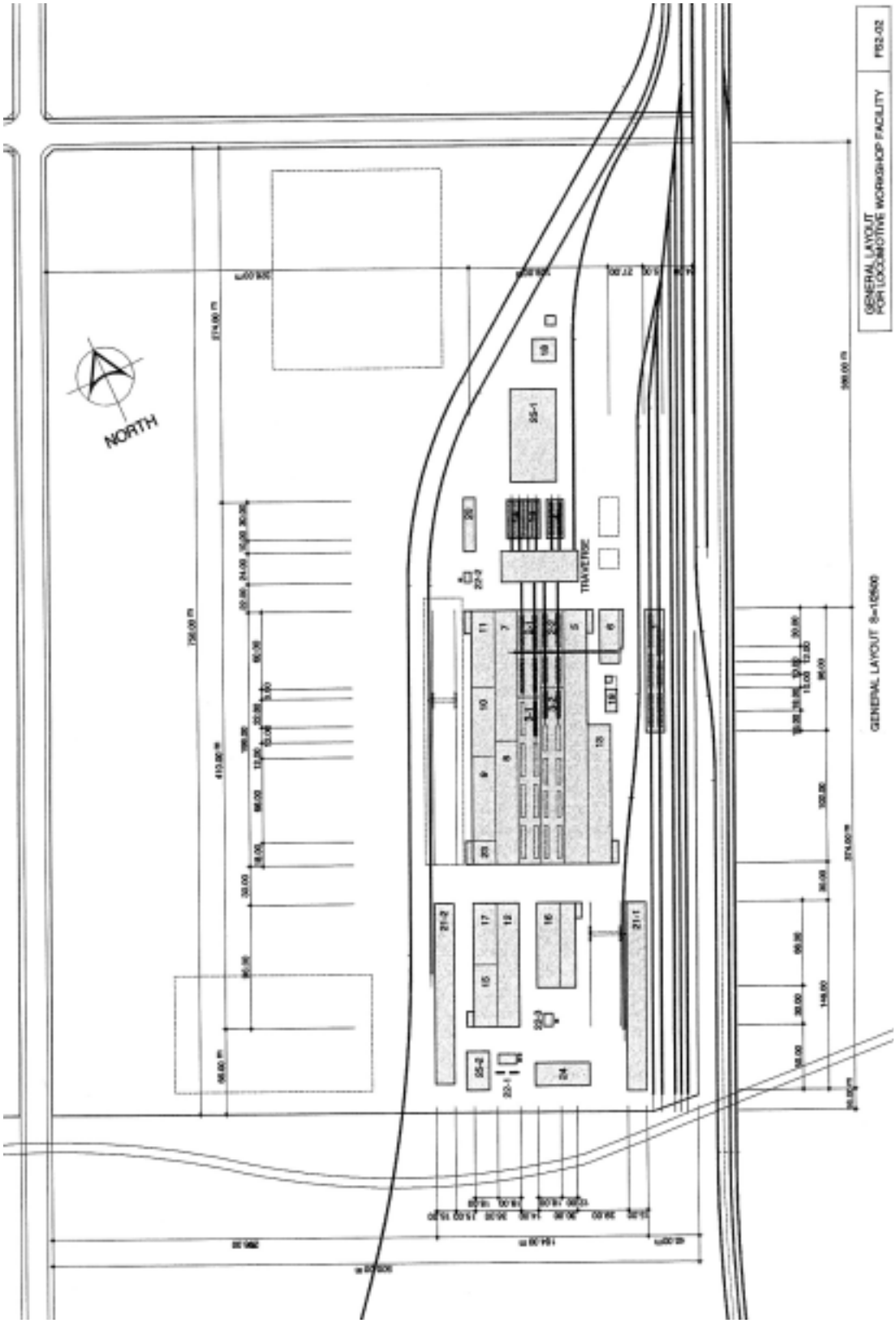


Fig 3.2.1 General layout for the new workshop

4) Organization and personnel

Based on the organization and daily working hour at Jubrin locomotive workshop, seven sections were allocated including one in charge of casting under the workshop manager. Personnel assumption is shown in Table 3.2.4.

Table 3.2.4 Personnel assumption

(person)

	2005	2006	2010	2015	2020
Total	420	420	530	770	1,150

Note ; Allocate 420 persons for Oct. to Dec. in 2005 to prepare the start of workshop operation in 2006

5) Management and operation cost

Table 3.2.5 Management and operation cost (1000sp/year)

	2005	2006	2010	2015	2020
Total	4,347	50,314	57,833	73,650	94,492

6) Construction cost

Table 3.2.6 Construction cost

Unit;1,000SP

Item		Cost		
		FC	LC	Total
Construction of new work shop	Land		37,500	37,500
	Civil work	106	228,249	228,355
	Track work	118,449	67,003	185,452
	Building work	377,505	1,522,149	1,899,654
	Mechanical work	5,017,833	314,479	5,332,312
	Subtotal	5,513,893	2,169,380	7,683,273
Engineering fee (5%)		384,164		384,164
Contingency (5%)		294,903	108,469	403,372
Total		6,192,960	2,277,849	8,470,809

(4) Economic and financial evaluation

Table 3.2.7 Economic and financial internal rates of return

Economic internal rates of return (EIRR)	Financial internal rates of return (FIRR)
21.0%	6.4%

(5) Environmental impact assessment

Examination of 23 related items resulted in that a little impact will be expected for seven items and their further study with the progress of the project would be necessary, however, as far as the environmental impact assessment is concerned, the project is feasible.

4. Comprehensive evaluation of the project (Conclusion)

(1) The project of new workshop construction at the site adjacent to Muslimia station to conduct the maintenance work for DLs and DCs, and brake shoes casting for all of rolling stock in GESR, will cope with the GESR's long term plan on rolling stock maintenance. It will also contribute to the GESR management.

(2) The following effects are expected in the execution of the project.

- Execution of rolling stock periodic maintenance in accordance with the yearly plan.
- Decrease of staying days at workshop for maintenance.
- Improvement of maintained rolling stock quality
- Improvement of technique on rolling stock maintenance, production and production control.
- Decrease of rolling stock maintenance cost
- Decrease of environmental impact

(3) The EIRR of the project from the national economic standpoint is 21.0%. The project is considered to be feasible.

(4) The FIRR of the project from the enterprise view of GESR is 6.4%. The project can be judged as financially viable in case reasonable interest loan is applied to investment.

(5) For the effective implementation of the project, some recommendations are made concerning the effective management of workshop.

Contents

Abbreviation and Glossary

ADT	Average Daily Traffic
AOC	Administration and Operation Cost
ATP	Automatic Train Protection
ATS	Automatic Train Stop
B/C	Benefit Cost Ratio
BOD	Biochemical Oxygen Demand
CCITT (ITU-T)	International Telecommunication Union
CIF	Cost, Insurance and Freight
COD	Chemical Oxygen Demand
CONOCO	Continental Oil Company
CT	Closed Track Circuit
CTC	Centralized Traffic Control
DC	Diesel Car
DEL (LDE)	Diesel Electric Locomotive
DGMO	Director Generals of Middle East Railways
DHL	Diesel Hydraulic Locomotive
DL	Diesel Locomotive
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
FC	Freight Wagon
FIRR	Financial Internal Rate of Return
FS（F/S）	Feasibility Study
GCEA	General Council for Environmental Affairs
GDP	Gross Domestic Products
GEHR	General Establishment of Hidjaz Railways
GESR	General Establishment of Syrian Railways
GORS	General Organization of Remote Sensing
GRDP	Gross Regional Domestic Products
HID	High Intensity Discharge
HMIS	Highway Maintenance and Inspection System
HVAC	Heating, Ventilation and Air Conditioning
IEC	International Electro Technical Commission
IRI	International Roughness Index
ISO	International Standard Organization
JICA	Japan International Cooperation Agency
JR	Japan Railway

LED	Light Emitting Diode
MOF	Ministry of Finance
MOT	Ministry of Transport
MP（M/P）	Master Plan
MRT	Mass Rapid Transport
NDP	Net Domestic Products
NEAP	National Environmental Action Plan
NEEDS	Nikkei Economic Evaluation Data System
NPV	Net Present Value
OD	Origin-Destination
OJT	On the Job Training
OLTC	On Load Tap Changer
OT	Open Ticket Circuit
PABX	Private Automatic Branch Exchange
PC	Passenger Coach
PC sleeper	Prestressed concrete sleeper
ROC	Rail Operating Cost
ROI	Return on Investment
ROE	Return on Equity
ROUC	Rail Operating Unit Cost
ROW	Right of Way
SDH	Synchronous Digital Hierarchy
SL	Steam Locomotive
SS	Suspended Solides
TQC	Total Quality Control
TTC	Travel Time Cost
TTUC	Travel Time Unit Cost
TTUC	Travel Time Unit Value
UIC	International Railway Union
UN	United Nations
UNDP	United Nations Development Programme
VOC	Vehicle Operating Cost
VOUC	Vehicle Operating Unit Cost

Chapter 1 Introduction

1.1 Back ground of the project

In the Master Plan Study on the Development of Syrian Railways, in addition to the renewal of rolling stock, the modernization of rolling stock maintenance has been adopted, hoping that the modernization of rolling stock maintenance will contribute to the management of GESR through the efficient and economical execution of rolling stock maintenance.

From this point of view, the modernization of Jubrin locomotive workshop has been designated as the short term urgent project for the feasibility study.

1.2 Urgency and importance of this project

At present, 177 diesel locomotives (DL) are owned by the GESR, and large-scale scheduled inspection and large-scale unscheduled repairs of these locomotives are carried out at the Jubrin locomotive workshop. However, the workshop is narrow, its layout is inefficient, and facilities are old. Therefore, sufficient repair of locomotives is impossible, and the availability of the total locomotives is only 45 %.

In the modernized workshop, the periodic maintenance of DLs and DCs to be introduced and brake shoes casting for all rolling stock in GESR will be carried out, and it is aimed to reduce the number of days necessary for regular inspections and to reduce the number of rolling stock failures and to reduce the number of temporarily repairs.

It is also aimed to enhance availability of locomotives and diesel cars. At the same time, by the implementation of this project, it will become possible for the GESR to acquire the benefit of the technology transfer related to inspection and repair of rolling stock, quality control and the spare parts control system etc.

Chapter 2 Demand Forecast

2.1 Implementation methodology

The workflow for the demand forecast practice is divided into four tasks, which are subsequently divided into 13 sub-tasks as shown in Fig. 2.1.1. For all the tasks the data for 10 years was collected. The ten-year period was selected because during that period the Syrian economy has been gradually changing from a centrally planned economy to a free market one. There are two zoning systems; large zones which confirm to the administrative governorates boundaries, and small zones which group a number of main stations. The road transport OD has been prepared based on the traffic counts at stations on the governorate borders. The rail transport OD has been prepared based on the GESR data concerning transport between the stations. In addition the pipeline OD and air transport OD have been prepared on the basis of the pipeline and air networks respectively. The UN classification for commodities has been adopted in this study with some minor adjustment to reflect certain conditions particular to Syria.

Trip production, generation and attraction volumes were calculated for passengers, while for the commodities the production and consumption amounts were calculated. Trip distribution followed the present pattern because of the following reasons:

a. No drastic changes in the land use pattern in Syria are anticipated
b. Amount changes in the 32 commodity types are reflected in the OD table

Based on the results of a separate survey the passenger transport modal split model was prepared. For the freight transport, another survey revealed that the main criteria for mode selection was the minimum cost and accordingly the modal split model was prepared.

The future indicators were mainly produced from the econometric model and the population model. In addition a sub-model was developed to forecast supplementary indicators.

Assignment of the traffic was done on the basis of the small zones. In the freight OD and in the passenger OD, pipeline transport and air transport respectively were treated independently. The modal split model was used to assign the passengers traffic on the bus and rail modes and the freight traffic on the truck and rail modes.
The workflow is briefly described in the Fig 2.1.1. Details of the work are voluminous and are

represented in the Appendix 7 of Volume I..

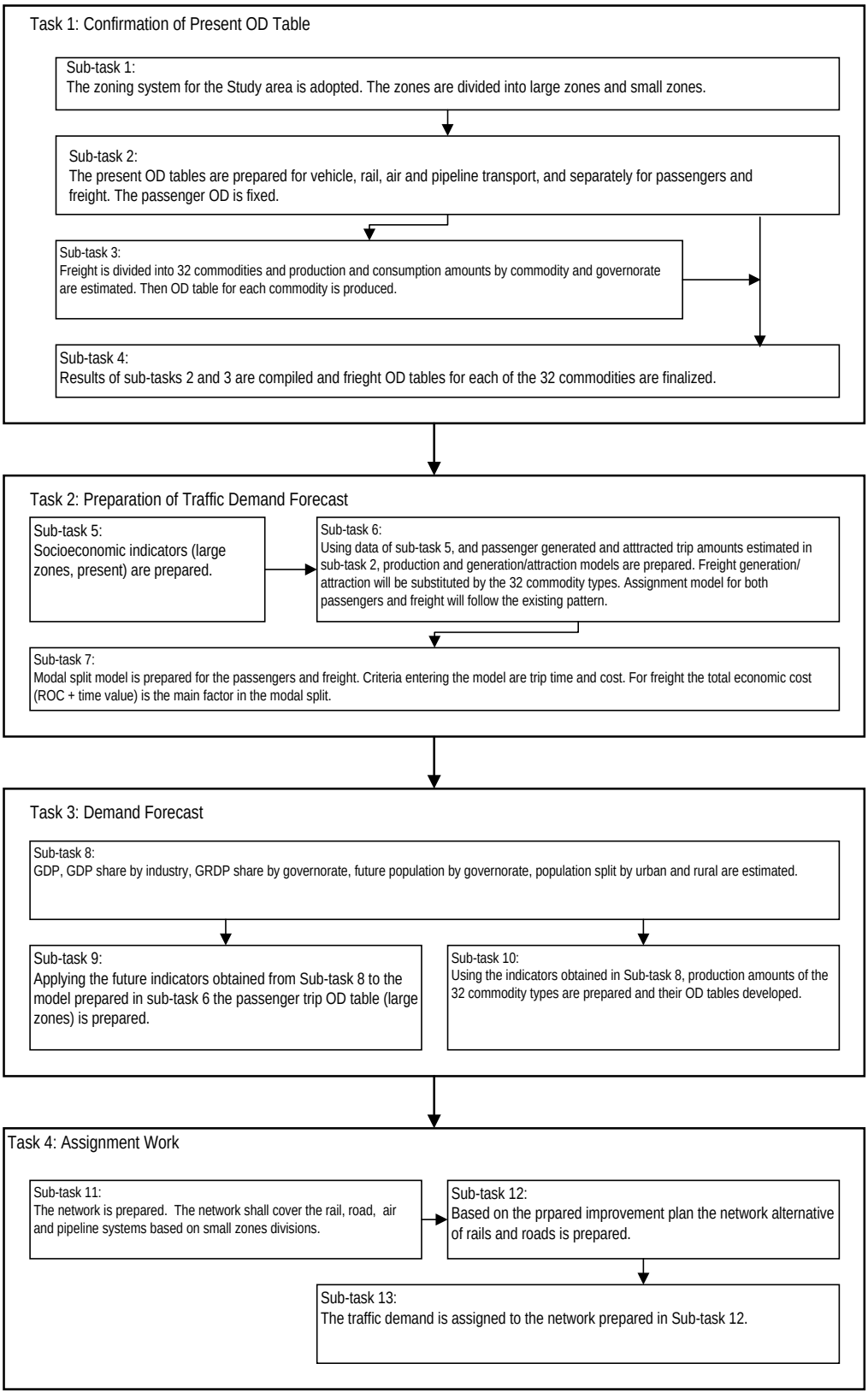


Fig 2.1.1 Flow chart for demand forecast work

2.2 Traffic demand forecast

Under the master plan the number of passengers and amount of freight transported by rail in the year 2020 are expected to increase by 6.3 times and 6.8 times the present figures for each respectively. The shares of rail transport of the total land based transport in 2020 are predicted to be 5% for passengers and 9% for freight (see Table 2.2.1).

Table 2.2.1 Summation of Traffic Demand Forecast excluding Intra-zonal Volume

Indicators	1999	2005	2010	2015	2020
GESR					
Passenger/day	2,323	4,182	6,186	9,860	14,546
Passenger-km/day	512,329	1,511,601	2,522,666	3,934,874	5,664,719
Ton/day	14,918	22,494	35,291	62,409	103,118
Ton-km/day	4,320,548	6,991,714	11,904,130	21,300,641	35,944,313
Road					
Passenger/day	129,973	138,985	189,029	211,867	303,546
Passenger-km/day	34,111,692	38,318,171	46,257,908	58,489,459	76,211,042
Ton/day	215,612	259,379	554,240	587,486	1,066,510
Ton-km/day	51,509,893	73,191,522	107,202,860	162,601,950	245,610,890

Passenger and freight railway traffics in 2020 are shown in Figures 2.2.1 and 2.

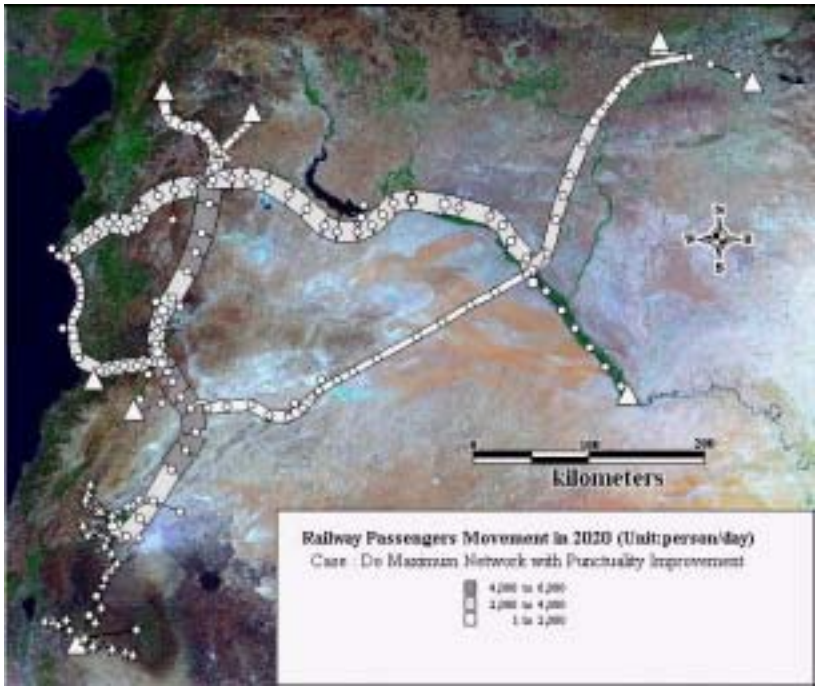


Figure 2.2.1 Passenger railway traffic assignment in 2020

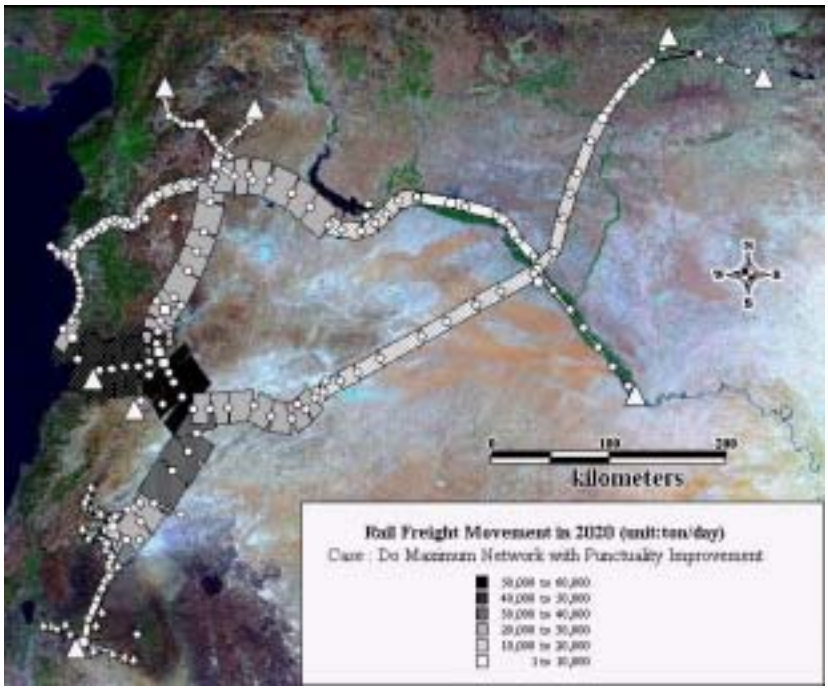


Figure 2.2.2 Freight railway traffic assignment in 2020

Chapter 3 Transportation Plan

3.1 Fundamental premises for setting up transportation plan

(1) Operating speed.

Passenger train 130km/h

Freight train 100km/h

However, the permissible speed of locomotive hauled passenger train is 100km/h.

(2) Signaling system

Signaling system is an automatic blocking system.

(3) Driving power system

As for powering system, diesel engine is adopted. Overnight sleeper train and a part of daytime passenger coach train are to be hauled by diesel electric locomotive (DEL), but as a rule, day time operating train is to be by diesel railcar (DC) train.

Regarding day time train, DEL traction passenger coach train and Diesel car train are co-used by 2010, but after 2010, all day time passenger trains are to be by small formation of diesel railcar (DC) train to perform frequent service.

(4) Train formation

1) Passenger train

Referring to the result of forecasted transportation demand, the formation of sleeper train is 9～11 coaches and daytime passenger coach train is 2～4 coaches and that of DC train is 1～5 cars considering frequent service.

2) Freight train

The single headed operation is the principle of freight train and hauling capacity is to be 1400～2000 tons with 70% of hauling efficiency and 60% of loading factor, referring to the current actual performance.

In addition to above, if the hauling capacity become half due to steep gradient, double headed operation is planned.

(5) Rolling stock and its characteristics

All of the train except sleeper train and a part of day time train is formed by only DC with possible maximum speed of 130km/h.

In case of locomotives, weeding out smaller output locomotives, high output locomotives will be assumed on the condition that the track will be renovated to secure above mentioned hauling capacity.

(6) Transportation demand

Result of transportation demand study is as follows.

Year	1999	2005	2010	2015	2020
Passenger/day	2,323	4,182	6,186	9,860	14,546
Passneger-km/day	512,329	1,511,601	2,522,666	3,934,674	5,664,719
Ton/day	14,918	22,494	35,291	62,409	103,118
Ton-km/day	4,320,548	6,991,714	11,904,130	21,300,641	35,944,313

(7) Riding factor and hauling factor

1) Riding factor

The riding factor of passenger train is premised as 70%. Seating capacity of 1st class coach is 60 and 2nd class is 80, while the capacity of sleeping car is 22.

2) Hauling factor

Based on the actual result, hauling factor of freight car is to be 70% and 60% of hauling capacity is loading weight.

3) Fluctuation of transportation

Based on the actual result, seasonal fluctuation of passenger train is to be 30% in section between Aleppo～Lattakia and 10% in other sections, and for freight train,10%.

3.2 Transportation plan

(1) Train operation plan

1) Passenger train operation plan

Passenger train is planned as in Table 3.1.

Table 3.1 Passenger train operation plan by section

Year		2005				2010				2015				2020			
Section	Train Type / Class	DC 1st	DC 2nd	PC	Total	DC 1st	DC 2nd	PC	Total	DC 1st	DC 2nd	PC	Total	DC 1st	DC 2nd	PC	Total
	No. of car/Train	2	2	9		2	2	9･4		3	2	11		3	2	11	
Aleppo ～ Damascus	Aleppo-Hama	4		4	8	6		2	8	12		2	14	16		2	18
	Hama-Homs	4		4	8	8		2	10	14		2	16	16		2	18
	Homs-Mhine	6		6	12	8		4	12	18		4	22	22		4	26
	Mhine-Damascus	6		6	12	10		8	18	18		6	24	22		6	28
Aleppo～ Midan Ekbas･Arri	No. of car/Train		1	2		1	1	2	3	1	1			1	2		
	Aleppo-Muslimia	2		4	6	4		2	6	6			6	6			6
	Muslimia-Midan Ekbas	2		4	6	4		2	6	6			6	6			6
	Muslimia-Arrai	2			2	2			2	2			2	2			2
Mhine～ Deir el Zor	No. of car/Train							9･4		3	2	11		3	2	11	
	Mhine-Tdmor	0			0			4	4	4		2	6	4		2	6
	Tadmor-Deir el Zor	0			0			4	4	4		2	6	4		2	6
Homs～ Lattaia	No. of car/Train	1	1	9･4		2	2	9･4		2	2	11		3	2	11	
	Homs-Tartous	4		4	8	4		4	8	8		2	10	10		2	12
	Tartous-Lattakia	4		4	8	4		4	8	8		2	10	8		2	10
Aleppo～ Lattakia	No. of car/Train	2	2	4		3	2	5		3	2			4	4		
	Aleppo-Jisr Elshogour	10		2	12	10		2	12	18			18	20			20
	Jisr Elshogour-Lattakia	10		2	12	10		2	12	18			18	20			20
Aleppo～ Deir el Zor	No. of car/Train	2	2	9･4		2	2	9･4		2	2	11		2	2	11	
	Aleppo-Raqqa	2		6	8	4		4	8	8		2	10	18		2	20
	Raqqa-Deir el Zor	2		6	8	4		4	8	8		2	10	16		2	18
Deir el Zor ～Qamishili	No. of car/Train	1	1	9		2	2	9･4		2	2	11		2	2	11	
	Deir el Zor-Hassaka	2		8	10	4		6	10	6		4	10	10		4	14
	Hassaka-Qamishili	2		8	10	4		6	10	6		4	10	10		4	14
No. of car/Train				2				2			1			1	1		
Qamishili-Al-Yaroubiye				4	4			4	4	4			4	4			4
No. of car/Train											1			1	1		
Damascus ～Darra										6			6	6			6
No. of car/Train				2				2			1				1		
Deir el Zor～Al Bukamal				2	2			2	2	2			2	2			2

2) Freight train operation plan

Yearly and sectional train operation plan is as indicated in Table 3.2.

Table 3.2 Yearly and sectional freight train operation plan

Year			Hauling	2005			2010			2015			2020		
Section			Capacity	Phosphate	Other	Total	Phosphate	Other	Total	Phosphate	Other	Total	Phosphate	Other	Total
Jubrin-Damascus	Jubrin-Aleppo		1400		2	2		4	4		8	8		16	16
	Jubrin-Ansari		1400		12	12		12	12		32	32		58	58
	Aleppo-Ansari		1400		4	4		10	10		18	18		32	32
	Ansari-Wudehi		1400		18	18		24	24		50	50		90	90
	Wudehi-Abu Dhour		1400		14	14		16	16		36	36		64	64
	Abu Dhour-Sinjar		1400		12	12		16	16		32	32		56	56
	Sinjar-Hama		1400		12	12		14	14		30	30		52	52
	Hama-Homs		1400		14	14		18	18		36	36		62	62
	Homs-Mhine		1400	14	16	30	18	36	54	22	65	87	26	110	136
	Mhine-Khanat		1400		16	16		30	30		56	56		94	94
	Khanat-Dmeir		1400		18	18		30	30		58	58		98	98
	Dmeir-Damascus(f)		1400		6	6		8	8		10	10		12	12
Dmeir-Kaboun	Dmeir-Adra		1400		8	8		8	8		34	34		60	60
	Adra-Kaboun		1400		8	8		8	8		34	34		60	60
Aleppo-Midan Ekbas Arrai	Aleppo-Muslimia		1400		10	10		10	10		22	22		38	38
	Muslimia-Qatma		1400		2	2		4	4		10	10		14	14
	Qatma-Midan Ekbas	W	1250		2	2		6	6		10	10		18	18
	Muslimia-Arrai	W	1250		2	2		4	4		8	8		14	14
Mhine-Tadmor-Deir el Zor	Mhine-Al Fajiwa		1400	14	2	16	18	12	30	22	20	42	26	36	62
	Al Fajiwa-Al Sharqia		1400	12	2	14	14	12	26	18	20	38	22	36	58
	Al Sharqia-Tadmor		1400		2	2		12	12		22	22		38	38
	Tadmor-Deir el Zor(f)		1400		0	0		12	12		20	20		36	36
Homs-Lattakia	Homs-Tartous	W	1400	14	26	40	18	46	64	22	68	90	24	102	126
	Tartous-Sharbit		1400		4	4		4	4		8	8		14	14
	Sharbit-Lattakia (p)		1400		4	4		4	4		8	8		14	14
Wudehi-Lattakia	Wudehi-Bishmaroun		2000		4	4		6	6		10	10		18	18
	Bishmaroun-Mhambel		2000		4	4		6	6		12	12		20	20
	Mhambel-Frika		1400		6	6		8	8		16	16		28	28
	Frika-Sheikhana		1400		6	6		8	8		16	16		26	26
	Sheikhana-Arkabir		1400		6	6		6	6		12	12		20	20
Jubrin-Deir el Zor-Yaroubiye	Jubrin -Tel Blat		2000		8	8		8	8		14	14		28	28
	Tel Blat-Sheikh Ahmad		2000		8	8		8	8		14	14		26	26
	Sheikh Ahmad - Qadissiya		2000		8	8		8	8		14	14		26	26
	Qadissiya-Al Grin		2000		8	8		8	8		14	14		26	26
	Al grin-Raqqa		2000		6	6		6	6		12	12		24	24
	Raqqa-Deir el Zor(f)		2000		6	6		4	4		8	8		16	16
	Deir el Zor(f)-Hassaka		2000		4	4		8	8		12	12		22	22
	Hassaka-New Qamishli		2000		2	2		4	4		6	6		10	10
	New Qamishli-Qahtaniyya		2000		2	2		4	4		6	6		2	2
	Qahtaniyya-Tel Alo		2000		2	2		2	2		2	2		2	2
	Tel Alo-Al Yaroubiye		2000		0	0		0	0		2	2		2	2
Damascus(f)-Daraa	Damascus-Alkesweh		1400		0	0		1	1		34	34		58	58
	Alkesweh-Sanamein		1400		0	0		0	0		16	16		28	28
	Sanamein-Daraa		1400		0	0		0	0		14	14		24	24
Deir el Zor-Bukamal	Deir el Zor-Tabiye		1400		6	6		6	6		8	8		10	10
	Tabiye-Mayadin		1400		2	2		4	4		6	6		10	10
	Mayadin-Al Bukamal		1400		2	2		2	2		4	4		6	6

Note: "W" is assisting run of a locomotive

The train exclusively transporting phosphate rock is planned to operate on the section of Tartous～Homs～Mhine～Al-Sharqia, and other freight train is planned as general freight transporting train.

3) Train kilometer and car kilometer

Table 3.3 indicates daily train kilometer and car kilometer calculated by yearly transportation plan.

Table 3.3 Train kilometer and car kilometer

Year		1999	2005	2010	2015	2020
Passenger/day		2,323	4,182	6,186	9,860	14,546
Passneger-km/day		512,329	1,511,601	2,522,666	3,934,674	5,664,719
Ton/day		14,918	22,494	35,291	62,409	103,118
Ton-km/day		4,320,548	6,991,714	11,904,130	21,300,641	35,944,313
Train km /Day	Passenger Train	2,931.5	14,223.2	16,340.4	22,790.8	28,866.6
	Freight Train	11,453.4	18,448.3	30,853.9	53,039.6	86,478.1
	Total	14,384.9	32,671.5	47,194.3	75,830.4	115,344.7
DC	Train Km/day	0.0	6,151.8	8,446.0	18,712.2	24,788.0
	Car km/day	0.0	21,318.2	34,563.6	80,034.2	120,717.6
PC	Train km/day	2,931.5	8,071.4	7,894.4	4,078.6	4,078.6
	Car km/day	18,141.9	50,989.2	50,036.4	41,781.0	41,781.0
FC	Car km/day	174,268.6	280,414.9	468,979.3	806,201.9	1,314,467.1
LOC Car km/day	For Passenger train		8,878.5	8,683.8	4,486.5	4,486.5
	For freight train		21,096.7	35,426.4	60,908.1	99,803.4
	Total	14,767.1	29,975.2	44,110.2	65,394.6	104,289.9

3.3 Necessary number of rolling stock

Table 3.4 indicates necessary number of rolling stock by year.

Table 3.4 Necessary number of rolling stock by year

Year	2005	2010	2015	2020
PC	190	190	140	140
DC	55	85	195	290
DL(Main Line)	80	115	185	285
DL(Shunting)	25	35	55	85
FC	5,000	7,500	10,800	18,000

Chapter 4 Maintenance Plan

4.1 Number of vehicle to be inspected in a year and standard process (2006, 2010, 2015 and 2020)

4.1.1 Yearly number of vehicle to be inspected

(1) Interval of inspection

Interval of inspection is stated in Master plan as follows.

1) Inspection cycle of locomotive

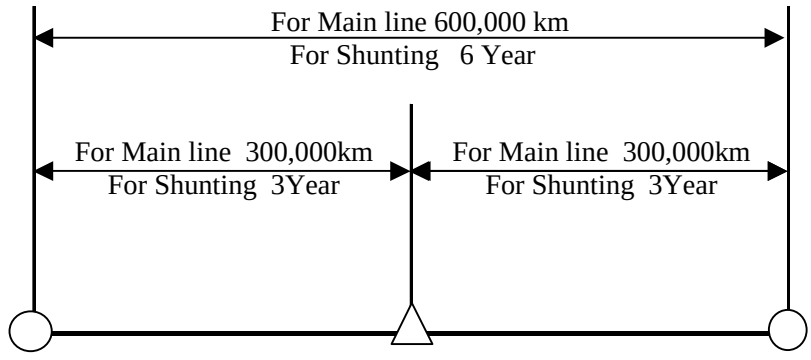
Major parts inspection (M5)	Main line locomotive	300,000km(In 2020, 450,000 km)
	Shunting locomotive	3 years
Overall inspection (M6)	Main line locomotive	600,000km(In 2020, 900,000km)
Shunting locomotive	6 years	

2) Inspection cycle of diesel railcar

Major parts inspection (D5)	300,000km(In 2020, 450,000km)
Overall inspection (D6)	600,000km(IN 2020, 900,000km)

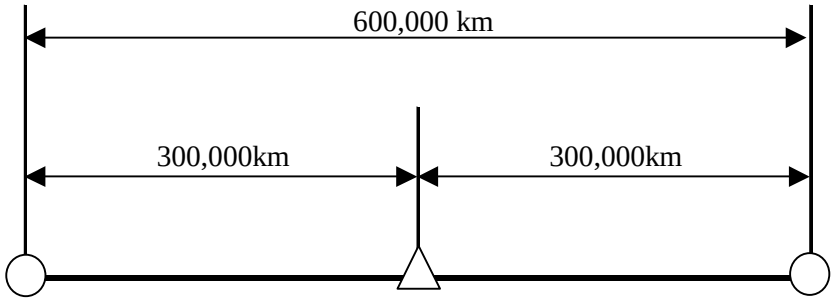
(2) Maintenance system

Fig. 4.1.1 and Fig. 4.1.2 indicate maintenance systems of diesel locomotive and diesel rail car of 2015, respectively, based on the Inspection cycle.



Note; In 2020, 300,000km for M5 and 600,000km for M6 will be extended to 450,000 km for M5 and 900,000 km for M6.

Fig. 4.1.1 Maintenance system of diesel locomotive (2015)



Note; In 2020, 300,000km for D5 and 600,000km for D6 will be extended to 450,000 km for D5 and 900,000 km for D6.

Fig. 4.1.2 Maintenance system of diesel rail car (2015)

(3) Rate of shop in

Rate of shop in is indicated as follows.

Main line locomotive ; 0.31 (In2020, 0.21)

Shunting locomotives ; 0.18

Diesel railcar ; 0.34(In 2020, 0.23)

(4) Annual number of vehicles to be inspected

1) Annual number of vehicles to be inspected are considered due to the capacity of workshop facilities.

Annual number of vehicles to be inspected is as indicated in Table 4.1.1 Number of rolling stock inspected in a year.

Table 4.1.1 Number of rolling stock inspected in a year

Year		2006		2010		2015		2020	
Type of car \ Type of Inspection		Overall inspection	Major parts inspection	Overall inspection	Major parts inspection	Overall inspection	Major parts inspection	Overall inspection	Major parts inspection
Locomotive	Main line	28	28	40	40	64	64	98	98
	Shunting	8	8	8	8	8	8	8	8
	Total	36	36	48	48	72	72	106	106
Diesel rail car		21	21	32	32	72	72	109	109

Note; Figures in 2020 are based on the same inspection cycle as those in 2006～2019, for the convenience of study.

2) Related to the examination on construction and installation of building, facilities and equipment, estimated the number of DLs and DCs to be inspected with some allowance.

However, on maintenance system, estimated them in much likely way.

Number of vehicles to be inspected for study on the maintenance system is as in the Table 4.1.2.

Table 4.1.2 Number of Dls and DCs for periodic inspection by year (car/year)

		2006	2010	2015	2020
DL	M5	24	31	46	62
	M6	20	24	20	45
	Total	44	55	66	107
DC	D5	11	17	50	64
	D6	11	17	39	58
	Total	22	34	89	122

4.1.2 Standard process

The standard process is as in master plan when the maintenance facilities plan is build up.

(1) Day of standard process of locomotive

	2015	2020
Major parts inspection (M5)	30days	29days
Over all inspection (M6)	40days	37days

(2) Day of standard process of diesel railcar

	2015	2020
Major parts inspection (D5)	22days	21days
Over all inspection (D6)	30days	28days

4.2 Annual quantities of major parts to be inspected

(1) Rolling stock major parts

Table 4.2.1 Annual quantities of DL major parts to be inspected

(Piece, set/year)

	2006~2009		2010~2014		2015~2019		2020~2024	
	Periodic	Temporary	Periodic	Temporary	Periodic	Temporary	Periodic	Temporary
Engine	44	2	55	3	66	4	107	6
Traction generator	44	2	55	3	66	4	107	6
Traction motor	264	12	330	18	396	24	642	36
Bogie truck	88	4	110	6	132	8	214	24
Wheel set	264	12	330	18	396	24	642	36
Others	Omitted							

Table 4.2.2 Annual quantities of DC major parts to be inspected

	2006~2009		2010~2014		2015~2019		2020~2024	
	Periodic	Temporary	Periodic	Temporary	Periodic	Temporary	Periodic	Temporary
Engine	18	1	27	1	71	3	98	5
Hydorlic transmission	18	1	27	1	71	3	98	5
Bogie truck	44	2	68	4	178	8	244	12
Wheel set	88	4	136	8	356	16	488	24
Others	Omitted							

(2) Brake shoes

Total quantities of brake shoes casting estimated referring to the actual data on casting at Aleppo PC workshop and procurement are shown in Table 4.2.3.

Table 4.2.3 Total quantity of brake shoes to be cast

(t/year)

	2006	2010	2015	2020
Total	1,500	2,100	3,400	5,400

4.3 Inspection work for main parts

4.3.1 Current situation of inspection work at Jubrin workshop

(1) Mainly, M5 and M6 inspection for DLs are being put into practice, in accordance with those in Table3.2.10.

(2) M5 and M6 for DLs are being practiced with no difference between inspection work.

- Man-hour for M5 of LDE2800 : 7500 to 9,000 Man-hour
- Cost of supplies (M5of LDE2800411) : 892,000SP
- Staying period in workshop : 2months to more than 6 years

(3) There would be some items necessary to be improved on maintenance (inspection and repair) work.

4.3.2 Inspection plan at the new workshop

(1) Various improvement of maintenance works would be necessary to realize good quality on maintained rolling stock, such as the betterment of cleaning, washing, non-destructive inspection, and so on. For the purpose, necessary equipment, apparatus, devices, etc. are planned to be installed.

(2) Assumed the bases of work volume by type for DLs and DCs, namely, man-hour and maintenance costs in planning. (Refer to the original report).

4.4 Quality control for rolling stock maintenance

It would be necessary to concretize clearly the quality of maintained rolling stock into the items on function, economical efficiency, service for customers and impact to environment and to realize the sufficient quality.

In solving the problems, it would be convenient to analyze them by using Characteristic Diagram or Cause and Effect Diagram.

4.5 Spare parts control (Inventory control)

Spare parts would be divided into major parts used in circulation and ones consumed each time of inspection.

Kinds and quantities to be stored and controlled should be fixed, mainly in consideration of the past experiences with careful examination.

In inventory control, increase of turnover ratio for spare parts, periodic check and supply for decreased quantity caused by usage or consumption of them should be practiced.

Some amount of expenses are included in the engineering fee of Table 5.9.1 and Table 6.1.1.

Chapter 5 Construction Plan of Workshop

5.1 Basic policy on workshop construction

There are two alternatives for the modernization of Jubrin locomotive workshop, one is the expansion of Jubrin workshop and the other is the construction of new one.

Adopted the construction of new one, in comparison and examination on the contents and costs of construction work, and the long-range plan of GESR on rolling stock maintenance. Hence, the feasible study on the modernization of Jubrin locomotive workshop had been made for the construction of new one.

5.2 Facilities of locomotive and diesel railcar maintenance

5.2.1 Basic concept

(1) Capability of inspection and maintenance facilities

Capability of inspection and maintenance facilities is so planned as to cope with number of rolling stock to be inspected in 2015.

(2) Foundry

1) Facility is mainly to produce brake block.
2) Production capacity of brake block is 3,400ton per year.
3) Facility to cast copper alloy is provided, as well.

(3) Thermal supply facility

The heat source for work and heating is by steam supplied from boiler.

(4) Related facility of pollution

A pollutant produced by workshop should be treated inside of workshop to get rid of pollution.

1) Drainage is mainly containing oily drain. To decontaminate, pressurized floating is adopted to eliminate SS, oil, COD and BOD.

2) Waste such as parts of vehicle and packing material are to be incinerated.
3) Consideration is to be made to avoid the influence to outside from source of workshop noise.

(5) Acetylene gas facility

For gas welding, acetylene gas generator is provided and gas is supplied to welding site through pipe.

(6) Reuse of the facilities in Jubrin workshop

Main facilities currently used at Jubrin workshop are equipped in the 1970s, aged around 20～30 years. Accordingly, at the time of new workshop construction, those will be age of 25～35 years which is replacing time of facilities, furthermore if those facilities are to be reused, workshop should be closed due to removing. Consequently, the facilities currently used at Jubrin workshop are not planned to reuse at newly constructed workshop.

5.2.2 Inspection and maintenance facilities for locomotive and diesel railcar

Inspection and maintenance facilities for locomotive and diesel railcar are planned assuming main devices provided on the locomotive and diesel railcar, as a general.

5.2.3 Construction cost

(1) Assumption of construction cost estimation

1) Time of estimation Jan. 2001
2) Exchange rate US$=¥115
3) Contract of construction is to be in 2003 and commencement of construction at site, Apr. 2004.
4) Assumptions
   (a) If the estimation of cost of device is obtainable, apply this estimation.
   (b) If the device was purchased in the past, the estimation is made considering past cost record and elapse of age.
   (c) If the device has not been used, the estimation is made referring to the cost of device

with the same function, size and etc.

(d) Assumption is made considering that contract will be carried out in 2003.

5) On the estimation, currency for procurement of devices is foreign currency and inland transportation and installation costs are by domestic currency. Furthermore, foreign currency is also adopted if the materials for construction are not obtainable in Syria.

6) The cost of facilities is consisted of purchasing cost of devices, transportation costs, costs for foundation of facilities, installation costs, wiring costs for power supply and piping costs.

(2) Estimation of construction cost of maintenance machinery

Estimation of construction cost of maintenance machinery is indicated in Table 5.2.1 Construction cost of machinery.

Table 5.2.1 Construction cost of machinery.

Unit;1,000SP

Item	FC	LC	Total
Machine & equipment	4,679,312	299,504	4,978,816
Supervisor fee	104,555		104,555
Measuring instruments・tool & etc	233,966	14,975	248,941
Total	5,017,833	314,479	5,332,312

5.2.4 Process of construction

The construction process is made to cope with commencement of maintenance work of locomotive in Jan. 2006 and diesel railcar, Jan. 2009.

5.3 Maintenance system of devices for rolling stock inspection and maintenance

5.3.1 Present status of Jubrin workshop

Maintenance system of facilities in Jubrin workshop was studied. The maintenance systems of respective shops and organization were found good. However, the most of devices are from foreign countries. Accordingly, the corrective maintenance instead of preventive maintenance is carried out.

5.3.2 Maintenance system of inspection and maintenance devices

(1) Maintenance system

It must be organized into the maintenance section in charge of installation and maintenance of workshop facilities, and the maintenance shop in charge of maintenance practice

However, maintenance of track and telecommunication devices are to be entrusted respective shops outside of workshop, and the maintenance work of highly innovated machine which need special technique is to be entrusted to manufacturer.

(2) Maintenance staff

Number of maintenance staff is planned as 5% of staff in charge of rolling stock maintenance and foundry in the workshop.

(3) Cost for material and consumables

This cost is planned as 5% of material cost and total of miscellaneous cost.

(4) Maintenance cost by year

Yearly maintenance cost is as Table 5.3.1 “Maintenance cost by year”.

Table 5.3.1 Maintenance cost by year

Cost \ Year		2006	2010	2015	2020
Personnel cost	Number of staff	21	27	39	58
	Personnel cost	869	1,118	1,615	2,401
Material and consumable cost		4,746	6,331	10,832	15,942
Total (1000 SP)		5,615	7,449	12,447	18,343

5.4 The size of inspection and maintenance shop for locomotive and railcar

5.4.1 Basic concept of new workshop construction

Basic items of new workshop construction

(1) Commencement of locomotive maintenance by new workshop is assumed as Jan. 2006.

(2) Commencement of diesel railcar maintenance at new workshop is assumed as Jan. 2009.

(3) Capacity of new workshop is to be able to maintain the locomotive and diesel car fleet in 2015.

(4) Brake block manufacturing shop commences the production in Jan. 2006 with capability of 3,400tons per year.

(5) Number of working days in a year is 295 as it is, and working days in a month is 24 days due to the properly designed capability of provided facilities.

5.4.2 Planning of principal working site size

(1) Simultaneous number of rolling stock at principal working site

Simultaneous number of rolling stock at principal working site is one of key item to decide the size of workshop. Accordingly, simulation was made to minimize the simultaneous number of rolling stock at principal working site.

Simultaneous number of rolling stock at principal working site as Table 5.4.1 “Simultaneous number of rolling stock at principal shop (2015)”.

Table 5.4.1 Simultaneous number of rolling stock at principal shop (2015)

Workshop	Kind of car	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Final ajustiment shop	DL	3	3	1	1	3	3	1	1	3	3	1	1	3	3	1	1	3	3	1	1	3	3	1	1
	DC	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Total	5	5	3	3	5	5	3	3	5	5	3	3	5	5	3	3	5	5	3	3	5	5	3	3
Dismounting/mountion shop	DL	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	1
	DC	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2
	Total	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
Car-body washing & air blow shop	DL	1			1	1			1	1			1	1			1	1			1	1			1
	DC	1		1		1		1		1		1		1		1		1		1		1		1	
	Total	2		1	1	2		1	1	2		1	1	2		1	1	2		1	1	2		1	1
Car-body maintenance shop	DL	11	11	11	10	11	11	11	10	11	11	11	10	11	11	11	10	11	11	11	10	11	11	11	11
	DC	5	6	6	6	5	6	6	6	5	6	6	6	5	6	6	6	5	6	6	6	5	6	6	6
	Total	16	17	17	16	16	17	17	16	16	17	17	16	16	17	17	16	16	17	17	16	16	17	17	17
Car-body painting shop	DL	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2
	DC	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2
	Total	2	3	3	4	2	3	3	4	2	3	3	4	2	3	3	4	2	3	3	4	2	3	3	4
Trial run track	DL			1	1			1	1			1	1			1	1			1	1			1	1
	DC	1		1		1		1		1		1		1		1		1		1		1		1	
	Total	1		2	1	1		2	1	1		2	1	1		2	1	1		2	1	1		2	1
Shop-out	DL	1			1	1			1	1			1	1			1	1			1	1			1
	DC		1		1		1		1		1		1		1		1		1		1		1		1
	Total	1	1		2	1	1		2	1	1		2	1	1		2	1	1		2	1	1		2

(2) Planning of principal working site size

Based on the layout and number of rolling stock to be inspected in a year which are calculated by simultaneous number of rolling stock at principal work site, the area of principal work site is planned.

Total area of principal work site is 33,954 m^2.

(3) Design concept of maintenance facilities

Settled the design policy for maintenance facilities and equipment on the following items.

1) Arrangement of maintenance building
2) Final adjustment shop
3) Dismounting/mounting shop
4) Car-body washing & air blow shop and car-body painting shop
5) Car-body maintenance shop
6) Engine maintenance shop
7) Engine performance testing room
8) Track of trial run in workshop
9) Bogie maintenance shop
10) Wheel-set maintenance shop
11) Rotating machine maintenance shop
12) Machining shop
13) Maintenance shop for electrical parts and air brake parts
14) Shops for castings, forge, iron-work and springs

15) Warehouse, place to put waste and scrapped metal

16) Fuel reserve tank.

5.5 Preliminary design for locomotive workshop buildings

5.5.1 Basic conditions for the preliminary design

(1) Site conditions

The project site for the new locomotive workshop is located some 30 km north of Aleppo city, southwest of Muslimia station. The required area for the site is about 37.5 ha, north-south 750 m long and east-west 500 m long respectively.

(2) Climatic conditions

No special climatic phenomena exist in the Project location; therefore there are no special precautions for consideration in the design of workshop building and project implementation schedule.

(3) Topography and geology

The topsoil is mainly silt with small stones. The bearing capacity of the soil appears sufficiently strong to support building foundations.

There are very few risks of floodwater and landslide occurrences. Consequently, the land is judged as suitable for the construction of the locomotive workshop.

(4) Infrastructure such as Road, Power Supply, Telephone, Drinking Water and Drainage System

There are two cement plants, glass plant, Muslimia station and houses around the Project site. Therefore, it is easy to access and to connect to existing and planned infrastructure.

5.5.2 Basic concept for the preliminary design

(1) Project site layout plan

The main workshop building is placed parallel to the main railroad of Aleppo to the Turkish border and test run railroad for repaired locomotives and diesel cars.

The locomotives to be repaired shall enter into the main workshop building through a

branch line near the Muslimia station.

(2) Planning of procurement for building materials

Among the general building materials that are necessary for the project construction works, cement, sand, coarse aggregate, glaze, etc. are available in the local market. However, steel products such as steel parts, doors and windows, including reinforcing bars are imported. Thus, most of the needed building materials are locally available except for steel products and wooden materials.

5.5.3 Preliminary design for the locomotive workshop

(1) Building area and structure type for each building

The locomotive workshop consists of many buildings and facilities such as main workshop building, administration building, canteen, etc. Names of each building and facility, area and structure type are described in Table 5.5.1 below.

Table 5.5.1 Name of each building, area and structure type

Name of building		Area (m^2)	Structure type
1	Final adjustment shop	1,440	Steel structure
2	Main workshop building	19,764	Steel structure
3	Car-body washing & air-blow shop	360	Steel structure
4	Engine performance test room	720	Steel structure
5	Iron work, spring inspection & repair shop	3,456	Steel structure
6	Car-body painting shop	780	Steel structure
7	Foundry shop	2,160	Steel structure
8	Storehouse for dangerous materials	144	Reinforced concrete structure
9	Boiler room	162	Reinforced concrete structure
10	Garage	378	Steel structure
11	Storehouse	4,290	Steel structure
12	Substation (1)	112	Reinforced concrete structure
13	Substation (2)	40	Reinforced concrete structure
14	Substation (3)	70	Reinforced concrete structure
15	Administration Building	1,512	Reinforced concrete structure
16	Canteen (1)	5,184	Reinforced concrete structure
17	Canteen (2)	1,080	Reinforced concrete structure
18	Waste water treatment room	150	Reinforced concrete structure
19	Incinerator	150	Reinforced concrete structure
20	External work	39,500	

(2) General layout of workshop buildings

The layout of workshop buildings is shown on Fig 5.5.1 hereinafter.

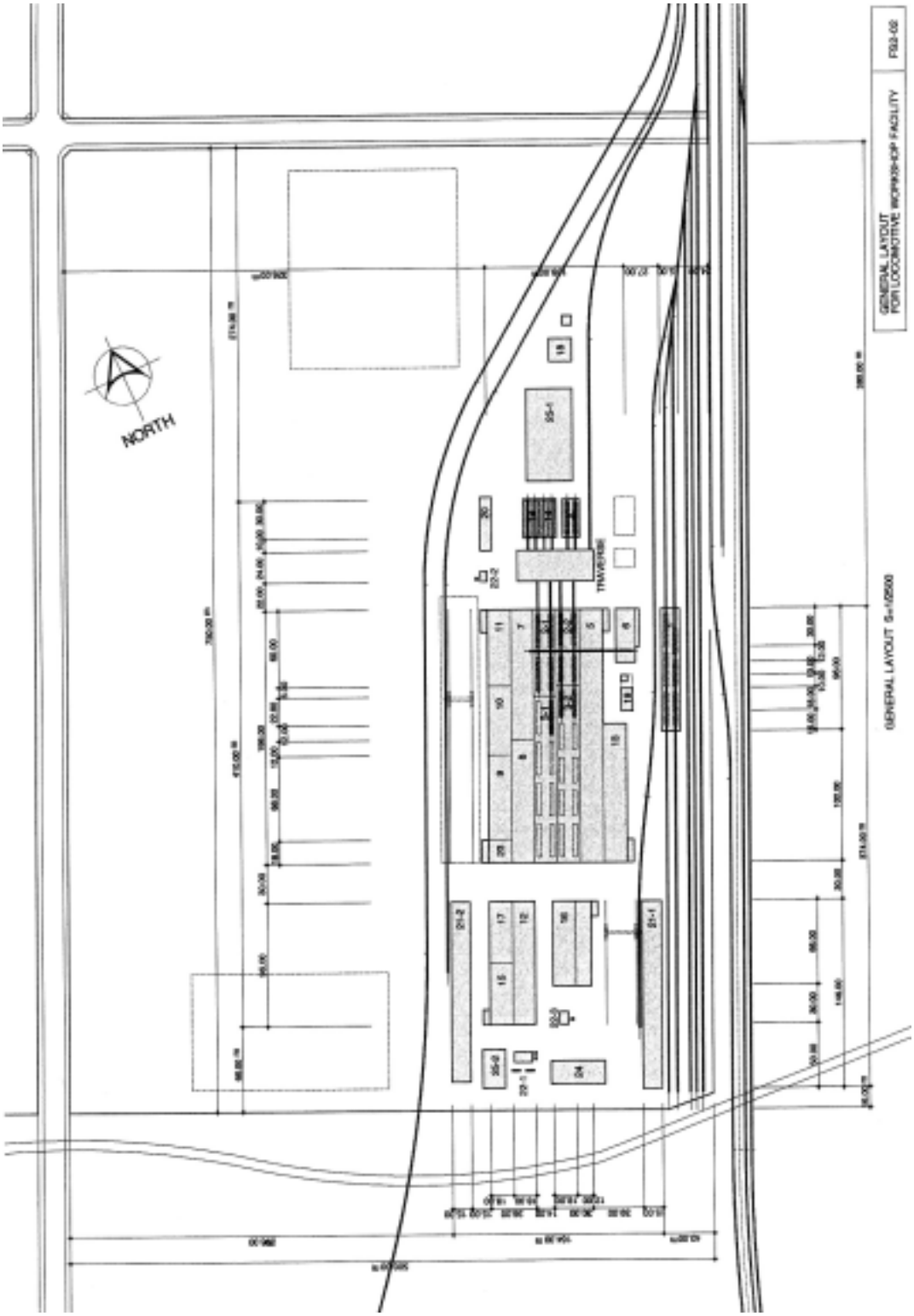


Fig 5.5.1 General Layout for Locomotive Workshop

5.5.4 Cost estimation of structural works and finishing works

The cost for each building (structural and finishing works) and external work is estimated as 1,282.4MSP.

The cost for the building services is discussed in section 5.6.3.

5.6 Building services

5.6.1 Planning principles of building services

The following building services are planned.

1. Building services for each building
2. External facility services

(1) Planning of building services for each building

The following facilities are planned for building.

1) Lighting facility
   (a) Indoor lighting facility
   (b) Indoor emergency lighting facility
   (c) Emergency guiding lamp facility
   (d) Outlet facility

2) Communication and fire prevention facility
   (a) Telephone facility
   (b) Electrical clock facility
   (c) Paging facility
   (d) Automatic fire detection and alarm facility

3) Lightning protection facility
4) Water and sanitary facility
5) Heating, ventilation and air conditioning (HVAC) facility
6) Hot water supply facility

(2) Planning of external facility services

The following facilities are planned for external facility services.

1) Electricity incoming and supply facilities

(a) 66/20kV substation (to be extended to the existing 66kV substation, which is located, about 7 km south of the project site)

(b) 20/6.6kV substation (receiving substation)

(c) 6.6kV/400-230V substation (for main workshop)

(d) 6.6kV/400-230V substation (for foundry workshop)

(e) 20kV transmission lines (2 circuits)

2) Outdoor lighting facility

3) Telephone incoming facility

4) Water supply, water drainage and fire fighting facility

(a) Water supply facility

(b) Water drainage facility

(c) Fire fighting facility

(3) Planning of procurements for building services

Almost all equipment and materials to be used for building services will be procured in Syria. However, local procurement of the electrical equipment such as switchgear and transformer is difficult because these equipments require high reliability, durability and minimum maintenance. Therefore they will be procured from Europe and/or Japan.

5.6.2 Outline design of building services

(1) Electricity incoming and supply facilities

The maximum demand in Muslimia Workshop is estimated as 5MVA.

The electricity is supplied by two (2) circuits of 20kV transmission line from the existing 66kV substation which is located about 7 km south of the Project Site to the 20/6.6kV receiving substation in Muslimia Workshop.

For the main workshop building and foundry shop, which have large power demand, the

electricity is supplied by 6.6kV high voltage from 20/6.6kV receiving substation. The low voltage (400-230V) supplies for low voltage building services such as lighting, air-conditioning and ventilators.

(2) Lighting facility

1) Indoor lighting facility

Generally, fluorescent lamps mounted on the wall or ceiling are provided in the room. However, HID lamps such as mercury vapor lamps are provided in the workshop where the ceiling is high.

2) Outdoor lighting facility

For crime prevention, the pole mounted mercury vapor lamp is provided in the premises.

(3) Communication and fire prevention facility

1) Telephone facility

The telephone line is incoming from the exchange station located about 1.2 km north of the Project Site, which will start operation in 2001. The numbers of telephone lines are as follows:

- subscriber line : 10 lines
- extension line : 30 lines

2) Electrical clock facility

A master and secondary electrical clock system, which is easily maintained and managed, is provided.

3) Paging facility

The paging facility for calling employees and announcement of time is provided in the major room.

4) Automatic fire detection and alarm facility

Heat detector or smoke detector is provided for each building in relation to the room height. A main fire alarm panel is installed in the office room. A fire alarm panel with a bell, red lamp and push button is installed in each building.

(4) Lightning protection facility

Lightning rods are installed on the building and elevated water tank.

(5) Water supply, water drainage and fire fighting facility

1) Water supply facility

The pumping station, which is located about 1.5 km south of the project site, is planned for building services and workshop equipment use.

Water demand for building services and workshop equipment use is estimated as 100m^3 per day. A 300m^3 underground water tank and a 100m^3 elevated water tank are planned.

2) Water drainage facility

The water drainage system is separate for the building services and industrial wastewater containing used oil. Wastewater from the building services directly flows into the sewage tank. On the other hand, industrial wastewater is divided into wastewater and used oil at the oil/water separator, and after that the wastewater flows to the sewage tank. Wastewater flows from the said sewage tank to the existing main sewage pipe which is located about 1.5km south of the Project Site.

3) Sanitary facility

Arabic and European type sanitary fixtures are provided in the toilets.

4) Fire fighting facility

The fire extinguishers (ABC powder type) are provided in the rooms. In addition, the following water fire fighting facility is provided in order to check the spread of fire in the buildings.

- AC motor driven pump
- Engine driven pump
- Water hydrants
- Hose box (with 20m hose)

(6) Heating, ventilation and air conditioning (HVAC) facility

For cooling during the summer and heating during the winter, air-conditioning facility is

provided in the managers' rooms and office rooms. The type of air-conditioner is air-cooled, heat pump and packaged type.

The ventilation facility is provided for each building.

(7) Hot water supply facility

For the employee's bathrooms, electric boiler (500 liters) is provided. Also, for drinking tea, electric boiler (20 liters) is provided in the kitchen and canteen.

5.6.3 Construction cost estimation

The cost of building services is estimated in this section.

The total building services cost is estimated as 617.3MSP.

5.7 Operation and maintenance for the workshop facility

The estimated annual operation and maintenance cost for buildings and building services is shown as follows:

(Unit: 1,000 SP)

Item	2006～2009	2010～2014	2015～2020
Buildings	358.8	717.6	1,076.4
Building Services	27,985.3	55,970.6	83,955.9
Total	28,344.1	56,688.2	85,032.3

5.8 Track plan of workshop

Newly built rolling stock workshop will be planned to have Muslimia station of Aleppo – Midan Ekbas line as a connecting station. Muslimia station is connected with cement industry track at both ends of west side. And also on east side, Joban Bec and industry line for Free Zone and glass industry is connected. (Fig.5.8.1)

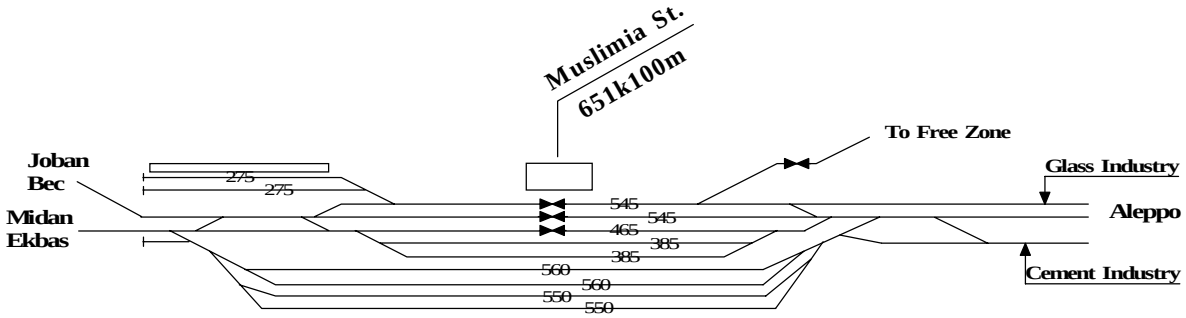


Fig.5.8.1 Sketch of Musulimia station track layout

Also, in future, connecting Muslimia station and Jubrin station, there is an industrial complex planned at the middle of these stations, it is expected the increase of departure/arrival of freight train at this station and therefore, it is expected to have existing single track to be doubled for increasing freight train, locomotives and diesel railcars and also expected the increasing of marshalling works, thus, draw-out track will become necessary.

Land for locomotive/diesel railcar workshop is planned to be built at cement factory side of Aleppo direction, industry track for cement factory which is now branched off from the existing main line will be moved to the west side of cement factory and track facility plan within the workshop will be planned as to have new workshop to be constructed between main line and cement industry track.

Therefore, workshop track will be allocated branched off from cement industry line.

Muslimia station and locomotive/diesel railcar workshop will be shown in Fig.5.8.2 in considering such conditions. Further, estimated Muslimia station layout is shown in Fig.5.8.3.

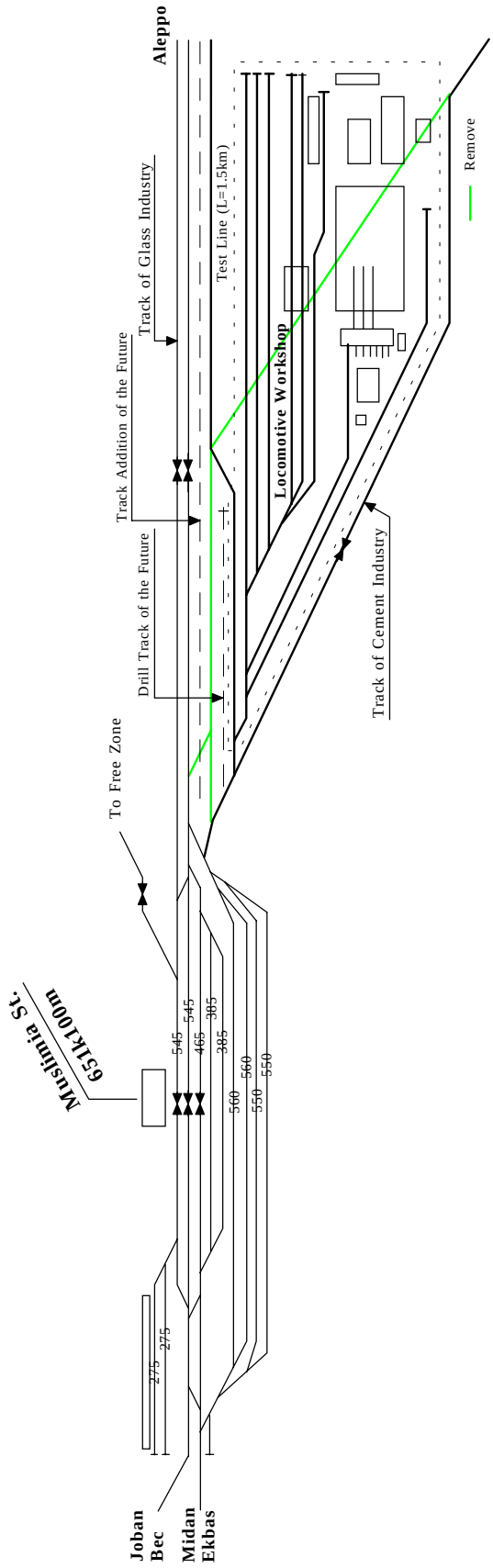


Fig.5.8.2 Sketch of Muslimia St. and Loco. Work shop Layout

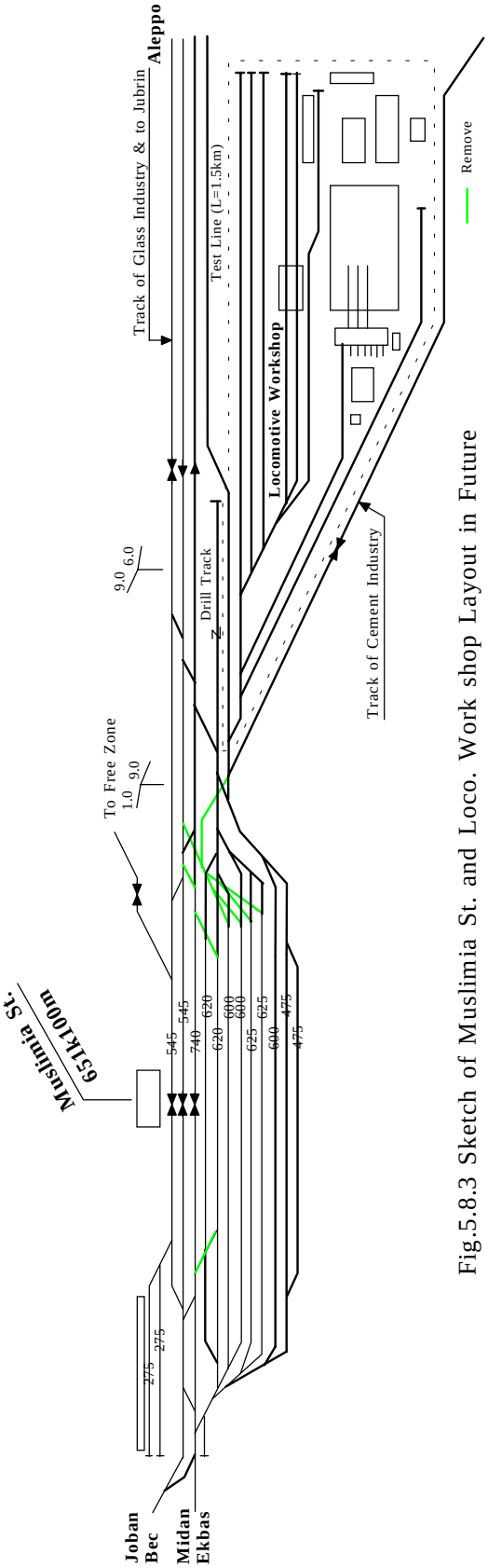


Fig.5.8.3 Sketch of Muslimia St. and Loco. Work shop Layout in Future

5.9 Construction cost

The construction cost is roughly summarized as in Table 5.9.1 “Rough construction cost”.

Table 5.9.1 Construction cost

Unit;1,000SP

Item		Cost		
		FC	LC	Total
Construction of new work shop	Land		37,500	37,500
	Civil work	106	228,249	228,355
	Track work	118,449	67,003	185,452
	Building work	377,505	1,522,149	1,899,654
	Mechanical work	5,017,833	314,479	5,332,312
	Subtotal	5,513,893	2,169,380	7,683,273
Engineering fee (5%)		384,164		384,164
Contingency (5%)		294,903	108,469	403,372
Total		6,192,960	2,277,849	8,470,809

5.10 Comments on the issues discussed with GESR side on the Draft Final Report

The study team commented on the following issues discussed with GESR side in the study.

- Extension of the inspection cycle for main line locomotives and the increase in number of shunting locomotives
- Enforcement of two-day off per week
- Extension of rails in Dismounting / Mounting shop for locomotives

Details on the above are omitted. Refer to the main report.

Chapter 6 Project Implementation Schedule

Construction of the new workshop would be implemented, on the assumption that the start of its operation would be in Jan. 2006 for DL maintenance and brake shoes casting, and in Jan. 2009 for DC maintenance. Accordingly, the installation of facilities and equipment for DC maintenance would finish in 2008.

6.1 Implementation schedule

Implementation schedule is shown in Fig 6.1.1.

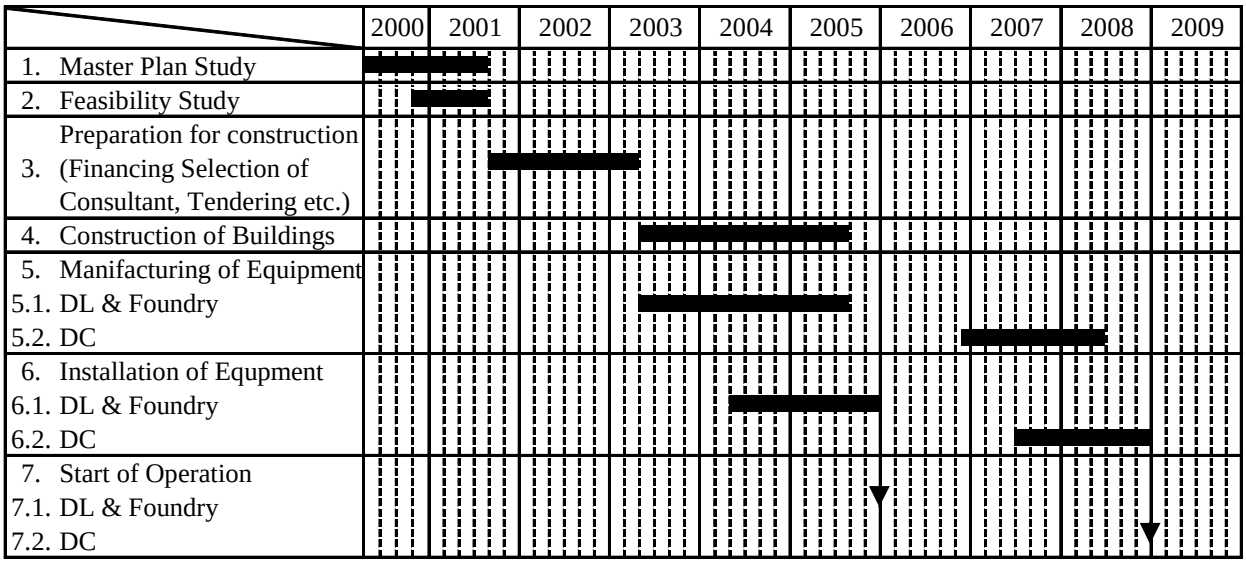


Fig. 6.1.1 Project Implementation Schedule

6.2 Amount of investment

Yearly amount of investment for the new workshop construction are shown in Table 6.1.1 Workshop construction plan and cost.

Table 6.2.1 Annual cost of construction work (Excluding contingency)

Unit: million SP

Works・kind of equipment		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Land	FC																0.0
	LC(Personal expense)																0.0
	LC(Other)			37.5													37.5
	Sub tatal	0.0	0.0	37.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.5
Building work	FC			42.8	42.8	42.7											128.3
	LC(Personal expense)			85.5	85.5	85.5											256.5
	LC(Other)			299.2	299.2	299.2											897.6
	Sub tatal	0.0	0.0	427.5	427.5	427.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,282.4
Building services	FC			83.1	83.1	83.1											249.3
	LC(Personal expense)			33.9	33.9	34.0											101.8
	LC(Other)			88.7	88.7	88.8											266.2
	Sub tatal	0.0	0.0	205.7	205.7	205.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	617.3
Track formation work	FC																0.0
	LC(Personal expense)		156.7														156.7
	LC(Other)		71.6														71.6
	Sub tatal	0.0	228.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	228.3
Track work	FC		23.7	94.7													118.4
	LC(Personal expense)		4.5	18.2													22.7
	LC(Other)		8.9	35.4													44.3
	Sub tatal	0.0	37.1	148.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	185.4
Mechanical work	FC				2,128.1	2,353.1		245.7	275.1		3.9					11.9	5,017.8
	LC(Personal expense)																0.0
	LC(Other)				130.9	152.1		11.2	13.5		2.1					4.7	314.5
	Sub tatal	0.0	0.0	0.0	2,259.0	2,505.2	0.0	256.9	288.6	0.0	6.0	0.0	0.0	0.0	0.0	16.6	5,332.3
Total	FC		23.7	220.6	2,254.0	2,478.9	0.0	245.7	275.1	0.0	3.9	0.0	0.0	0.0	0.0	11.9	5,513.8
	LC(Personal expense)	0.0	161.2	137.6	119.4	119.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	537.7
	LC(Other)	0.0	80.5	460.8	518.8	540.1	0.0	11.2	13.5	0.0	2.1	0.0	0.0	0.0	0.0	4.7	1,631.7
	Sub tatal	0.0	265.4	819.0	2,892.2	3,138.5	0.0	256.9	288.6	0.0	6.0	0.0	0.0	0.0	0.0	16.6	7,683.2
Engineering fee(5%)	FC	24.0	45.2	75.6	71.7	71.7	16.0	40.0	40.0								384.2
	LC(Personal expense)																0.0
	LC(Other)																0.0
	Sub tatal	24.0	45.2	75.6	71.7	71.7	16.0	40.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	384.2
Grand total	FC	24.0	68.9	296.2	2,325.7	2,550.6	16.0	285.7	315.1	0.0	3.9	0.0	0.0	0.0	0.0	11.9	5,898.0
	LC(Personal expense)	0.0	161.2	137.6	119.4	119.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	537.7
	LC(Other)	0.0	80.5	460.8	518.8	540.1	0.0	11.2	13.5	0.0	2.1	0.0	0.0	0.0	0.0	4.7	1,631.7
	Sub tatal	24.0	310.6	894.6	2,963.9	3,210.2	16.0	296.9	328.6	0.0	6.0	0.0	0.0	0.0	0.0	16.6	8,067.4

Note; Sub total in Grand total is equal to the Total decreased by the Contingency in the Table 5.9.1.

Chapter 7 Management and Operation plan of Workshop

(1) Organization

Arranged two workshop vice managers and seven sections under the workshop manager. One of seven sections is casting one, the others are general affairs, technical affairs, Diesel engine, mechanical, electric machinery and production ones.

(2) Working hours

- Rolling stock maintenance work

  Ordinary period : 4 hours 15 minutes/day
  Ramadan period: 3 hours 45 minutes/day

- Casting works for brake shoes

  Ordinary period : 7 hours / day

  Ramadan period : 6 hours 30 minutes /day

(3) Work volume of rolling stock maintenance

Table 7.1 Work volume of rolling stock maintenance

(Man-hour/year)

	2006	**2010**	**2015**	**2020**	Remark
DL	285,000	346,000	389,000	639,000	Summation of periodic and temporary inspection work
DC	60,000	93,000	237,000	330,000	
Total	345,000	439,000	626,000	969,000	

(4) Personnel

Table 7.2 Personnel

(person)

Year / Section	**2005**	**2006**	**2010**	**2015**	**2020**
Rolling stock	360	360	450	630	970
Casting	60	60	80	140	180
Total	420	420	530	770	1150

Note: 420 personnel would be allocated during the 4th quarter in 2005, in preparation for the opening of new workshop in 2006.

(5) Management and operation plan

The following items would seem to be basically essential to the betterment of workshop business.

- Yearly planning of rolling stock maintenance and its execution
- Settlement and execution of standard process for rolling stock periodic inspection
- Improvement of maintained rolling stock quality
- Increase of productivity and labour density
- Training of workers

(6) Operation cost

Table 7.3 Operation cost

(1000SP/year)

	2005	**2006**	**2010**	**2015**	**2020**
Total	4,347	50,314	57,833	73,650	94,492

Chapter 8 Economic and Financial Analysis

8.1 Economic Analysis

8.1.1 Outline of the Project

The construction of the new workshop will start in 2003 and end in 2005. The overhaul and repair works will start from 2006. Types of works in the workshop are maintenance works (M5, M6, D5, and D6), extra repairs and production of brake shoes for locomotives, diesel cars, passenger cars and freight cars.

The overhaul period for locomotives will be changed to those shown in Fig 4.1.1.
This overhaul period is also applied to D5 and D6. Volume of works, explained in other chapters is summarized in Table 8.1.1.

Table 8.1.1 Number of Overhauls

Year	Diesel Cars		Diesel Electric Locomotives	
	Number of Cars	Number of Overhauls	Number of Cars	Number of Overhauls
2006	55	22	116	44
2011	85	34	151	55
2016	195	89	221	66
2021	290	122	321	107

8.1.2 Benefits

(1) Type of benefits

Benefits are classified into two types. The first type comprises VOC, ROC and TTC savings. These are considered as the contribution of the operation of the new workshop to the realization of the benefits expected from the Master Plan.

The second type comprises the direct benefits resulting from the operation of workshop itself. These include:

1) Shortening of the Period of Overhaul Work (due to execution of all overhauls in Syria)
2) Shortening of the Period of Overhaul Work (due to difference in productivity between the Jubrin workshop and the new workshop)
3) Extension of the Periods between Overhauls

4) Decrease of Extra Works
5) Decrease of Overhaul Costs
6) Decrease of Wheel Adjustment Cost (due to use of brake shoes made by GESR)
7) Decrease of Brake Shoe Costs (due to use of brake shoes made by GESR)
8) Decrease of Reserved Cars

Benefits of Nos. 3 and 7, however, are limited in effect. The other six benefit types are therefore examined.

(2) VOC, ROC and TTC

ROC, VOC and TTC savings are calculated from traffic assignment results. Values related to benefits are summarized in Table 8.1.2.

Table 8.1.2 ROC, VOC and TTC Savings (unit: MSP/year)

Item	Master Plan	Without Workshop Project	W/O Workshop Project – Master Plan
Year 2005			
VOC sum	53,597	53,834	237
ROC sum	2,192	2,361	169
TTC sum	5,930	5,934	4
Total	61,719	62,129	410
Year 2010			
VOC sum	75,623	76,446	823
ROC sum	3,198	3,449	251
TTC sum	6,734	6,753	19
Total	85,555	86,648	1,093
Year 2015			
VOC sum	111,312	113,194	1,882
ROC sum	5,157	5,260	103
TTC sum	9,725	9,784	59
Total	126,194	128,238	2,044
Year 2020			
VOC sum	164,575	167,958	3,383
ROC sum	7,776	7,810	34
TTC sum	14,694	14,824	130
Total	187,045	190,592	3,547

(3) Direct benefit from workshop operation

In case of “without project”, diesel electric locomotives will substitute for diesel cars. Due to this, some benefits are examined only for diesel electric locomotives. Direct benefits are

summarized in Table 8.1.3. Extra necessary cars are converted to monetary term using the following prices: diesel car, 48 MSP; locomotive, 80 MSP.

Table 8.1.3 Direct Benefit Summary (unit: MSP)

Year	Direct Benefits*						Total
	1	2	3	4	5	6	
2006	92.0	143.0	2.6	27.3	49.7	310.0	624.6
2007	0.0	0.0	2.6	27.3	49.7	0.0	79.6
2008	0.0	0.0	2.6	27.3	49.7	0.0	79.6
2009	0.0	0.0	2.6	27.3	49.7	0.0	79.6
2010	184.0	0.0	2.9	56.7	77.2	920.0	1,240.8
2011	0.0	0.0	2.9	56.7	77.2	0.0	136.8
2012	0.0	0.0	2.9	56.7	77.2	0.0	136.8
2013	0.0	0.0	2.9	56.7	77.2	0.0	136.8
2014	0.0	0.0	2.9	56.7	77.2	0.0	136.8
2015	92.0	0.0	3.8	77.7	128.5	460.0	762.0
2016	0.0	0.0	3.8	77.7	128.5	0.0	210.0
2017	0.0	0.0	3.8	77.7	128.5	0.0	210.0
2018	0.0	0.0	3.8	77.7	128.5	0.0	210.0
2019	0.0	0.0	3.8	77.7	128.5	0.0	210.0
2020	368.0	79.0	5.2	155.4	204.1	920.0	1,731.7
2021	0.0	0.0	5.2	155.4	204.1	0.0	364.7
2022	0.0	0.0	5.2	155.4	204.1	0.0	364.7
2023	0.0	0.0	5.2	155.4	204.1	0.0	364.7
2024	0.0	0.0	5.2	155.4	204.1	0.0	364.7
2025	0.0	0.0	5.2	155.4	204.1	0.0	364.7
2026	0.0	0.0	5.2	155.4	204.1	0.0	364.7
2027	0.0	0.0	5.2	155.4	204.1	0.0	364.7
2028	0.0	0.0	5.2	155.4	204.1	0.0	364.7
2029	0.0	0.0	5.2	155.4	204.1	0.0	364.7
2030	0.0	0.0	5.2	155.4	204.1	0.0	364.7
Res. V.	138.0	30.0	0.0	0.0	0.0	422.0	590.0

Note: *Benefits are categorized as follows

1. Shortening of Period of Overhaul Work (due to execution of all overhauls in Syria)
2. Shortening of Period of Overhaul Work (due to difference in productivity between the Jubrin workshop and the new workshop)
3. Decrease in Extra Works
4. Decrease in Overhaul Costs
5. Decrease in Wheel Adjustment Cost (due to use of brake shoes of GESR own making)
6. Decrease in Reserved Cars

8.1.3 Investment and Operation Costs

(1) Investment

The investment costs is explained elsewhere in this report and summarized in Table 8.1.4.

Table 8.1.4 Investments and Residual Values (unit: MSP)

Investment								
Year	Land	Building	Facilities	Track Bed	Track	Equipment	Engineer'g	Total
2001	0	0	0	0	0	0	48	48
2002	0	0	0	228.3	37.1	0	90.5	355.9
2003	37.5	427.5	205.7	0	148.3	0	151.2	970.2
2004	0	427.5	205.7	0	0	2259	143.3	3035.5
2005	0	427.4	205.9	0	0	2505.2	143.3	3281.8
2006	0	0	0	0	0	0	32	32
2007	0	0	0	0	0	256.9	80	336.9
2008	0	0	0	0	0	288.6	80	368.6
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	6	0	6
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	16.6	0	16.6
2016	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0	0
2026	0	0	0	0	0	0	0	0
2027	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0
Total	37.5	1282.4	617.3	228.3	185.4	5332.3	768.3	8451.5

(2) Operation Cost

An estimate of the operation costs of the workshop is summarized in Table 8.1.5.

Table 8.1.5 Operation Cost (unit: MSP)

Year	Personnel Cost	Building/Facility	Equipment	Total
2005	4.3	0	0	4.3
2006	17.4	28.2	4.7	50.3
2011	21.9	29.6	6.3	57.8
2016	31.9	30.9	10.8	73.6
2021	47.6	30.9	15.9	94.4

8.1.4 Economic analysis

(1) Economic Internal Rate of Return (EIRR), Benefit Cost Ratio (B/C) and Net Present Value (NPV)

EIRR, B/C and NPV are calculated on equity basis and shown in Table 8.1.6. EIRR obtained (21.0%) shows the economic viability of this project.

Table 8.1.6 EIRR, B/C, NPV

Year	Cost Total	Direct Benefit	Roc, VOC And TTC	Benefit Total	B-C	Discounted Value by 12%		
						Cost	Benefit	B-C
2001	23.9	0.0	82.1	82.1	58.2	23.9	82.1	58.2
2002	310.4	0.0	164.3	164.3	-146.1	277.1	146.7	-130.4
2003	894.2	0.0	246.4	246.4	-647.8	712.9	196.5	-516.4
2004	2,963.5	0.0	328.6	328.6	-2,634.9	2,109.4	233.9	-1,875.5
2005	3,214.1	0.0	410.7	410.7	-2,803.4	2,042.6	261.0	-1,781.6
2006	66.2	624.6	547.3	1,171.9	1,105.7	37.6	664.9	627.4
2007	347.0	79.6	683.8	763.4	416.4	175.8	386.8	211.0
2008	378.7	79.6	820.3	899.9	521.2	171.3	407.1	235.8
2009	50.3	79.6	956.8	1,036.4	986.1	20.3	418.6	398.3
2010	63.8	1,240.8	1,093.3	2,334.1	2,270.3	23.0	841.7	818.7
2011	57.8	136.8	1,283.7	1,420.5	1,362.7	18.6	457.4	438.8
2012	57.8	136.8	1,474.1	1,610.9	1,553.1	16.6	463.1	446.5
2013	57.8	136.8	1,664.5	1,801.3	1,743.5	14.8	462.3	447.5
2014	57.8	136.8	1,854.9	1,991.7	1,933.9	13.2	456.4	443.2
2015	90.2	762.0	2,045.2	2,807.2	2,717.0	18.5	574.4	556.0
2016	73.6	210.0	2,345.5	2,555.5	2,481.9	13.4	466.9	453.4
2017	73.6	210.0	2,645.8	2,855.8	2,782.2	12.0	465.8	453.8
2018	73.6	210.0	2,946.1	3,156.1	3,082.5	10.7	459.7	449.0
2019	73.6	210.0	3,246.4	3,456.4	3,382.8	9.6	449.5	439.9
2020	94.4	1,731.7	3,546.7	5,278.4	5,184.0	11.0	612.9	601.9
2021	94.4	364.7	3,546.7	3,911.4	3,817.0	9.8	405.5	395.7
2022	94.4	364.7	3,546.7	3,911.4	3,817.0	8.7	362.0	353.3
2023	94.4	364.7	3,546.7	3,911.4	3,817.0	7.8	323.2	315.4
2024	94.4	364.7	3,546.7	3,911.4	3,817.0	7.0	288.6	281.7
2025	94.4	364.7	3,546.7	3,911.4	3,817.0	6.2	257.7	251.5
2026	94.4	364.7	3,546.7	3,911.4	3,817.0	5.6	230.1	224.5
2027	94.4	364.7	3,546.7	3,911.4	3,817.0	5.0	205.4	200.5
2028	94.4	364.7	3,546.7	3,911.4	3,817.0	4.4	183.4	179.0
2029	94.4	364.7	3,546.7	3,911.4	3,817.0	4.0	163.8	159.8
2030+RV	-1,538.1	954.7	3,546.7	4,501.4	6,039.5	-57.5	168.3	142.7
Ref. RV*	-1,632.5	590.0		590.0				
	IRR	21.0%						
	B/C	1.94			Total	5,733.2	11,095.8	5,362.6
	NPV	5,363	MSP					

Note: *R.V.=Residual Value

(2) Sensitivity analysis

Sensitivity analysis shows that the 12% of EIRR is assured up to the point where benefits decrease to 0.5 times those of the standard case or costs increase by 2.0 times those of the standard case (Table 8.1.7).

Table 8.1.7 Sensitivity analysis results

Cost \ Benefit	1	0.95	0.9	0.7	0.5
1	21.0	20.1	19.3	15.6	11.6
1.05	20.2	19.3	18.5	15.0	11.1
1.1	19.4	18.6	17.8	14.4	10.7
1.4	15.9	15.2	14.5	11.6	8.3
2.0	11.6	11.1	10.5	8.2	5.3

8.2 Financial Analysis

8.2.1 Method of the Analysis

Financial analysis is required only for the projects with revenue. In this project, modernization of locomotive workshop is expected to contribute to increase of transport revenue to some extent. However, it is almost impossible to estimate accurately how much the revenue will go up. Therefore additional revenues cannot be taken into consideration in calculation of FIRR. In this financial analysis we take up the following items, which contribute to improvement of profit and loss status.

Savings of various costs in the workshop by modernization of facilities and improvement of operation and management

Savings of additional investment on locomotives by improvement of maintenance work in the workshop etc.

Savings of investment on maintenance facilities of diesel cars at the old workshop required when the new factory is not built

(1) Savings of Costs

It is assumed that the following costs are reduced by implementation of this project.

1) Overhaul Cost

If the new workshop is not constructed, it is necessary to send some of the locomotives for overhaul to the workshop located in any adjacent country such as Turkey due to insufficiency of maintenance capacity of existing workshop. Amount of savings by execution of the project is calculated on the assumption that overhaul costs are as follows.

at the Foreign Workshop:…….$90,000/Unit

at the New Workshop in Syria:……..SP1,931,000/Unit

2) Temporary Repair Cost

Under the present conditions, a diesel locomotive of GESR has to undergo an average

of 3.76 temporary repairs per year. It is possible to reduce the frequency of repairs to 0.2 per year in the new workshop or 0.5 even in the old Jubrin workshop. Amount of savings by reduction of temporary repair is calculated on the assumption that an average cost is SP58,000 (3% of the overhaul cost) per one unit.

3) Wheel-Shaving Cost

If brake blocks for rolling stock except locomotives are switched to products in the new workshop, wheel-shaving works are no more necessary. Amount of savings is calculated on the assumption that wheel-shaving works are required for 15% of passenger cars and diesel cars and 20% of freight cars per running of 50,000 car kilometers and average shaving cost is $960/car.

4) Wheel Replacement Cost

If cracks on wheel treads are too long and deep to be restored by shaving works, wheels must be replaced to new ones. Replacement also becomes unnecessary by switching brake blocks to own products. Amount of savings is calculated on the assumption that replacement of wheels is required for 15% of passenger cars and diesel cars and 20% of freight cars per running of 200,000 car kilometers and average replacement cost is $5,000/car.

(2) Savings of Investment on Rolling Stock

As inspection and repair works of diesel locomotives become more efficient by construction of the new workshop, less number of rolling stock is enough to transport the same volume of cargo and passengers. If the new workshop is not constructed, it will be necessary to purchase additional locomotives. In this analysis the amount of additional purchase is deducted from the investment on workshop construction. Investment on additional rolling stock is saved by various reasons, but the following three cases are taken up in this analysis.

1) Savings by Implementation of All Overhaul Works in Syria

If the new workshop is not constructed and some of the overhaul works are carried out in foreign country, operating days of locomotives will be reduced and purchase of additional rolling stock will be required. Because staying period for overhaul is longer in foreign country than in the new workshop and extra days for transportation to and

from the neighboring country are required for overhaul in foreign workshop.

2) Savings by Shortening of Staying Period for Overhaul

Staying Period for overhaul will be reduced in the new workshop because the efficiency is better than in the existing Jubrin workshop. If the new workshop is not constructed, purchase of additional locomotives will be required.

3) Savings by Decrease of Spare Rates of Locomotives

As technical level of maintenance is improved in the new workshop, spare rates of locomotives are expected to go down. If the new workshop is not constructed, purchase of additional locomotives is required by difference of spare rates.

(3) Savings of investment cost on the old workshop

If the new workshop is not built, maintenance facilities of diesel cars must be installed in the old factory to keep up with the situation. As this amount becomes unnecessary by construction of the new workshop, it should be deducted from the cost of the new workshop.

8.2.2 The Results of the Analysis

(1) Project Life

In this analysis the period of evaluation (project life) was set at 30 years (from 2001 to 2030).

(2) Sensitivity Analysis

In addition to the base case, the sensitivity analysis was made for the following five cases

Case 1: Increase of Workshop Construction Cost…… 5%
Case 2: Increase of Workshop Construction Cost……10%
Case 3: Decrease of Savings……..5%
Case 4: Decrease of Savings…….10%
Case 5: Increase of Workshop Construction Cost……10%
Decrease of Savings…….10%

(3) Financial Internal Rate of Return (FIRR)

The Results of the analysis for the base case are in Appendix 8.2.1. Financial Internal Rate of Return (FIRR) in the base case and cases of sensitivity analysis are as follows.

Table 8.2.1 Financial Internal Rate of Return (FIRR)

Case	FIRR
Base Case	6.4%
Sensitivity Analysis Case 1	5.8%
Sensitivity Analysis Case 2	5.2%
Sensitivity Analysis Case 3	5.8%
Sensitivity Analysis Case 4	5.1%
Sensitivity Analysis Case 5	4.0%

(4) Evaluation

FIRR is 6,4% for the base case and 4.0% for the worst case of the sensitivity analysis (Case 5). Financial institutions for international economic cooperation usually fix terms and conditions of their loans based upon the developing stage of the borrowing countries. Two of these organizations have confirmed to us that their interest rates applicable to the countries in the same developing stage as Syria are 2.20 % and 0.75 % respectively once the loan on the project is approved.

FIRR of this project does not seem to be high enough, but the foreign currency loan with such a low interest rate as above is available and the local portion not covered by foreign loan is supported by Government or financed by reasonable interest loan, it is feasible even in the worst case of the sensitivity analysis.

Chapter 9 Environmental Impact Assessment

9.1 Assessment process

The subject of this assessment is the project for "Modernization of the Locomotive Workshop". The project calls for the construction of a new workshop for maintenance of diesel locomotives, diesel cars and brake blocks. This assessment is a first step towards implementing a comprehensive assessment, which should be completed at the time of detailed design.

9.2 Environmental Setting

9.2.1 Project Location and Topography

The new workshop shall be constructed in the northeastern part of Aleppo city, in Muslimia area and attached to the existing railway station there.
The ground levels of the site where the workshop shall be constructed range from 413 to 423 meters above sea level. The ground level gradually increases from the railway line in the east towards the western direction.

9.2.2 Physical Environment

Soil investigation data shows that there is a silt layer of thickness 1 – 3 meters, followed by limestone layer (7 – 20 m) and chalk layer (30 – 100 m). The bearing capacity of the limestone layer is about 1.5 kg/cm^2.
Temperatures in Aleppo city peak to 38 – 40^{o}C degrees in July and August and fall to 0 – 5^{o}C degrees in December and January. During these two months over 80 mm of rainfall have been recorded while there is hardly any rainfall during July and August.
The main source of water in the area is groundwater drawn from wells, which is used for drinking water as well as agriculture. Presently wells are at depths of more than 100 meters and are mostly dry during the summer. Water samples analyzed in this study showed that the well water was not suitable for drinking, according to the Syrian draft water quality standards.
The Ministry of Environment data shows high levels of nitrogen dioxide, sulphur dioxide and suspended particulate matter in Aleppo city. The major sources of air pollution at the project site are the two cement plants operating there.

9.2.3 Human Resources

A field survey was done in an area of radius 2 kilometers surrounding the project location site. Five inhabited areas of which three are villages surround the project site. Total population in these areas is estimated at around 9,000 to 10,000 persons. Housing in the three villages is mainly formal, while that in the two more recently established housing areas is informal. Average household size was 13.4 persons, which reflects different generations, and family, relatives and workers living under one roof.

The land use activities have been surveyed within an area of 26.4 km^2, with the station located almost in the center. Agriculture activity accounts for 60% of total land use and industrial plants represent 9%.

18% of the surveyed population is working, of which 83% work in the Muslimia area. By work category ordinary workers in plants, farms and construction account for 50%, while those working on farms are 18%. Most of the work in the area is connected to the farms there, cement plants, and free zone area.

Although the villages near the station date back 200 years there are no significant historic buildings located there. The station building itself was constructed around 1910 and it has some Ottoman architectural significance.

9.2.4 Environmental Regulations, Institutions and Issues

The Draft Law on the Protection of the Environment is still in the discussion stage and it is not clear when it will be enacted. The Draft Law specifies the need for environmental impact assessment but does not specify the types of projects requiring the assessment or the contents of the assessment. Under this law GESR would implement the assessment and the Ministry of Environment and Aleppo Governorate would be included within the committee established to review the assessment reports.

The Syrian Syndicate of Engineers, Aleppo branch publication “Building Codes in Aleppo City” (1999) contains some articles, of relevance to mitigate environmental impacts from the project. These include provisions for treatment of waste and environmental pollutants generated during plant operation as well as precautions for workers safety. It should be noted however that Muslimia area is out of Aleppo’s master plan area and buildings there may not be

subject to all these conditions.

The major environmental issues in the project area are briefly summarized as follows:

(1) Water quality: Groundwater quality is poor and wells are dry during the summer season.
(2) Wastewater system: There is no wastewater drainage system and most houses have septic tanks, which are poorly maintained.
(3) Cement plants: Dust and noise are generated from the plants and blasting operations.
(4) Sheep holding area: The sheep holding area inside the station generates a bad odor.
(5) Inadequate road network: The sole main road from Aleppo is congested during certain hours of the day because of the trucks parked in front of the free zone area waiting for their turns to load and unload goods.

9.3 Impacts of Proposed Project

9.3.1 Sequence for Environmental Consideration

EIA is a continuing process from project conception, planning, preliminary design, and alternatives evaluation, to the detailed design and construction planning phases. The EIA should also identify the system for environmental monitoring, which should commence after the project is commissioned and continue for the duration of the project life.

The project under evaluation at present is in the preliminary design. The environmental assessment at this stage shall define detailed areas for attention.

The screening and scoping procedure followed hereafter shall be used for that purpose.

9.3.2 Overall Result

The screening and scoping procedure was followed to determine potential impact on 23 environmental items. Table 9.3.1 shows the potential degree of impact expected in 7 of these items.

Table 9.3.1 Overall Result

Environmental Item	New Workshop Project
A. SOCIAL ENVIRONMENT	
3. Traffic and public facilities	B
7. Public health condition	C
8. Waste	B
C. POLLUTION	
18. Air pollution	C
19. Water pollution	C
21. Noise and vibration	C
23. Offensive odor	C
Notes: Evaluation categories: A: Serious impact is predicted, B: Some impact is predicted, C: Extent of impact is not expected to be significant, but further examination is required, D: No impact is predicted, EIA is not necessary	

9.4 Evaluation

Based on the project need, review of the potential impacts on the environment and their scope and considering the impact on the environment of greater road traffic in the absence of the project for rehabilitation of rail transport, of which this project is an important component, it is considered feasible to implement the project from an environmental viewpoint. However the following points are important.

(1) Muslimia Area Development Plan

Unfortunately the Muslimia area is not included in the Aleppo city development plan. The utility service authorities have plans to develop the electricity network and telephones. However plans to modernize the water supply, wastewater drainage and road network are not clear. There is also no action to formalize the largely informal housing there.

In order to mitigate some negative environmental impacts the new workshop may have on the surrounding area, the development of these services is necessary. In that sense impacts of the project on traffic and public facilities and waste have been rated as B (some impact is predicted). Although the design and operation plans will incorporate measures to mitigate these impacts, if development in the area continues to lag behind then impact may not be totally avoided.

(2) Workshop Preliminary Design

The workshop preliminary design incorporates wastewater treatment plant and incineration. Ventilation and lighting facilities are included. Storehouses are prepared for storage of dangerous materials. Access to the site will be controlled by fence and gates. Rest-

rooms and canteens are included. The final design should include detailed measures the adequacy of which may then be evaluated.

(3) Workshop operation plan

During one shift it is estimated that about 1,000 personnel will be working in the workshop. An operation plan including safety precautions is required in order to guarantee their safety. The operation plan should also take into account the proper operation and maintenance of the facilities provided as countermeasures against environmental impact.

Chapter 10 Conclusion and Recommendation

10.1 Conclusion

(1) The long term planning on rolling stock maintenance in GESR is now going on, in which the maintenance workshop for locomotives, diesel railcars, passenger cars and freight cars are to be gathered in the same district adjacent to Muslimia station to be operated organically, effectively and economically as a whole.

(2) The project of new workshop construction at the site near Muslimia station is to cope with the long term plan, and to practice the modernized and efficient maintenance work of DLs and DCs being introduced hereafter, in addition, to cast the brake shoes for all rolling stock in GESR.

Through the execution of the project, the following effects would be expected.

1) Practice of periodic inspection of rolling stock in accordance with the yearly plan.
2) Decrease of staying days at workshop for maintenance work. (Raising up of working ratio)
3) Improvement of maintained rolling stock quality. (Decrease of rolling stock failure)
4) Improvement of technique on rolling stock maintenance, production, and workshop management and operation. (Process control, Quality control, Inventory control etc.)
5) Decrease of rolling stock maintenance cost.
6) Decrease of environmental impact

(3) Economic evaluation revealed that EIRR is 21.0%, and 5.3% for the worst case of 50% benefit decrease and 100 % cost increase.

Accordingly, the project is considered feasible from the national economic viewpoint, if the project execution is managed rationally.

Financial evaluation revealed that FIRR=6.4% for base case, and 4.0% for the worse case of 10% cost increase and 10% benefit decrease. The project is considered financially viable if the low interest foreign loan is available for foreign currency portion and local portion not covered by foreign loan is supported by government or financed by reasonable interest loan.

(4) As a total evaluation, the project of workshop construction for DLs and DCs maintenance and break shoes casting is feasible from national economic point of view and financial point of view.

10.2 Recommendation

The following items will be recommended for the raising of new workshop productivity further, which will result in the complete success of the project.

(1) Effort for decrease of staying days at the workshop for rolling stock inspection to be continued.
(2) Effort for improvement and enrichment of rolling stock maintenance work and brake shoes casting to be continued.
(3) Effort for raising of workers' net working rate to be continued.
(4) Management and operation of workshop based on some kind of profit and loss account. (To be designated as a special model case for management improvement in GESR)