Chapter 5 Transportation Plan

5.1 Fundamental premises for setting up transportation plan

Transportation plan is set up as follows based on above mentioned concept.

(1) Project sections and maximum speed

Passenger train 130 km/h (100)

Freight train 100 km/h

Note: ( ) is Maximum speed for Passenger Coach Train.

(2) Operation security system

Train operation security system which is a fundamental condition of train operation, is an automatic blocking system on double track section.

(3) Traction system

As for traction system, diesel engine is adopted to avoid electrification which requires big investment. Overnight sleeper train and some day time passenger train (only up to 2010) are hauled by diesel electric locomotive (DEL).

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 train is by small formation of diesel railcar (DC) train to perform frequent service.

(4) Train formation

1) Passenger train

Referring to the result of cross sectional transportation demand, the riding factor is premised as 70%, seasonal fluctuation is to be 110%, the formation of sleeper train is 9～11 coaches and daytime operating passenger coach train is 4 coaches, while, DC train is 2～5 cars considering frequent service.

2) Freight train

The single headed operation is the principle of freight train and hauling capacity is 1800 tons by French new DEL(3200 type), with 70% of hauling efficiency and 60%

of loading factor and is to be 110%.

With respect to train operation between Akkari and Al-Khanse, three alternative methods will be compared:

① single DEL traction (950 ton traction force) on 20‰ new track constructed in parallel with existing track.

② double DEL traction (1800 ton traction force) on 20‰ new track constructed in parallel with existing track.

③ single DEL traction (1800 ton traction force) on 12‰ new track constructed separately from the existing track route.

(5) Transportation Demand

Transportation volume of the section under Feasibility Study

Transportation volume of the section under Feasibility Study is indicated in Table 5.1.

Table 5.1 Estimated transportation volume in section of Tartous～Homs～Mhine～Al-Sharqia (per day)

	1999	**2005**	**2010**	**2015**	**2020**
Passenger	390	**1,660**	**3,200**	**5,578**	**6,768**
Passenger-Km	40,393	**157,888**	**364,512**	**583,139**	**733,923**
Ton	8,139	**15,142**	**26,500**	**44,250**	**71,212**
Ton-km	1,665,845	**2,751,711**	**4,921,746**	**7,337,964**	**10,957,060**

5.2 Selection of hauling system by Alternative A

(1) Hauling system

The freight train hauling system between Akkari～Al-Khansa with gradient of 20‰ should be decided by single headed locomotive hauling system or by double headed hauling system considering required number of locomotive, number of locomotive driver, track capacity, train handling system, travel time.

Alternative A-1 Single headed with 3200 type locomotive, hauling 950tons

Alternative A-2 Double headed with 3200 type locomotive, hauling 1,800tons

(2) Comparison

The evaluation of Alternative A-1 and Alternative A-2 is made as shown in Table 5.2 by the stand point of required number of locomotive, number of train crew, number of train,

travel time and train handling system.

Table 5.2 Evaluation

	A-1	A-2
Necessary number of Locomotive	◯	◯
Necessary number of Driver	◯	◯
Number of Train	△	◯
Travel time	△	◯
Train handling	▲	△

◯: No difference △: Somewhat inferior ▲: inferior

1) Number of train

In case of double headed operation, less number of train is good enough for transportation.

2) Travel time

Shorter travel time (including running time, handling time) is obtainable by double headed operation than single head operation between Akkari and Al-Khansa, as indicated in Table 5.3. The train running time between stations is regarded as not different by single headed operation or double headed.

This Alternative A-2 is advantageous Alternative A-1 due to shorter travel time.

Table 5.3 Train handling time

(Unit; Minute)

	Alternative A-1			Alternative A-2	
	Train handling time			Booster at rearmost	
	Dividing	Waiting	Coupling	Coupling	Uncoupling
Akkari	5			5	
Al-Khansa		15	15		5
Total	35			10	

(3) Evaluation

According to the above studies, the double headed operation is advantageous to the single headed operation. Therefore, Alternative A-2 will be defined as Alternative A in the Feasibility Study.

5.3 Train operation plan of Alternative A

(1) Passenger train operation plan

Table 5.4 Kind of train and number of train, and coaches in the train formation

Year	Train Type / Section	Passenger Corch Train									Diesel Car Train				Total Number of Train
		Sleeping Train					Day time Train				Day time Train				
	Formation (Class)	No. of Car/Train				Number of Train	No. of Car/Train			Number of Train	No. of Car/Train			Number of Train	
		Sleep.	1St	Other	Total		1St	2nd	Total		1St	2nd	Total		
2005	Tartous ～Homs1	4	3	2	9	2	2	2	4	2	1	1	2	4	8
	Homs1～Mhine	4	3	2	9	6				0	2	2	4	6	12
	Mhine～ Al Shrqia					0				0					0
	Formation (Class)	No. of Car/Train				Number of Train	No. of Car/Train			Number of Train	No. of Car/Train			Number of Train	Total No. of
		Sleep.	1St	Other	Total		1St	2nd	Total		1St	2nd	Total		
2010	Tartous ～Homs1	4	3	2	9	2	2	2	4	2	1	1	2	4	8
	Homs1～Mhine	4	3	2	9	4					2	2	4	8	12
	Mhine～ Al Shrqia	4	3	2	9	2	2	2	4	2					4
	Formation (Class)	No. of Car/Train				Number of Train	No. of Car/Train			Number of Train	No. of Car/Train			Number of Train	Total No. of
		Sleep.	1St	Other	Total		1St	2nd	Total		1St	2nd	Total		
2015	Tartous ～Homs1	5	4	2	11	2					2	2	4	8	10
	Homs1～Mhine	5	4	2	11	4					3	2	5	16	20
	Mhine～ Al Shrqia	5	4	2	11	2					3	2	5	4	6
	Formation (Class)	No. of Car/Train				Number of Train	No. of Car/Train			Number of Train	No. of Car/Train			Number of Train	Total No. of
		Sleep.	1St	Other	Total		1St	2nd	Total		1St	2nd	Total		
2020	Tartous ～Homs1	5	4	2	11	2					3	2	5	10	12
	Homs1～Mhine	5	4	2	11	4					3	2	5	20	24
	Mhine～ Al Shrqia	5	4	2	11	2					3	2	5	4	6

(2) Freight train operation plan

1) Hauling weight（tons）

Fig 5.1 indicates hauling weight by section.

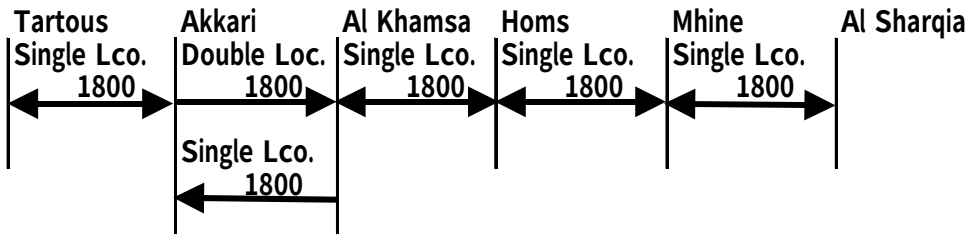

Fig 5.1 Hauling weight by section

2) Designed transportation capacity

Table 5.5 indicates kind of train and number of train. The number of train includes dead head train.

Table 5.5 Kind of train and number of train

Year	Item / Section		Number of FreightTrain			Dead head Loc. Train	Total
			Phosphate	Other	Total		
2005	Tartous ～Homs1	Tartous ～Akkari	10	20	30		30
		Akkari～Al-Khansa	10	20	30	10	40
		Al-Khansa～Homs2	10	20	30		30
	Homs1～Mhine		12	14	26		26
	Mhine～ Al Shrqia	Mhine～Al Fajwa	12	2	14		14
		Al Fajwa～ Al Shrqia	10	2	12		12
2010	Tartous ～Homs1	Tartous ～Akkari	12	36	48		48
		Akkari～Al-Khansa	12	36	48	18	66
		Al-Khansa～Homs2	12	36	48		48
	Homs1～Mhine		14	28	42		42
	Mhine～ Al Shrqia	Mhine～Al Fajwa	14	10	24		24
		Al Fajwa～ Al Shrqia	12	10	22		22
2015	Tartous ～Homs1	Tartous ～Akkari	16	52	68		68
		Akkari～Al-Khansa	16	52	68	26	94
		Al-Khansa～Homs2	16	52	68		68
	Homs1～Mhine		16	52	68		68
	Mhine～ Al Shrqia	Mhine～Al Fajwa	16	16	32		32
		Al Fajwa～ Al Shrqia	14	16	30		30
2020	Tartous ～Homs1	Tartous ～Akkari	18	80	98		98
		Akkari～Al-Khansa	18	80	98	40	138
		Al-Khansa～Homs2	18	80	98		98
	Homs1～Mhine		18	86	104		104
	Mhine～ Al Shrqia	Mhine～Al Fajwa	18	44	62		62
		Al Fajwa～ Al Shrqia	16	44	60		60

The train transporting phosphate is to be an exclusive train of phosphate, while others are to be an ordinary freight train.

(3) Train kilometer and car kilometer

Table 5.6 indicates train kilometer and car kilometer per day.

Table 5.6 Train kilometer and car kilometer (per day)

	1999	2005	2010	2015	2020
Passenger Train Km	170.7	1,632.4	2,028.4	3,030.0	3,288.8
Freight Train Km	3,466.9	6,701.2	11,074.0	16,075.8	25,348.8
Total Train km	3,637.6	8,333.6	13,102.4	19,105.8	28,637.6
PC Car km	22,512.1	6,275.8	7,685.2	7,642.8	7,642.8
DC Car Km	0.0	2,408.8	3,782.4	10,820.0	12,970.0
FC Car Km	52,696.9	101,858.2	168,324.8	244,352.2	385,301.8
DEL Km(for Passenger Train)		897.8	1,191.1	764.3	764.3
DEL Km(for Freight Train)		7,808.0	12,967.5	18,818.8	29,630.5
DEL Km (Total)	3,734.3	8,945.9	14,158.5	19,583.1	30,394.8

Remark : Figures in 1999 is calculated based on the passenger-kilometer and ton-kilometer

(4) Track capacity

On year 2005, the track capacity of all section on year 2005 is good enough for required

number of train operation, but if exceeded, its extent will be very slight.

On year 2010, he track capacity of following section, Akkari～Al-Khanse and 5km Point ～Homs, is not enough. There are some other sections where the track capacity is slightly short.

On year 2015, the track capacity is short for the most of sections for train operation plan.

On year 2020, the track capacity is not enough for the train operation plan, on all the sections.

(5) Necessary number of rolling stock

Table 5.7 indicates necessary number of car by kind of rolling stock.

Table 5.7 Necessary number of car by kind of rolling stock

	2005	2010	2015	2020
PC	25	30	25	25
DC	8	15	35	40
DL	26	42	58	89

5.4 Train operation plan of Alternative B

(1) Passenger train operation plan

1) Premises

The sectional transportation volume, train formation, designed transportation capacity, number of train by kind of train, train formation and train operating line system are the same as 5.3 “Train operation plan of Alternative A”.

2) Track usage

The down train uses existing track (-20‰), while up train, newly built track (+12‰) apart from existing line.

(2) Freight train operation plan

1) Premises

The rate of transportation fluctuation, hauling efficiency and actual load rate are the same as 5.3 “ Train operation plan of Alternative A”.

2) Hauling tonnage : 1,800tons by single 3200 type locomotive

3) Track usage

The down train uses existing track (-20‰), while up train, new track (+12‰).

(3) Designed transportation capacity

Designed transportation capacity is the same as Alternative A. However, Alternative B adopts single headed locomotive train, there is no dead head train.

Table 5.8 indicates kind of train and number of train.

Table 5.8 Kind of train and number of train

Year	Item / Section		Number of FreightTrain			Dead head Loc. Train	Total
			Phosphate	Other	Total		
2005	Tartous ～Homs1	Tartous ～Akkari	10	20	30		30
		Akkari～Al-Khansa	10	20	30	0	30
		Al-Khansa～Homs2	10	20	30		30
	Homs1～Mhine		12	14	26		26
	Mhine～ Al Shrqia	Mhine～Al Fajwa	12	2	14		14
		Al Fajwa～ Al Shrqia	10	2	12		12
2010	Tartous ～Homs1	Tartous ～Akkari	12	36	48		48
		Akkari～Al-Khansa	12	36	48	0	48
		Al-Khansa～Homs2	12	36	48		48
	Homs1～Mhine		14	28	42		42
	Mhine～ Al Shrqia	Mhine～Al Fajwa	14	10	24		24
		Al Fajwa～ Al Shrqia	12	10	22		22
2015	Tartous ～Homs1	Tartous ～Akkari	16	52	68		68
		Akkari～Al-Khansa	16	52	68	0	68
		Al-Khansa～Homs2	16	52	68		68
	Homs1～Mhine		16	52	68		68
	Mhine～ Al Shrqia	Mhine～Al Fajwa	16	16	32		32
		Al Fajwa～ Al Shrqia	14	16	30		30
2020	Tartous ～Homs1	Tartous ～Akkari	18	80	98		98
		Akkari～Al-Khansa	18	80	98	0	98
		Al-Khansa～Homs2	18	80	98		98
	Homs1～Mhine		18	86	104		104
	Mhine～ Al Shrqia	Mhine～Al Fajwa	18	44	62		62
		Al Fajwa～ Al Shrqia	16	44	60		60

No dead head operation of locomotive, but designed transportation capacity is the same as the case of Alternative A.

(4) Train kilometer and car kilometer

Table 5.9 indicates train kilometer and car kilometer per day.

Table 5.9 Train kilometer and car kilometer (per day)

	2005	2010	2015	2020
Passenger Train Km	1,711.8	2,107.8	3,129.3	3,388.1
Freight Train Km	6,899.7	11,312.2	16,393.4	25,706.1
Total Train km	8,611.5	13,420.0	19,522.7	29,094.2
PC Car km	6,533.9	7,943.3	7,943.3	7,861.2
DC Car Km	2,488.2	3,941.2	11,137.6	13,367.0
FC Car Km	104,875.4	171,945.4	249,179.7	390,732.7
DEL Km(for Passenger Train)	941.5	1,234.8	786.1	786.1
DEL Km(for Freight Train)	7,589.7	12,443.4	18,032.7	28,276.7
DEL Km (Total)	8,531.2	13,678.2	18,818.9	29,062.8

Compared with the Alternative A plan, the track length is extended as about 1.3 times consequently, train kilometer, passenger car and diesel railcar kilometer are enlarged, meanwhile the locomotive kilometer becomes shorter as the cancellation of double headed operation even with the extension of operation track length.

(5) Necessary number of rolling stock

1) Premises

The same premises as Alternative A plan are adopted.

2) Necessary number of vehicles by the type

Table 5.10 indicates necessary number of car by kind of rolling stock

Table 5.10 Necessary number of car by kind of rolling stock

	2005	2010	2015	2020
PC	25	30	25	25
DC	8	15	35	40
DEL	23	37	51	78

(6) Travel time

In case of trains on up track between Tartous ～Homs, the express diesel railcar train needs 1 hour 16 minutes, which is almost equal with the case of Alternative A plan while the freight train requires 2 hours 45 minutes, 50 minutes extended compared with Alternative A. This means that travel time of Alternative B case requires 40 minutes more than that of Alternative A even after subtracting 10 minutes for coupling and dividing of boosting locomotive for Alternative A.

5.5 Comparison of Alternative A and B

Alternative A - parallel track addition - and Alternative B - track addition by newly built track apart from existing line - are compared regarding items of the number of trains, track capacity, travel time, necessary number of rolling stock and train handling. Table 5.11 indicates comparison results.

Table 5.11 Comparison Alternative A and Alternative B

			A	B	B-A	Remarks
Train kilometer	2005		8,333.6	8,611.5	277.9	
	2010		13,102.4	13,420.0	317.6	
	2015		19,105.8	19,522.7	416.8	
	2020		28,637.6	29,094.2	456.5	
Car kilometer	2005	PC	6,275.8	6,533.9	258.1	
		DC	2,408.8	2,488.2	79.4	
		FC	101,858.2	104,875.4	3,017.2	
		DL	8,705.8	8,531.2	-174.7	
	2010	PC	7,685.2	7,943.3	258.1	
		DC	3,782.4	3,941.2	158.8	
		FC	168,324.8	171,945.4	3,620.6	
		DL	14,158.5	13,678.2	-480.4	
	2015	PC	7,642.8	7,861.2	218.4	
		DC	10,820.0	11,137.6	317.6	
		FC	244,352.2	249,179.7	4,827.5	
		DL	19,583.1	18,818.9	-764.2	
	2020	PC	7,642.8	7,861.2	218.3	
		DC	12,970.0	13,367.0	397.0	
		FC	385,301.8	390,732.7	5,431.0	
		DL	30,394.8	29,062.8	-1,331.9	
Number of up and down trains (at Peak section)	2005		48	38	-10.0	Akkari～ Al Khans
	2010		74	56	-18.0	
	2015		104	78	-26.0	
	2020		148	110	-38.0	
Travel time(UP Train) (Trtous～ Homs)	Passenger T.		1:14:00	1:13:00	-1:00	Alternative A plan includes 10 minutes of coupling and uncoupling time for boosting locomotive
	Freight T.		2:05:00	2:45:00	40:00	
Number of Rolling stock	2005	P C	25	25	0	
		D C	8	8	0	
		D L	26	23	-3	
	2010	P C	30	30	0	
		D C	15	15	0	
		D L	42	37	-5	
	2015	P C	25	25	0	
		D C	35	35	0	
		D L	58	51	-7	
	2020	P C	25	25	0	
		D C	40	40	0	
		D L	89	78	-11	
Number of locomotive driver	2005		180	170	-10	
	2010		240	230	-10	
	2015		290	275	-15	
	2020		330	310	-20	
Train handling of boosting locomtive			Need	No need		

In views of comparison of the above item, Alternative B is advantages to Alternative A from the view point of train operation aspects.

Chapter 6 Plan of Rolling stock and Depot

6.1 Basic plan of rolling stock

Accompanying the increase of the volume of transportation, operation plan of rolling stock will be as follows :

(1) In the future, the diesel cars will be used for the passenger train mainly in the domestic transportation. (Up to 2010, daytime passenger coach train tracted by DEL will be partly used.)

(2) Locomotive will be used for freight trains, night passenger trains mainly in the domestic transportation and international passenger trains.

(3) For performing the frequent service of domestic passenger transportation, DC trains composed of 1-5 cars are operated.

(4) In the driving cabs of locomotive and diesel car, the ATS (Automatic train stop) device are installed.

6.2 Basic plan of depots

According to the increase of numbers and type of rolling stock, depot will be improved as follows :

(1) New Homs locomotive depot will be constructed.

(2) Maintenance/repair machines and testing equipments for diesel cars will be introduced at the existing Tartous and Homs locomotive depots.

(3) Maintenance/repair machines and testing equipments for ATS will be introduced at the existing Tartous and Homs locomotive depots.

6.3 Places of periodical inspection of rolling stock

1. Locomotive

Depot name	M1	M2	M3	M4
Tartous	○	○	○	○
Homs	○	○	○	○

2. Diesel car

Depot name	D1	D2	D3	D4
Tartous	○	○	○	○
Homs	○	○	○	○

3. Passenger coach and freight wagon

Depot name	Passenger coach	Freight wagon
Tartous	○	○
Homs	○	○

6.4 Staged improvement plan and cost

(Unit : Million SP)

Year	Content	Amounts of cost	Total
2001 to 2005	1.Construction of locomotive depot	415	703
	2.Equipment of diesel car depot	288	
2006 to 2010	1.Equipment of diesel car depot	288	334
	2.Modernization of locomotive depot	46	
Total			1,037

6.5 Education

Accompanying with the introduction of diesel cars, new locomotives and ATS device, it is necessary to educate or train the related staff on their maintenance.

Chapter 7 Track Facilities Improvement

7.1 Concept of Track Facilities Improvement Plan

Although the basic policy of track facilities improvement is established based on 3rd class track of Russia, now it is decided to introduce UIC standard for future improvement or new construction of railways. As a consequence, the Project sections to be improved will be based on UIC standard, however, there are places inevitably to use partly the existing track alignment and track structures. Main specification for the Project sections is as follows;

- Design Speed — DEL Passenger Train ----------120km/h
  (Operating maximum speed----100km/h)
  DC Passenger Train ------130km/h
  Freight Train ----------100km/h
- Maximum Radius of Curve R=600m (for standard alignment excluding station yard)
  R=300 – 400m (inevitable case in existing alignment)
- Maximum Cant — 150mm
- Maximum Slack — 20mm
- Maximum Gradient — 12‰
  20‰ (Akkari – Al Khansa section :
  Double tracking in parallel with existing track)
- Design Load — UIC 702, Axle load 25ton
- Rail — UIC 60 (60.3kg/m)
  (New track and rehabilitation of existing track)
- Sleeper — PC Sleeper (UIC B70) L=2.600m, 1,540 – 1,667/km
  (New track and rehabilitation of existing track)
- Fastening — Pandrol with elastic pad
  (New track and rehabilitation of existing track)
- Ballast — Crushed Stone, 300mm (Under Sleeper) (New track)
  250mm (Under Sleeper) (Rehabilitation of existing track)
- Turnout — Main Line 11#, Sub Line 9#

- Center to center distance between adjacent tracks
  between station 5.0m, station yard 5.0 – 12.5m
- Track formation width Single Track 7.0– 7.5m Double Track 12.0 – 12.5m

In order to secure the safety of train operation after double tracking, the usage of each track of every station will be fixed. Consequently, the usage of platform will be by direction method and if necessary, the new platform will be installed.

7.2 Track Capacity Strengthening Plan

Master Plan and Feasibility Study indicate that the passenger and freight demand are forecasted to increase between Tartous ~ Homs ~Mhine to Al-Sharqia during the year 2001 to 2020, and the track capacity will become insufficient.

In order to increase the track capacity of single track section, it is possible to operate 120 trains/day by installing one or two new signal stations in between stations and in case the number of train exceeds beyond the capacity increased by installing signal stations or the ground configuration does not allow to build signal stations, double tracking would become necessary.

In between Akkari and Al-Khansa (39.4km), there is a continuous section of about 24km with grade of 20‰, which is more than 12‰, the largest gradient stipulated in Syria railways, and will hinder the train operation.

The route to connect Akkari and Al-Khansa with the maximum grade of 12‰ will be studied.
(See Fig.7.2)

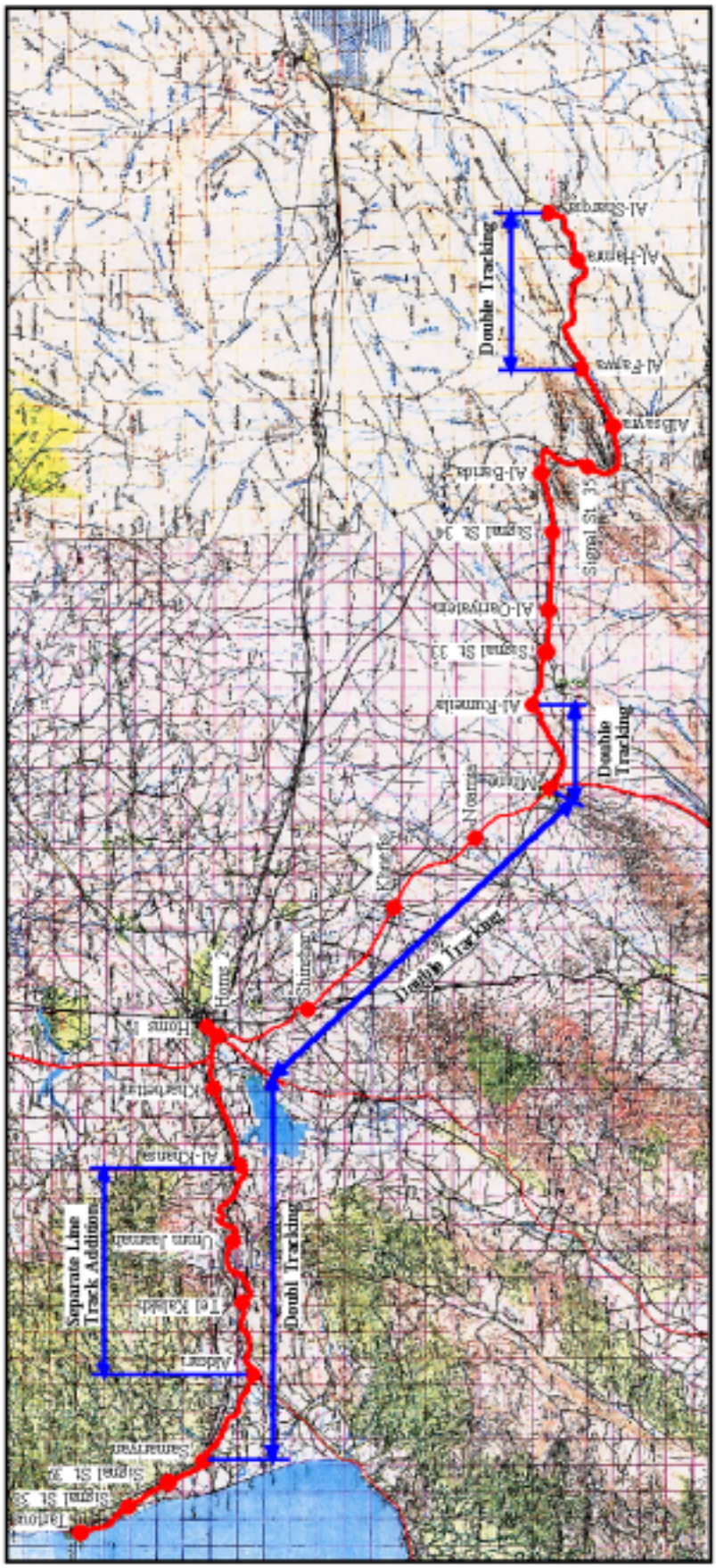

Fig.7.2 Track Capacity Strengthening Plan

7.2.1 Tartous – Homs (102k216m)

Signal stations to be built following the traffic increase or the necessary timing of double tracking construction are summarized in Table 7.2.1.

Table 7.2.1 Improvement Plan between Tartous and Homs 1

Station Name	km	Distance (St. to St.)	State of Line	Year of Improvement	Remarks
Tartous	102,216	4,711			
Signal St. 38	97,505	6,275	New Station	2020	
Signal St. 39	91,230	5,223	New Station	2020	
Samariyan	86,007	21,960			
			Double Tracking	2010	No suitable place for signal station
Akkari	64,047	10,964			
			Double Tracking	2015	No suitable place for signal station
Tel Kalakh	53,083	12,782			
			Double Tracking	2015	No suitable place for signal station
Umm Jaamah	40,301	15,687			
			Double Tracking	2010	No suitable place for signal station
Al-Khansa	24,614	16,162			
			Double Tracking	2015	No suitable place for signal station
Kharbettin	8,452	2,669			
5 km	5,783	5,783	D. Tracking	2010	Junction Point
Homs 1	0				

Note: km=Existing km

(1) Tartous – Kharbettin (Section adopting Alternative A: Akkari～Al Khansa)

In between these stations, install two (2) signal stations and

Signal station 38,Signal station 39, Samariyan station, Akkari station, Tel Kalakh station, Umm Jaamah station, Al-Khansa station and Kharbettin station rough sketch of track layout of yard are shown in Fig.7.2.1 – Fig.7.2.8. At signal station 38 install 4 stabling sidings to detain those cars waiting for loading at Tartous station as not to disturb the increasing arrival and departure trains.

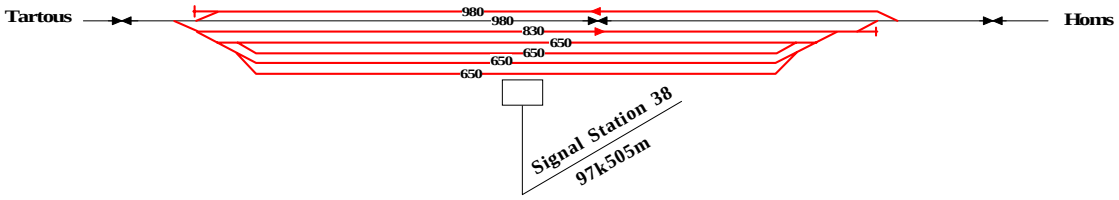

Fig. 7.2.1 Station Yard Track Layout of Signal Station 38

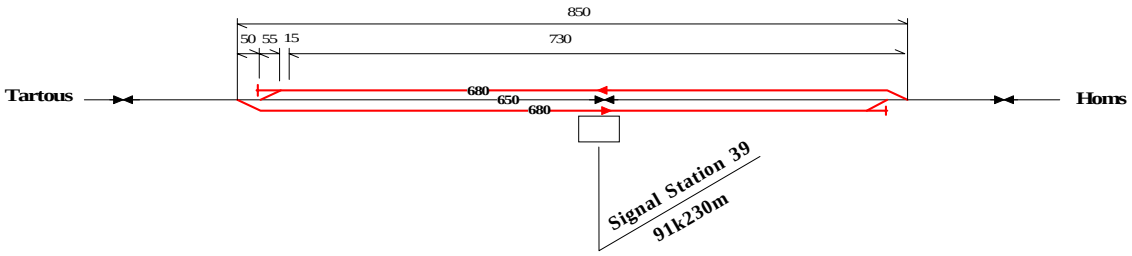

Fig. 7.2.2 Station Yard Track Layout of Signal Station 39

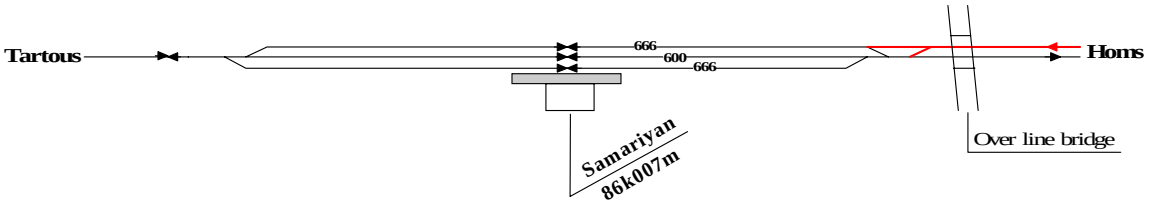

Fig. 7.2.3 Station Yard Track Layout of Samariyan Station

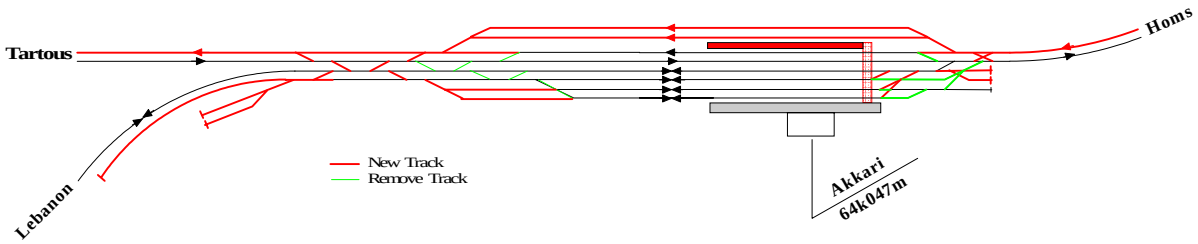

Fig. 7.2.4 Sketch of Akkari station track layout

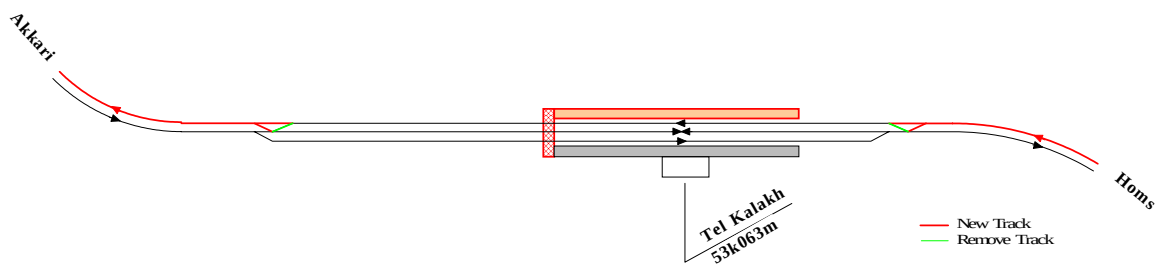

Fig. 7.2.5 Sketch of Tel Kalaakh station track layout

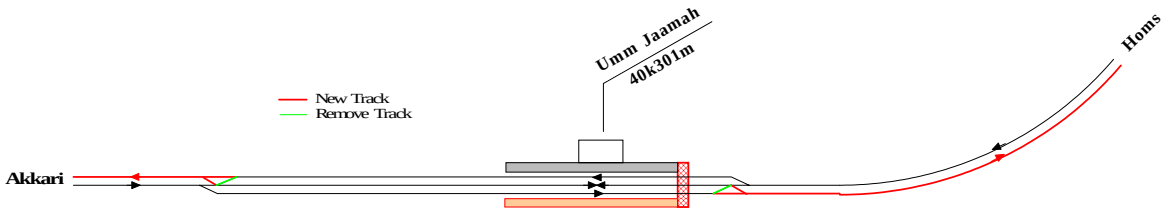

Fig. 7.2.6 Sketch of Umm Jaamah station track layout

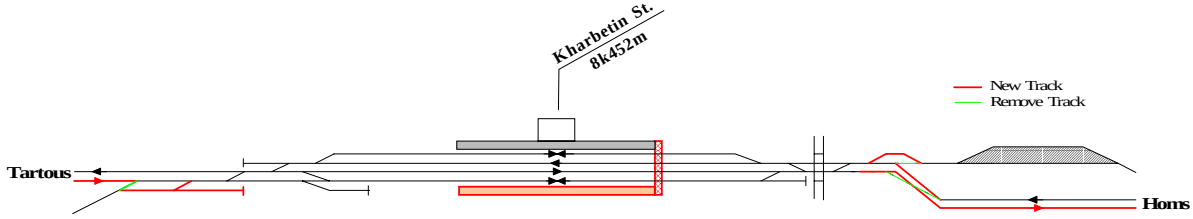

Fig. 7.2.7 Sketch of Al-Khansa station track layout

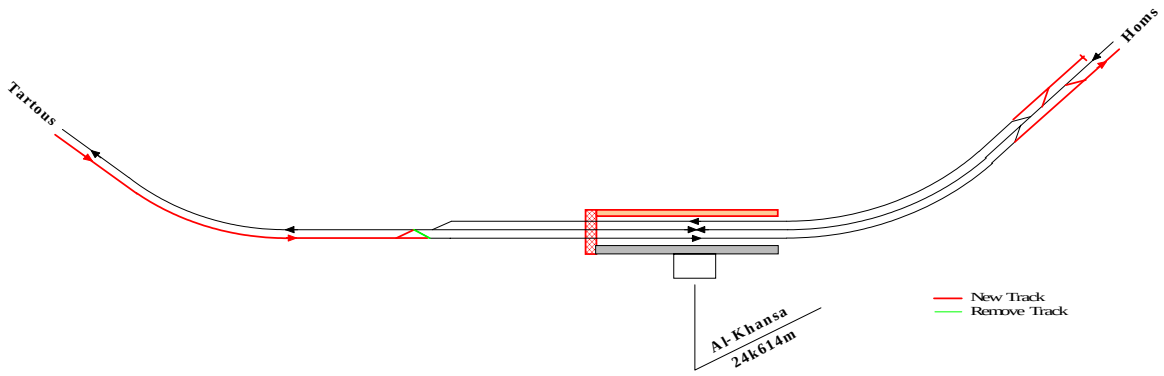

Fig. 7.2.8 Sketch of Kharbettin station track layout

(2) Kharbettin – Homs 1 (Homs 2)

There are 2 branch points in this section. One is so-called 5km point, the other is 2km point.

5km point, is the joining point from Aleppo direction and 2km point is the branch point for Damascus direction and Homs 1 direction. Especially, 5km point would be the joining point for double track, grade separation, therefore, will be made.

With respect to 2km, on the other hand, Homs 1 direction is only for passenger train service, therefore, Damascus direction will become the main route.

Improved track layout of Kharbettin station is shown in Fig.7.2.8. And sketch of improvement between Kharbettin – Homs 1, Homs 2, is shown in Fig.7.2.9.

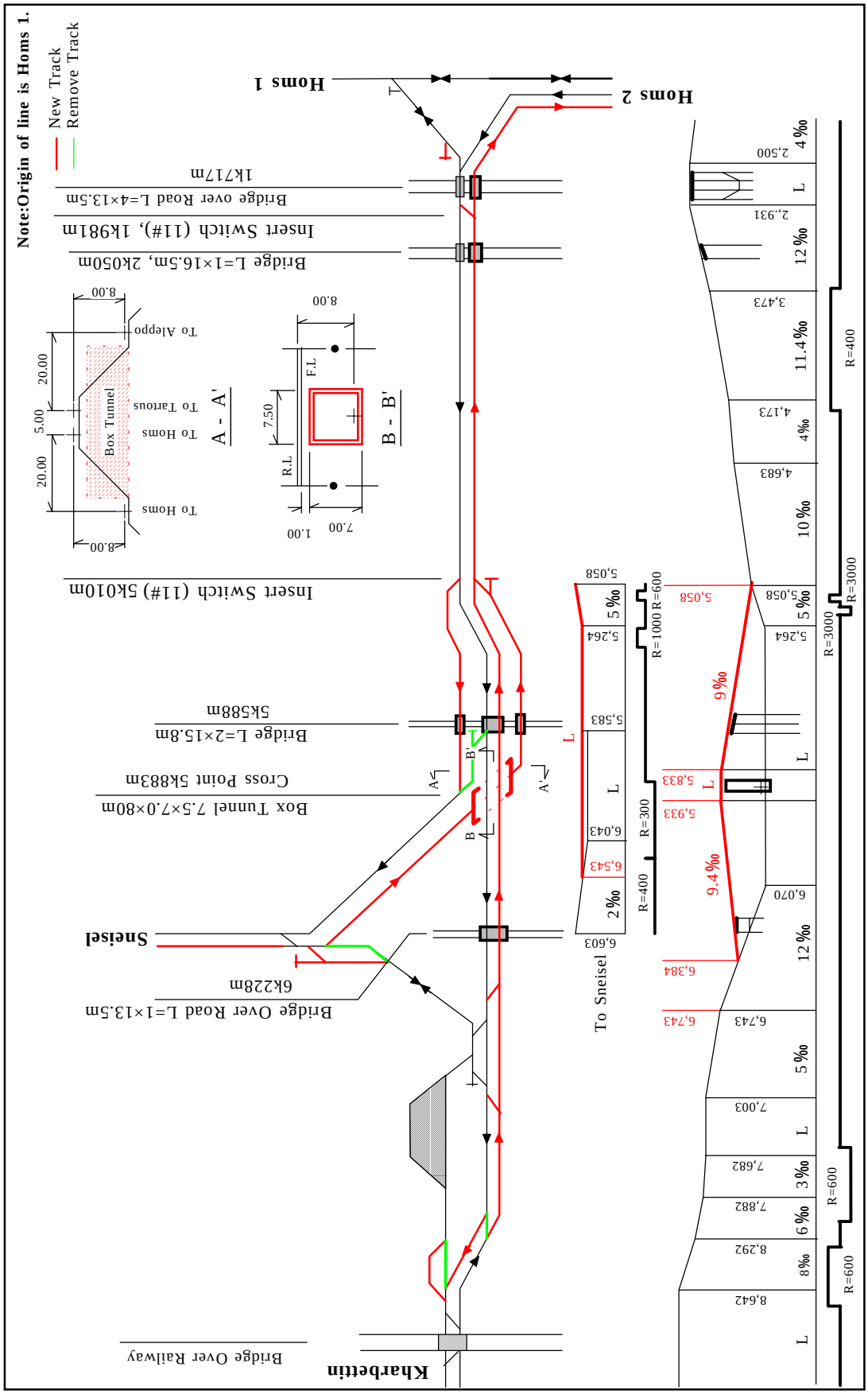

Fig.7.2.9 Sketch of Improvement of the Area near 5km point

7.2.2 Between Homs 2 – Mhine

The necessary timing of construction of double tracking or signal stations to cope with the traffic increase of this section, is summarized in Table 7.2.2.

Table 7.2.2 Improvement Plan between Homs 1 and Mhine

Station Name	km	Distance (St. to St.)	State of Line	Year of Improvement	Remarks
Homs 1 (P)	0				
Homs 2 (F)	4,120	4,120			
			Double Tracking	2015	No suitable place for signal stations
Shinshar	18,299	14,179			
			Double Tracking	2015	No suitable place for signal stations
Khnefis	31,856	13,557			
			Double Tracking	2010	No suitable place for signal stations
Noamia	52,956	21,100			
			Double Tracking	2020	No suitable place for signal stations
Mhine	67,793	14,837			

Homs 1 is an exclusive passenger station and the scale of facilities is fully provided.

Sketches of Homs 2, Shinshar, Khnefis, Noamia and Mhine station improvement track layout are shown in Fig.7.2.10 — Fig7.2.14.

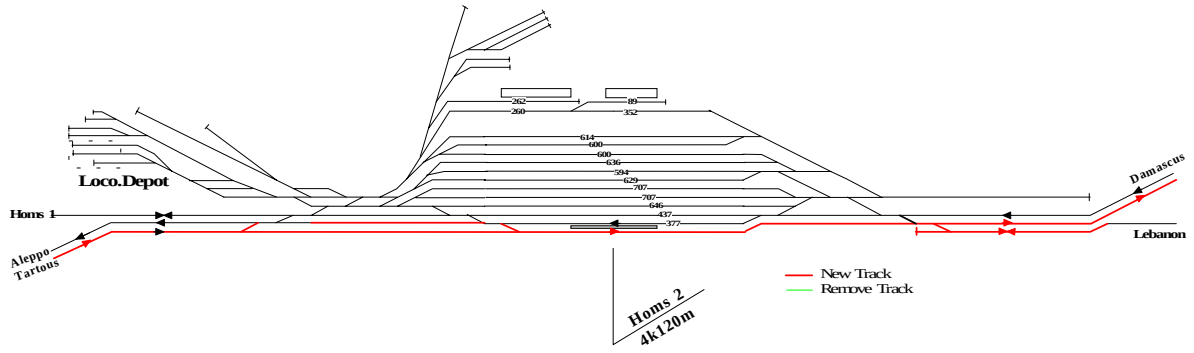

Fig.7.2.10 Sketch of Homs 2 station improvement track layout

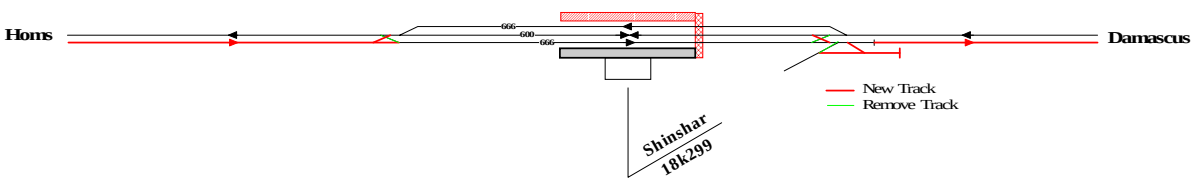

Fig.7.2.11 Sketch of Shinshar station improvement track layout

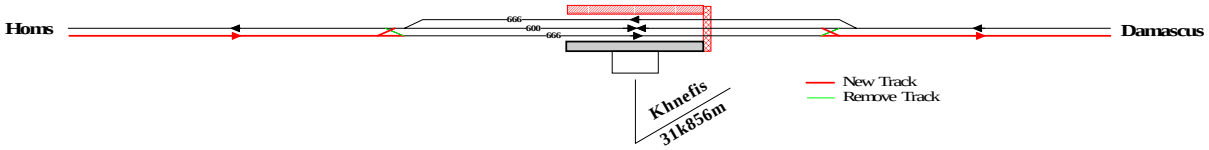

Fig.7.2.12 Sketch of Khnefis station improvement track layout

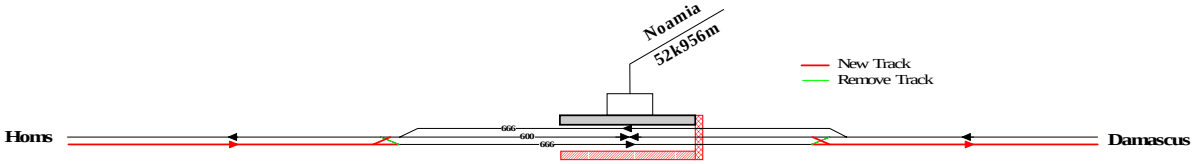

Fig.7.2.13 Sketch of Noamia station improvement track layout

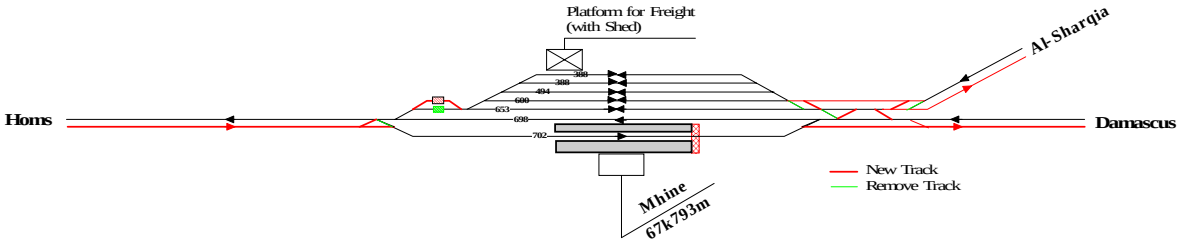

Fig.7.2.14 Sketch of Mhine station improvement track layout

7.2.3 Mhine – Al-Sharqia

The necessary timing of construction of double tracking or signal stations to cope with the traffic increase is summarized in Table 7.2.3.

Table 7.2.3 Improvement Plan between Mhine and Al-Sharqia

Station Name	km	Distance (St. to St.)	State of Line	Year of Improvement	Remarks
Mhine	0				
			Double Tracking	2010	No suitable place for signal station
Al-Rumeila	12,150	12,150			
Signal St. 33	20,700	8,550	New Station	2010	
Al-Qariyatein	25,914	5,214			
Signal St. 34	37,514	11,600	New Station	2010	
Al-Barida	47,814	10,300			
Signal St. 35	56,000	8,186	New Station	2015	
Al-Bsayra	66,572	10,572			
Al-Fajwa	81,772	15,200			
			Double Tracking	2010	No suitable place for signal station
Al-Hamra	98,072	16,300			
			Double Tracking	2010	No suitable place for signal station
Al-Sharqia	110,772	12,700			

Track layout alteration of Al-Rumelia, signal station, Al-Fajwa and Al-Sharqia are shown in Fig.7.2.15 – Fig.7.2.18.

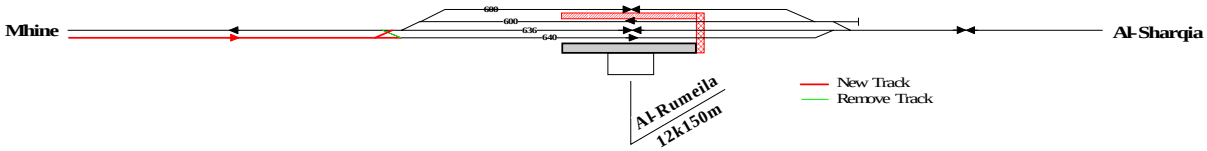

Fig. 7.2.15 Sketch of Al-Rumeila station improvement track layout

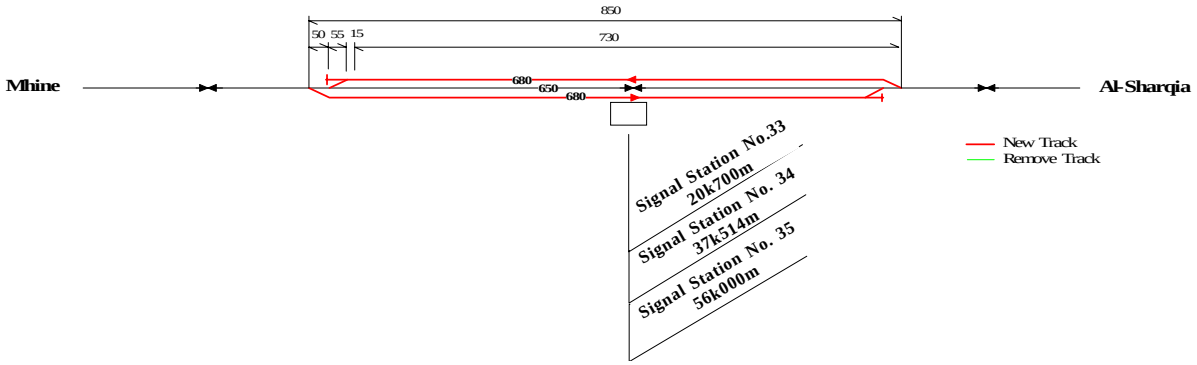

Fig.7.2.16 Sketch of Signal station track layout

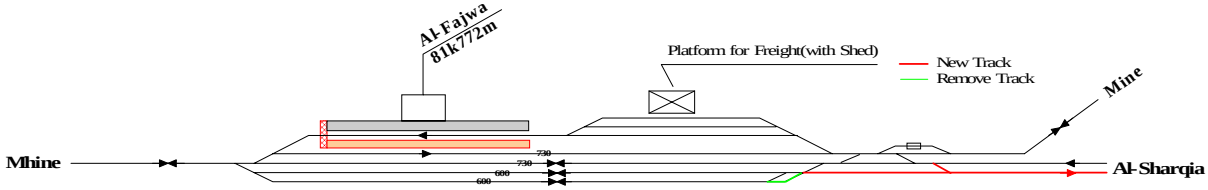

Fig.7.2.17 Sketch of Al-Fajwa station improvement track layout

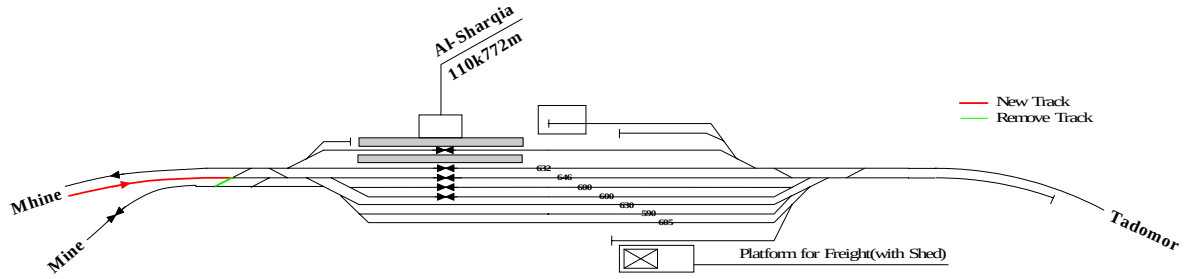

Fig. 7.2.18 Sketch Al-Sharqia station improvement track layout

7.2.4 Track Addition of Separate Route between Akkari – Al-Khansa (Alternative B)

The double tracking will be implemented. In double tracking, the present track will be used as going down track only and a new track of improved alignment with 12‰ will be exclusively used as climbing up train.

Outline plan and profile are shown in Fig.7.2.19 and Fig.7.2.20.

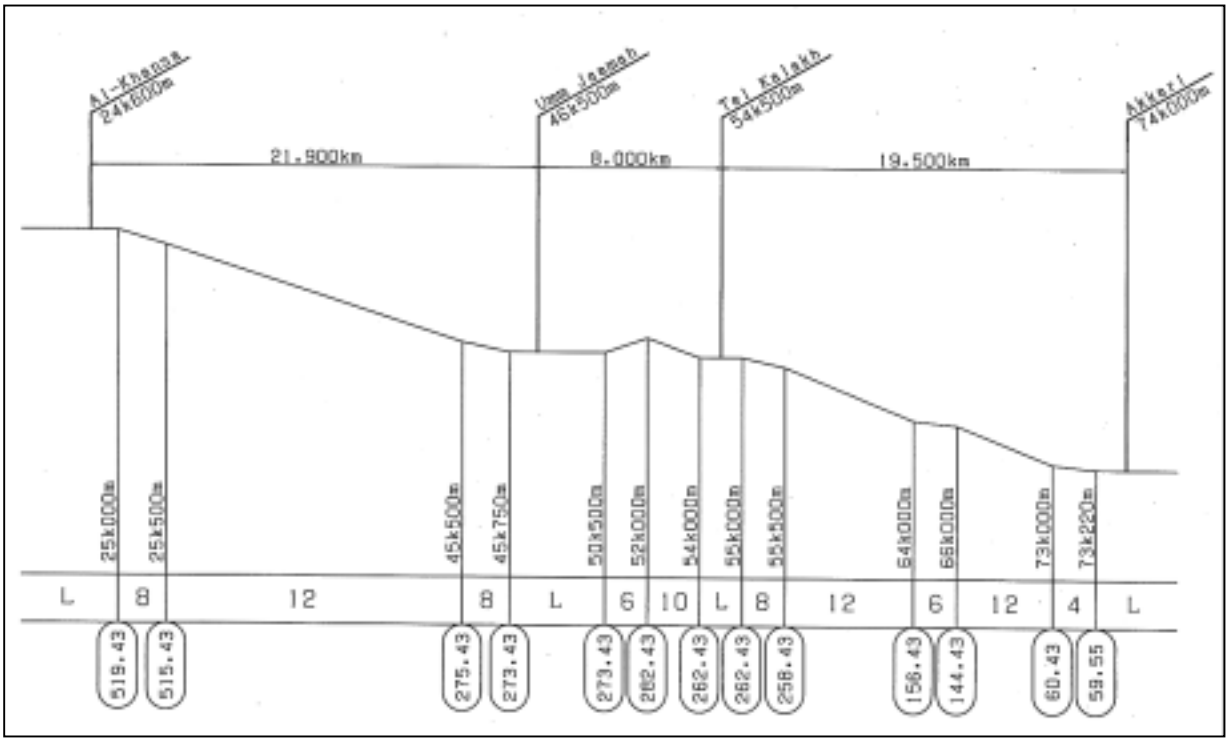

Fig.7.2.20 Outline profile of separate line

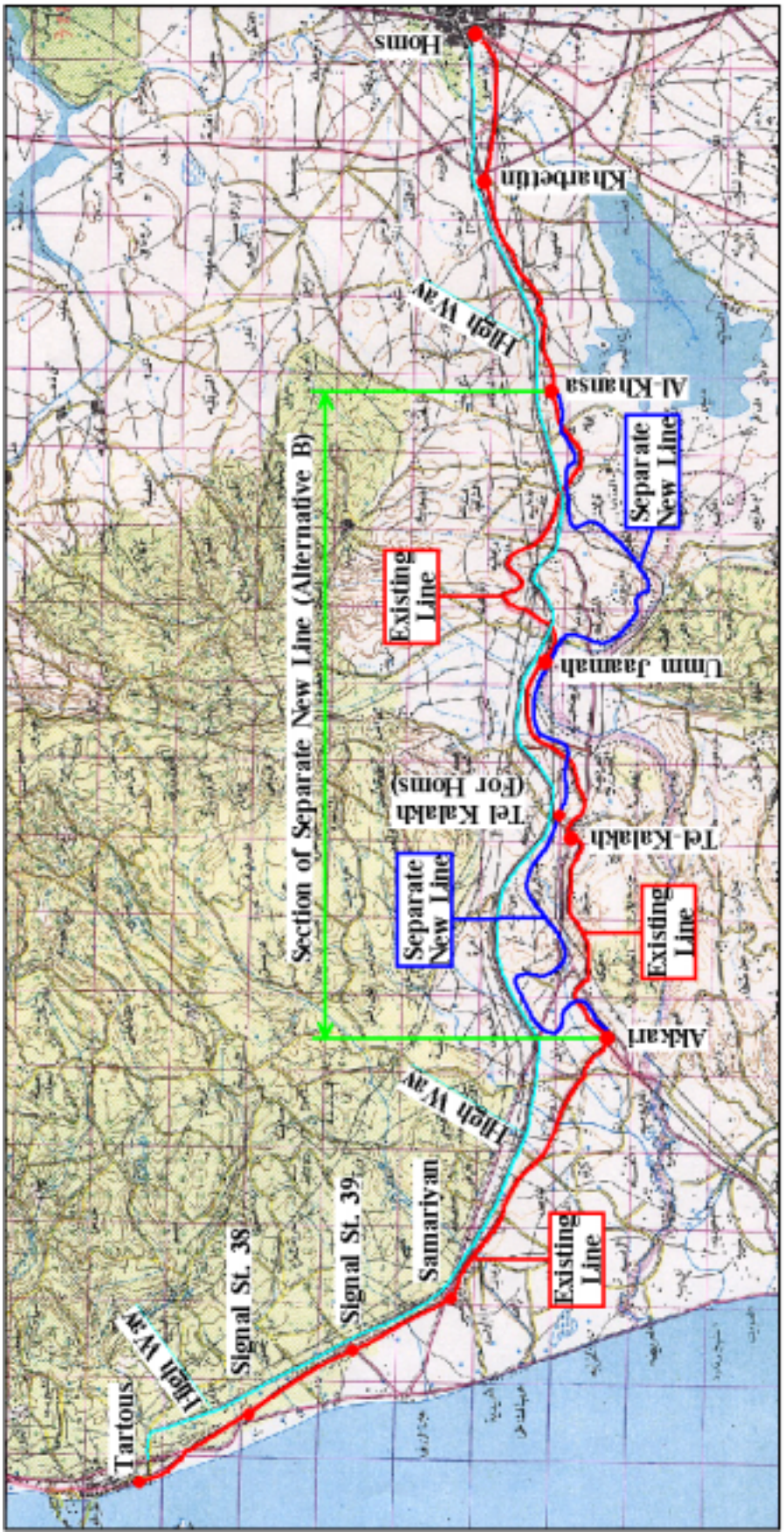

Fig.7.2.19 Outlined Plan

Sketch of track layout of Tel Kalakh station towards Homs is shown in Fig.7.2.21.

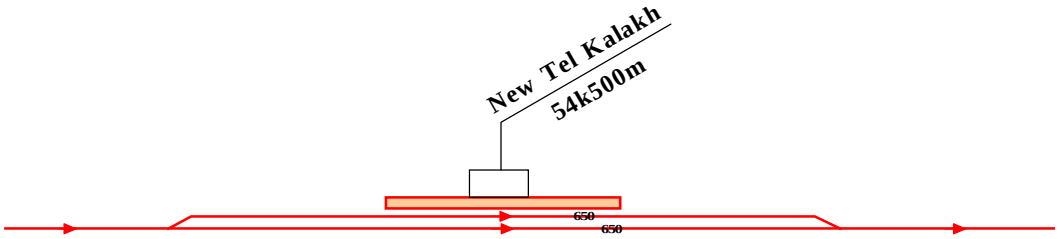

Fig.7.2.21 Sketch of track layout of Tel Kalakh station

7.2.5 Transport improvement plan between Tartous – Homs – Mhine – Al-Sharqia

(1) Alternative A

To make double tracking by laying one new track in parallel with the existing track. The train will be hauled by double locomotives. This is called Alternative A.

(2) Alternative B

To make double track by adding second track on separate route having improved grade between Akkari – Al-khansa. The train will be hauled by one locomotive. This is called as Alternative B.

7.3 Preliminary Design

Basic concept of permanent way specification and structures in Feasibility study section (Tartous –Homs – Mhine – Al-Sharqia) is as stated below.
Specification for track for Alternative B between Akkari to Al Khansa is as shown in 7.3.3.

7.3.1 Track Structures

- Radius Curvature : Minimum Radius Curvature 300m (same as existing line)
- Grade: Maximum Gradient 20/1,000 (same as existing line)
- Formation Width : 3.05m from track center line
- Track Spacing : 5. 0m
- Bridge : Reinforced concrete of girder type structure
- Culvert : Reinforced concrete of box type rigid formation

- Transverse Pipe : Reinforced concrete pipe
- Number of sleeper for track :

  Straight track or more than 1,200m radius of curve : 1600/km

  less than 1,200m radius of curve : 1,840/km

7.3.2 Station and Signal Station

- Grade : Existing station is as the same as present condition

  New signal station should have level track in principle.
- Track Effective Length : 650m
- Track Center Distance : Existing station : the same as present condition

  Newly built track : 5.5m
- Turnout : 1/11 (for side track 1/9)
- Number of sleeper for track : 1,600/km (side track 1,440/km)

7.3.3 Design Specification of Separate Route (Alternative B)

(1) Track Structure

- Radius of Curvature : Minimum radius of curvature 600m
- Gradient : Maximum grade 12/1,000
- Formation Width : 3.05m from track center line
- Track Spacing : 5.0m
- Bridge : Deck steel truss girder and reinforced concrete girder structure
- Culvert : Reinforced concrete box rigid structure
- Transverse Pipe : Reinforced concrete pipe
- Number of Sleeper : Straight track and radius of curve more than 1.200m : 1,600/km

  Radius of curve less than 1,200m : 1,840/km

(2) Station (Tel Kalakh, Umm Jaamah)

- Gradient : Level
- Effective Track Length : 650m
- Number of Track : 2 tracks

- Track Spacing : 5.5m
- Turnout : 1/11
- Number of Sleeper : 1.600/km
- Passenger Platform : Width 2.0m, Length 200m

7.3.4 Construction Quantity

Outlined design quantity of each section are shown in Table 7.3.1 – Table 7.3.3.

Table 7.3.1. Between Tartous and Homs

Items	Unit	Alternative A								Alternative B
		Tartous ～ Samariyan		Samariyan ～ Akkari	Akkari ～ Tel Kalakh	Tel Kalakh ～ Umm Jaamah	Umm Jaamah ～ Al-Khansa	Al-Khansa ～ Kharbettin	Kharbettin ～ Homs2	Akkari ～ Al-Khansa
		Signal St.38	Signal St.39							
Land	m²	36,000	16,000	108,000	55,000	64,000	78,000	61,000	82,000	1,470,000
Building compensation	Type								1	1
Enbankment	m³	36,000	14,000	168,000	87,000	158,000	135,000	94,000	296,000	6,990,000
Cutting	m³	35,000	9,000	81,000	31,000	32,000	169,000	62,000	1,000	4,860,000
Crossing pipe	m	60		70	5	30	5		45	320
Concrete	m³	150	190	370	3,280	3,230	850	190	3,920	3,990
Reinforced concrete	m³	150	160	220	500	330	780	200	2,410	12,700
Bridge	m			447	11	311	161	107	253	482
Improve over line bridge	place			2						
Tunnel crossing with highway	place						2			
Remove bridge	m								63	
Deck type truss bridge	m									700
Girder type viaduct	m									5,000
Newly install track	km	5.1	1.7	21.7	16.2	12.6	15.7	16.4	14	49.4
Newly install turnout	set	14	6	2	26	4	4	8	15	6
S.C. new install	set				1					
Car stopper newly install	set	2	2		5			1	5	2
Remove track	km	0.1	0.1		1.2				3.7	
Remove turnout	set			1	16	2	2	1	5	
emove car-stopper	set				1				2	
New install crossing	place			16	4	8	4	12	6	8
Station building	ridge	1	1							2
Fence	m	2,100	2,100							4,200
Passenger platform etc.	m²			440	680	440	440	440	450	800

Table 7.3.2 Table of Quantity between Homs and Mhine

Items	Unit	Homs2 ～ Shinshar	Shinshar ～ Khnefis	Khnefis ～ Noamia	Noamia ～ Mhine
Land	m²	71,000	68,000	106,000	74,000
Embankment	m³	127,000	39,000	116,000	88,000
Cutting	m³	1,300	32,000	33,000	23,000
Crossing pipe	m	10	5	60	20
Concrete	m³	30	20	250	110
Reinforce concrete	m³			70	50
Bridge	m	96	36	263	249
New track	km	15.2	13.6	21.1	14.8
New turnout	set	7	6	4	11
Install car-stopper	set	1	1		
Remove turnout	set	1	4	2	5
Remove car-stopper	set	3	1		
Install railway crossing	place	4	8	14	6
Passenger platform etc.	m²		440	440	440

Table 7.3.3 Table of Quantity between Mhine and Al-Sharqia

Item	Unit	Mhine ～ Al-Rumeila	Al-Rumeila ～ Al-Qariyatein Signal St. 33	Al-Qariyatein ～ Al-Barida Signal St. 34	Al-Barida ～ Al-Bsayra Signal St. 35	Al-Fajwa ～ Al-Hamra	Al-Hamra ～ Al-Sharqia
Land	m²	61,000	16,000	16,000	16,000	82,000	64,000
Embankment	m³	101,000	25,000	25,000	35,000	197,000	96,000
Cutting	m³	36,000				63,000	51,000
Crossing pipe	m	85	30	20		65	75
Concrete	m³	560	90	60	140	880	710
Reinforce concrete	m³	350			135	620	470
Bridge	m	12			18	99	18
New track	km	12.2	1.7	1.7	1.7	16.3	12.7
New turnout	set	2	6	6	6	4	1
Install car-stopper	set		2	2	2		
Remove track	km		0.1	0.1	0.1		
Remove turnout	set	1				1	2
Install railway crossing	place	4					
Station Building	ridge		1	1	1		
Fence	m		2,100	2,100	2,100		
Passenger platform etc.	m²	430				450	

7.4 Work Execution Plan

Grand total length of feasibility study track route is approximately 276 km.

For these sections, particular examination of execution method and of execution sequence are necessary for the following two (2) places;

7.4.1 Execution Plan near 5km Point from Homs

Execution sequence is as follow and Fig.7.4.1 shows the detailed sequence.

7.4.2 Execution Plan near by Akkari of Alternative B.

Plan of Alternative B of Akkari –Al-Khansa is to make grade separation crossing between the separate line and existing line and to make right-side train operation by the method of relocating the existing line route.
Construction sequence including the separate track route are explained as below.

(1) Together with the construction of separate route, relocating part of track of existing line will be constructed.

(2) After switching the existing track to relocated part of track, which goes under the separate route track, relocated track will be offered for use.

(3) At the place of existing track near by Akkari station which has been switched to relocated part of track separate route facilities will be constructed.

(4) After the completion of the entire separate route, both separate and existing route will be used as up and down track.

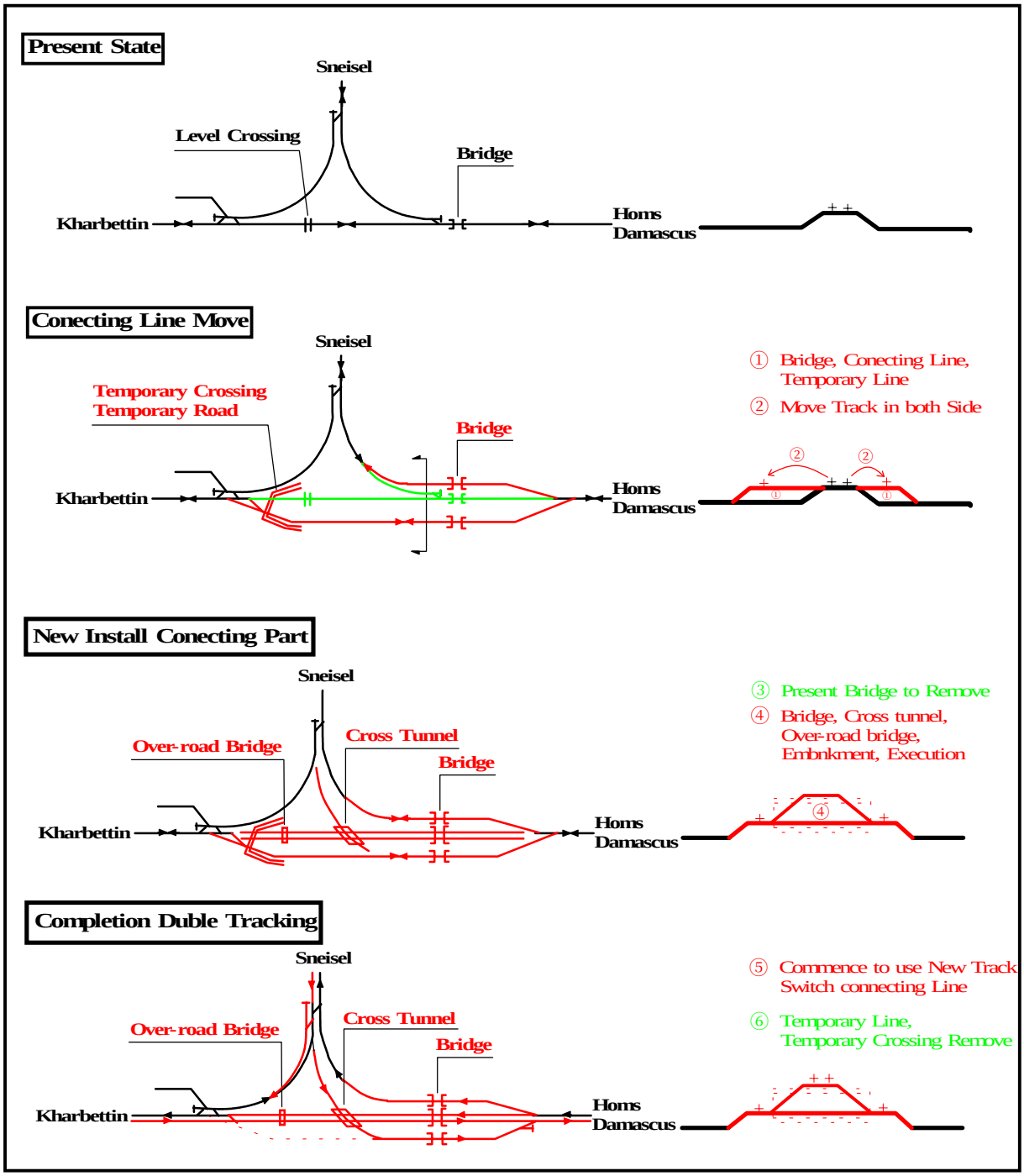

Fig.7.4.1 Homs 5km Execution Sequence

7.5 Outline of Construction Cost

Each section-wise estimated construction cost is shown in Table 7.5.1 – Table 7.5.3.

Table 7.5.1 Cost between Tartous and Homs

Unit: 1,000S.P.

Items	Alternative A(Akkari - Al-Khansa)								Alternative B
	Tartous ～ Samariyan		Samariyan ～ Akkari	Akkari ～ Tel Kalakh	Tel Kalakh ～ Umm Jaamah	Umm Jaamah ～ Al-Khansa	Al-Khansa ～ Kharbettin	Kharbettin ～ Homs2	Akkari ～ Al-Khansa
	Signal St. 38	Signal St. 39							
Land	8,640	3,840	25,992	10,972	8,362	7,840	7,502	18,774	213,960
Roadbed	24,128	8,344	91,055	57,311	87,673	107,446	59,757	134,015	1,723,551
Bridge	1,075	1,625	134,805	7,164	81,130	195,870	28,615	90,625	2,333,600
Track	127,151	46,185	416,840	385,077	256,527	316,536	329,818	303,271	962,149
Station	19,006	19,006	308	476	308	308	308	315	38,740
Total	180,000	79,000	669,000	461,000	434,000	628,000	426,000	547,000	5,272,000

Table 7.5.2 Cost between Homs and Mhine

Unit: 1,000S.P

Items	Homs2 ～ Shinshar	Shinshar ～ Khnefis	Khnefis ～ Noamia	Noamia ～ Mhine
Land	11,360	10,848	3,536	2,226
Roadbed	55,002	25,833	59,656	44,014
Bridge	24,000	9,000	66,450	62,725
Track	305,638	269,011	406,050	306,727
Station	0	308	308	308
Total	396,000	315,000	536,000	416,000

Table 7.5.3 Cost between Mhine and Al-Sharqia

Unit: 1,000S.P

Items	Mhine ～ Al-Rumeila	Al-Rumeila ～ Al-Qariyatein Signal St. 33	Al-Qariyatein ～ Al-Barida Signal St. 34	Al-Barida ～ Al-Bsayra Signal St. 35	Al-Fajwa ～ Al-Hamra	Al-Hamra ～ Al-Sharqia
Land	1,824	480	480	480	2,445	1,905
Roadbed	55,937	11,329	11,329	17,529	101,756	57,252
Bridge	6,220	0	0	5,800	30,990	9,105
Track	235,718	46,185	46,185	46,185	324,494	251,738
Station	301	19,006	19,006	19,006	315	0
Total	300,000	77,000	77,000	89,000	460,000	320,000

Chapter 8 Signal and Telecommunication Systems

8.1 Installation Scheme of Signal and Telecommunication

Signal and telecommunication facilities for the Feasibility Study (F.S.) section (Tartous～Homs～Mhine～Al-Sharqia 275km) were being used since 1982 with equipment of Type 2.

This type adopts a semi-automatic-block system for single line.

Telecommunication cables (7Q1.4mm) are buried in the ground along the section. (Cable Section)

As for electrical power supply the 20KV lines of the GESR from the substation of the electric power company are installed along the railway line of the F.S. section and led to the transformer in the each station.

Replacement time of the signal and telecommunication equipment and devices is schemed based on the Master Plan Report, namely it will be done by year 2010.
Also, section improvement plan in this F.S. will be put into effect based on the Master Plan Report, accordingly signal and telecommunication equipment and devices is to be additionally installed or altered at the time of section improvement.

Signal and telecommunication facilities should be selected carefully considering maintainability from various points.

In the installation of telecommunication cables and transmission system, there should be considered the increase of computer terminals and communication lines due to the expansion of information systems in the GESR such as freight information system, ticket reservation and vending system and other management system in the future.

8.2 Plan of Signal Equipment and Devices

8.2.1 Block instruments and signals

Double track section

- Samariyan～Homs 2～Rmeli～Al Rumeila
- Al Fajwa～Al Sharqia

The indication of the signal is to be automatically controlled by the track circuits installed continuously both in the station yard area and in the inter-station section. (automatic block system)
Indication of color light signals is to be the same as the current system.

Single track section

- Tartous～ Samariyan
- Homs1～Homs2
- Rmeli～Al Fajue

Automatic block signal system is to be installed in which continuous track circuits are to be provided in the station yard area, whereas in the inter-station section, short track circuits (CT, OT) are to be installed only at the home signals of stations to detect train going/coming.
Indication of color light signals is to be the same as the current system.
Distant signal is to be installed at the outside of the home signal for the purpose of repeating signal aspect in the same way as the current system.

8.2.3 Interlocking devices

The electronic interlocking devices (computerized interlocking systems) covering the interlocking of the several stations are to be installed at the major stations and are to be connected to the signal interface relays of the each station by the optical fiber cores.
Stations in which the electronic interlocking devices are to be installed in this project are the following stations.

Tartous, Akkari, Kharbettin, Homs1, Homs2, Mhine, Al-Fajue, Al-Sharqia

8.2.4 Level crossing protection devices

Level crossing protection devices are to be installed at the many level crossings with no signal protection devices at present in addition to the replacement of the present protection devices. In addition to the crossing alarm and crossing gate, warning devices to the trains are to be provided to inform the obstacle to the drivers by using manipulator at the level crossing.

8.2.5 ATS/ATP (Automatic Train Stop/Automatic Train Protection)

In order to prevent train accidents caused by the sharp increase in traffic density, ATS/ATP (Automatic Train Stop/Automatic Train Protection) system is to be used in all the section lines.

ATS/ATP system is to be installed to prevent train collisions, which occur when judgment and action of the driver are erroneous, by stopping a train automatically before it runs into the block section indicating red signal.

And it is also to be used for the purpose of train speed restriction against the oversight of the sign on driver part in the section with a speed limit such as the turnouts and curved section.

8.2.6 CTC (Centralized Train Control)

CTC system, in which the switches and signals of the remote stations are watched and controlled from the CTC center directly, is to be installed to control and supervise efficiently train operation of the section after section lines are upgraded.

Opening of CTC operation

- Tartous～Mhine year 2015
- Al Rumeila～Al Sharqia year 2020

CTC control center of this section lines is to be located in the station yard of Homs 2.

Tartous and Homs 2, having many signals and switches for train operation within station, are not to be controlled from the CTC center, however CTC station unit is to be installed in Tartous and Homs 2 to display indication of their some signals, train existence and other necessary information at the CTC center. (displayed station)

8.2.7 Centralized monitoring device

The centralized monitoring device is to be installed to detect and inform the deterioration of various signal and telecommunication equipment along the railway lines, or to detect failures of equipment and to inform it to the CTC center/maintenance depot to repair.

8.3 Plan of telecommunication equipment and devices

8.3.1 Telecommunication cable

Complex optical fiber cable (2Qcu24opt) is to be installed ,or optical fiber cable and metallic cable are to be installed under ground along the FS project line sections.

8.3.2 Fiber optic transmission system

STM-1 (155.52Mbps), interface name of SDH (Synchronous Digital Hierarchy), is to be used for the fiber optic transmission system.

8.3.3 Digital exchanger

Telephone network of the GESR is to be systematized by one numbering plan.
Digital telephone exchangers in FS project lines are to be installed in the three stations.
(Homs, Mhine and Tartous)

8.3.4 Radio communication

Radio communication link between the train driver and stationmaster in the station area (dispatching radio communication line) is to be extended to the CTC center (Homs) when operation of section lines is to be centralized.

Radio frequencies which are used for the radio link between adjacent stations at present are to be utilized for the communications between maintenance employee (track, signal and telecommunication) working alongside the track and relevant station/depot , or to be used in the case of accident.(train drivers could carry this radio telephone set throughout their duty)

8.4 Maintenance organization

8.4.1 Basic idea of maintenance

Inspection of equipment is to be conducted at regular intervals and to get necessary data.
Such data as installation date, inspection date and data, date of failure, kind of failure and repaired result are to be accumulated for equipment by equipment.
Equipment failure records and deterioration records are to be accumulated at the maintenance depot in charge
These many kinds of data are to be utilized for later inspection and restoration of later failure.

8.4.2 Maintenance employees

Number of maintenance employees of the signal and telecommunication equipment and devices are to be increased, because new signal stations, double tracking and new level crossings with signal protection devices are to be constructed.

Number of maintenance employees in the FS project section lines is to be 112 by 2020**.**

Except engineers in the head office, number of maintenance employees stationed in the depots in the FS project section lines is as follows.

- Tartous(32), Homs(40), Mhine(25), Al-Shrqia(15)

Maintenance staff is to be collectively positioned so that they can be dispatched to any site in trouble within at least one hour from a depot in charge.

8.5 Phased investment plan for signal and telecommunication equipment

8.5.1 Phased investment plan

Construction stage of the FS project line sections is divided into three stages (2006～2010, 2011～2015, 2016～2020) in the same way as a Master Plan Report. (Table 8.5.1)

8.5.2 Comparison between Alternative A and Alternative B

- In Alternative B, it is necessary to install extra metallic cables along the new route. (around 50km)
- In Alternative B, the length of 20kv access line to the signal devices will become more than double.
- In Alternative B, it will become troublesome to maintain equipment and devices due to dispersion of equipment and devices
- In Alternative B, construction expenses will become high (by 40 million S.P.)

Table.8.5.1 Phased investment plan for signal & telecommunication equipment

(Unit:SP in million)

Item	Year / Classification	2005-2010	2010-2015	2015-2020	Remarks
Investment in replacement of equipment	Tartous-Homs2-Mhine-Al sharqia				ATS/ATP inclusive
Investment in double track	Samariyan-Akkari Akkari-Tel Kalakh Tel Kalakh-Umm Jaamah Umm Jaamah-Al Khansa Al Khansa-Kharbettin Kharbettin-Homs2 Homs2-Shinshar Shinshar-Khnefis Khnefis-Noamia Noamia-Mhine Mhine-Al Rumeila Al Fajwa-Al Sharqia				
Investment in signal station	Signal Station A Signal Station B Signal Station C Signal Station D Signal Station E				
Investment in CTC	Tartous-Homs2 (Homs2)-Mhine (Mhine)-AL Sharqia				
Construction expenses Alternative A	Foreign Currency Local Currency Personnel expenses Local currency Other expenses Total	1,416 164 0 1,580	113 15 0 128	110 15 0 125	1,639 194 0 1,833
Construction expenses Alternative B	Foreign Currency Local Currency Personnel expenses Local currency Other expenses Total	1,446 174 0 1,620	113 15 0 128	110 15 0 125	1,669 204 0 1,873

Chapter 9 Investment Planning in Staged Development Plan

9.1 Precondition for Calculating the Amount of Investment

In principle, the amount of investment is calculated on the basis of the following preconditions.

(1) In calculating the amount of investment, the price as of January 2001 is applied, and factor related to future escalation are not considered.

(2) The currency conversion rate is :

US $ 1 = ¥115 = SP 46, as of January 2001

(3) The amount of investment is divided into the local currency portion and the foreign currency portion, and both are calculated in Syrian Pound.

(4) As for the improvement and construction cost, the labor cost and material cost (including machine depreciation) are calculated for each construction work item.

(5) The Labor cost is calculated in the local currency for each construction work item.

(6) In calculating the labor cost, material and so forth, the unit prices for each kind of work are based on the data supplied by Syrian side. As for the unit prices for works which have not been conducted in Syria so far, new prices are established suitably by taking into consideration the actual results of construction works in Japan.

(7) As for the imported materials (including rolling stock) and so forth calculated in foreign currencies, CIF prices are applied by taking into consideration the actual results in the GESR.

(8) Rolling stock cost between Tartous – Homs – Mhine – Al-Sharquia is estimated by multiplying the ratio of rolling stock kilometer in this section against that in the whole CESR network by the total rolling stock cost GESR invest from 2001 to 2020.

(9) As the engineering fee, 5 % of the improvement and construction cost is earmarked.

(10) As the contingency fee, 10% of the improvement and construction cost is earmarked.

9.2 Investment Planning in the Staged Development Plan

The amount of investment by item of improvement and construction is as shown in Table 9.1.

Table 9.1.1 Investment Cost (Alternative A)

Unit : million S.P.

Items	Currency			Total
	Foreign	Local Pesonnel	Local Others	
Track and Structure				
Investment Cost	3,673	1,680	2,381	7,734
Engineering Fee (Cost×5%)	184	84	119	387
Contingency (Cost×10%)	367	168	238	773
Sub Total	4,224	1,932	2,738	8,894
Signal and Telecommunication				
Investment Cost	1,639	194	0	1,833
Engineering Fee (Cost×5%)	82	10	0	92
Contingency (Cost×10%)	164	19	0	183
Sub Total	1,885	223	0	2,108
Locomotive and Diesel Car Depot				
Investment Cost	767	225	45	1,037
Engineering Fee (Cost×5%)	38	11	2	52
Contingency (Cost×10%)	77	23	5	104
Sub total	882	259	52	1,193
Rolling Stock				
Investment Cost	14,396	1,442	157	15,995
Sub Total	14,396	1,442	157	15,995
Total				
Investment Cost	20,475	3,541	2,583	26,599
Engineering Fee (Cost×5%)	304	105	121	530
Contingency (Cost×10%)	608	210	243	1,060
Ground Total	21,387	3855.85	2,947	28,190

Table 9.1.2 Investment Cost (Alternative B)

Unit : million S.P.

Items	Currency			Total
	Foreign	Local Pesonnel	Local Others	
Track and Structure				
Investment Cost	4,433	3,232	3,818	11,483
Engineering Fee (Cost×5%)	222	162	191	574
Contingency (Cost×10%)	443	323	382	1,148
Sub Total	5,098	3,717	4,391	13,205
Signal and Telecommunication				
Investment Cost	1,669	204	0	1,873
Engineering Fee (Cost×5%)	83	10	0	94
Contingency (Cost×10%)	167	20	0	187
Sub Total	1,919	235	0	2,154
Locomotive and Diesel Car Depot				
Investment Cost	767	225	45	1,037
Engineering Fee (Cost×5%)	38	11	2	52
Contingency (Cost×10%)	77	23	5	104
Sub total	882	259	52	1,193
Rolling Stock				
Investment Cost	13,486	1,348	148	14,982
Sub Total	13,486	1,348	148	14,982
Total				
Investment Cost	20,355	5,009	4,011	29,375
Engineering Fee (Cost×5%)	343	183	193	720
Contingency (Cost×10%)	687	366	386	1,439
Ground Total	21,385	5558.15	4,590	31,534

(1) Investment cost (excluding engineering fee and contingency fee) by means of each alternative plan, each line and each item are shown in Table 9.2, Table 9.3.

Table 9.2 Investment Cost of Alternative A

Unit : million S.P.

Railway Section	Tartous ～ Homs	Homs ～ Mhine	Mhine ～ Al-Sharqia	Total
Track and Structure				
Land	93	28	10	131
Structure	1,150	347	363	1,860
Track	2,669	1,593	1,481	5,743
Sub Total	3,912	1,968	1,854	7,734
Signal and Telecommunication				
Electronics Equipment	177	134	113	424
Electrical Equipment	426	211	250	887
Cable	203	123	196	522
Sub Total	806	468	559	1,833
Locomotive and Diesel Car Depot				
Building	201	491	0	692
Machine	110	235	0	345
Sub total	311	726	0	1,037
Rolling Stock				
Locomotive	4,861	1,811	1,610	8,282
Diesel Car	551	832	221	1,604
Passengr Car	205	245	207	657
Freight Car	2,737	1,401	1,314	5,452
Sub Total	8,354	4,289	3,352	15,995
Total	13,383	7,451	5,765	26,599

Table 9.3 Investment Cost of Alternative B

Unit : million S.P.

Railway Section	Tartous ～ Homs	Homs ～ Mhine	Mhine ～ Al-Sharqia	Total
Track and Structure				
Land	280	28	10	318
Structure	4,708	347	363	5,418
Track	2,673	1,593	1,481	5,747
Sub Total	7,661	1,968	1,854	11,483
Signal and Telecommunication				
Electronics Equipment	179	134	113	426
Electrical Equipment	432	211	250	893
Cable	235	123	196	554
Sub Total	846	468	559	1,873
Locomotive and Diesel Car Depot				
Building	201	491	0	692
Machine	110	235	0	345
Sub total	311	726	0	1,037
Rolling Stock				
Locomotive	3,849	1,810	1,610	7,269
Diesel Car	551	832	221	1,604
Passengr Car	205	245	207	657
Freight Car	2,737	1,401	1,314	5,452
Sub Total	7,342	4,288	3,352	14,982
Total	16,160	7,450	5,765	29,375

Further, the improvement cost of Homs 2 and Mhine stations are included in the investment cost of between Homs 2 and Mhine section.

Also, the improvement cost of Tartous Locomotive Depot and Diesel Car depot are included in between Tartous and Homs section and the improvement cost of Homs Locomotive Depot and Diesel Car Depot are included in Homs – Mhine section.

(2) Investment Cost of Classified Foreign and Local Cost by means of each Alternative Plan, each line and each item are shown in Table 9.4, Table 9.5.

Table 9.4 Investment Cost of Classified Foreign and Local Currency for Alternative A

Unit: million S.P.

Section	Items	Structure & Track	Signal & Telecom	Depot	Rolling Stock	Total
Tartous - Homs	F/C	1,728	732	231	7,519	10,210
	L/C Personel	914	74	65	752	1,805
	L/C Others	1,270	0	15	83	1,368
	Total	3,912	806	311	8,362	13,391
Homs - Mhine	F/C	1,010	418	536	3,861	5,825
	L/C Personel	373	50	160	387	970
	L/C Others	585	0	30	41	656
	Total	1,968	468	726	4,291	7,453
Mhine - Al-Sharqia	F/C	935	489	0	3,016	4,440
	L/C Personel	393	70	0	303	766
	L/C Others	526	0	0	33	559
	Total	1,854	559	0	3,350	5,763
Ground Total	F/C	3,673	1,639	767	14,396	20,475
	L/C Personel	1,680	194	225	1,442	3,541
	L/C Others	2,381	0	45	157	2,583
	Total	7,734	1,833	1,037	15,995	26,599

Table 9.5 Investment Cost f Classified Foreign and Local Currency for Alternative B

Unit: million S.P.

Section	Items	Structure & Track	Signal & Telecom	Depot	Rolling Stock	Total
Tartous - Homs	F/C	2,488	762	231	6,607	10,088
	L/C Personel	2,466	84	65	661	3,276
	L/C Others	2,707	0	15	74	2,796
	Total	7,661	846	311	7,457	16,275
Homs - Mhine	F/C	1,010	418	536	3,861	5,825
	L/C Personel	373	50	160	386	969
	L/C Others	585	0	30	41	656
	Total	1,968	468	726	4,292	7,454
Mhine - Al-Sharqia	F/C	935	489	0	3,018	4,442
	L/C Personel	393	70	0	302	765
	L/C Others	526	0	0	33	559
	Total	1,854	559	0	3,350	5,763
Ground Total	F/C	4,433	1,669	767	13,486	20,355
	L/C Personel	3,232	204	225	1,349	5,010
	L/C Others	3,818	0	45	148	4,011
	Total	11,483	1,873	1,037	14,983	29,376

9.3 Schedule of Investment

Investment schedule starts from the year 2001 until 2005 for existing line track improvement and emphasis is placed to recover the track to the originally constructed condition in order to exert the safe and stable transportation. Also, this term is to make preparation to strengthen the transport capacity.

Investment for double tracking, establishing signal stations for strengthening transporting capacity is scheduled to start 5 years prior to the timing to become necessary.

Table 9.5 shows the investment schedule by means of each section and each item.

Table 9.5 Schedule of Investment

Railway Section	Item	2001～2005	2006～2010	2011～2015	2016～2020	Remarks
Tartous - Homs	Structure and Track					
	Signal and Telecom					
	Loco & DC Depot					
Homs - Mhine	Structure and Track					
	Signal and Telecom					
	Loco & DC Depot					
Mhine - Al-Sharqia	Structure and Track					
	Signal and Telecom					
Rolling Stock	Locomotive					
	Diesel Car					
	Passenger Car					
	Freight Car					
Improvement Cost (million SP)	Alternative					Total
	A	3,358	8,941	7,111	7,189	26,599
	B	3,358	12,271	6,925	6,821	29,375

Note : ═══ Rehabilitation
▬▬▬ Modernization
■ ■ ■ To cope with the increase of the traffic
"Improvement Cost" means the construction cost excluding engineering fee and contingency fee.

9.4. Organization for Staged Development Plan

Out of grand total length of 276km for Feasibility Study, work execution length for track addition and establishing signal station are approximately 88km between Tartous and Homs, app. 64km between Homs and Mhine and app. 32km between Mhine and Al-Sharqia respectively.

The track improvement of existing line will be completed by year 2005 and construction improvement work by the year 2010. In order to make smooth execution of short-term Urgent Project, it is deemed necessary to firmly establish the work execution organization.

It also becomes necessary to establish exclusive organ other than existing organization at Head Office of GESR and at Central Region and allocate specialists in charge.

One example of Work Execution Organization is shown in Fig.9.1

Organization Concept is as follows:

- Direction and establishment of entire improvement plan shall be enacted by the Head Office.
- Ordering construction work and contractual work shall be conducted by the Head Office.
- Construction office shall be under the direct control of the Head Office and will be the separate office from local traffic department.
- Adjustment work for construction, consultation and so forth shall be all entrusted to the Construction Office.
- Staff of construction office shall be allocated in line with the cost & detail of the work.
- Supervision staff shall be selected in making good use of construction consultant and construction corporation.
- In accordance with the jurisdiction of the construction office, supplemental staff shall be allocated.
- Daily maintenance and repair work of existing line shall be implemented by the existing organization.

- From the long-term point of view, capable members shall be allocated to bring up the succeeding engineers.

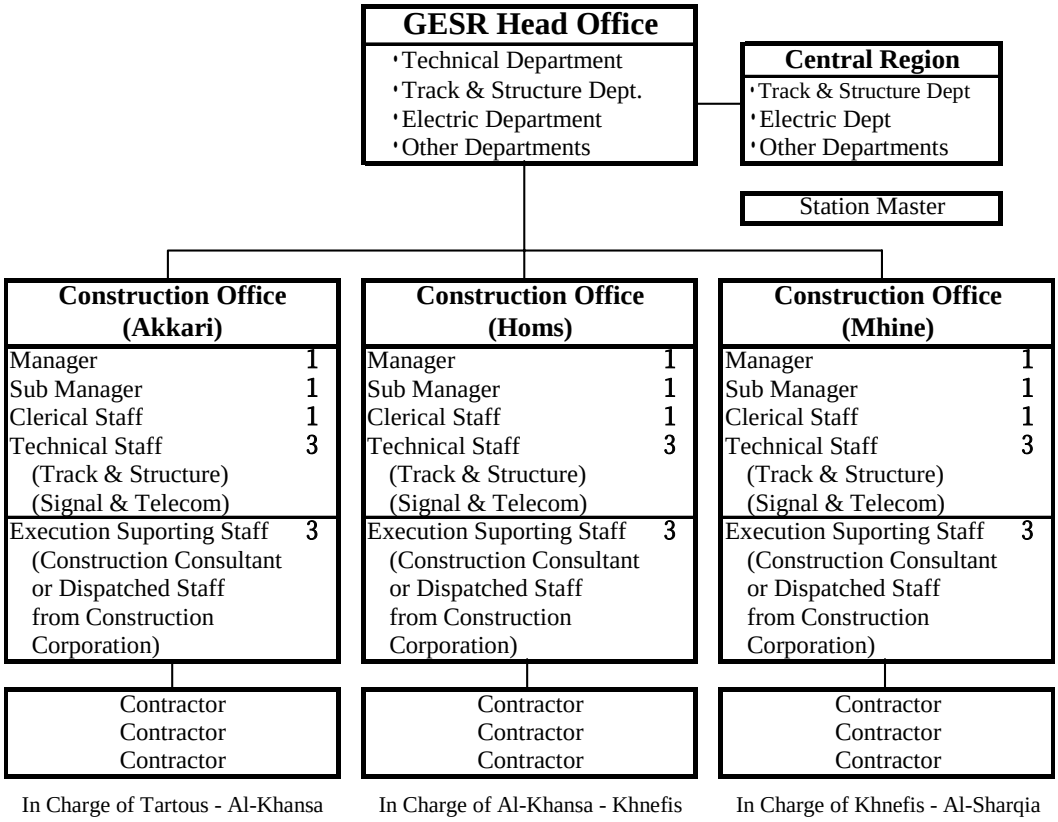

Fig.9.1 Example of Work Execution Organization

Chapter 10 Administration and Operation Plan and Business Improvement Plan

10.1 Administration and Operation Plan

10.1.1. Organization

After the completion of rehabilitation/modernization work, Tartous, Homs and Al Sharqia Section should be still operated under the control of Central Regional Office of GESR to which it belongs now.

10.1.2. Number of Personnel

(1) Car Inspection Workshops and Depots

Number of personnel required for the Section is calculated by following formula.

Number of Personnel for Car Inspection in the Section……P

Total Number of Personnel for Car Inspection in GESR……..T

Total car km of GESR……...G

Car km of the Section……S

$$P = T \times S / G$$

Table 10.1.1 shows the personnel plan for car Inspection in the Section.

Table 10.1.1 Personnel Plan of Car Inspection in Tartous, Homs and Al Sharqia Section

Year	Number of Employees				
	at Present	2005	2010	2015	2020
Altanative A	569	517	652	750	1,069
Altanative B	569	529	664	763	1,081

(2) Station Personnel and Train Crew

Number of Station Personnel and Train Crew for the section is shown in Table 10.1.2 and 10.1.3.

Table 10.1.2 Plan of Station Personnel and Train Crew (Alternative A)

Year	Number of Employees				
	at Present	2005	2010	2015	2020
Driver	90	175	235	285	325
Assistant Driver	60	0	0	0	0
Subtotal	150	175	235	285	325
Station Personnel	611	280	280	280	280
Conductor	100	100	110	135	165
Subtotal	711	380	390	415	445
Total	861	555	625	700	770

Table 10.1.3 Plan of Station Personnel and Train Crew (Alternative B)

Year	Number of Employees				
	at Present	2005	2010	2015	2020
Driver	90	155	215	245	280
Assistant Driver	60	0	0	0	0
Subtotal	150	155	215	245	280
Station Personnel	611	255	280	280	280
Conductor	100	100	110	115	170
Subtotal	711	355	390	395	450
Total	861	510	605	640	730

(3) Personnel for Track Maintenance

The present number of personnel will be enough for the maintenance of the section.

(4) Personnel in Electrical Sector

The number of personnel in electrical sector is assumed to increase as follows (Table 10.1.4)

Table 10.1.4 Number of Employees in Electrical Sector for Both Alternative A and B

Year	at Present	I Stage	II Stage	IIIStage	IVStage
		2001～2005	2006～2010	2011～2015	2016～2020
Number of Increase					
Rehabilitation		0	12	0	0
New Section		0	12	6	7
Total Number of Increase		0	24	6	7
Total Number of Maintenance Employee	75	75	99	105	112

*** New Section: Including New Signal Stations and Double Tracking**

Table 10.1.5 Total Personnel Plan (Alternative A)

Year	at Present	2005	2010	2015	2020
Car Inspection	569	517	652	750	1,069
Station Personnel & Train Crew	861	555	625	700	770
Track Maintenance	248	248	248	248	248
Electrical Sector	75	75	99	105	112
Total	1,753	1,395	1,624	1,803	2,199

Table 10.1.6 Total Personnel Plan (Alternative B)

Year	at Present	2005	2010	2015	2020
Car Inspection	569	529	664	763	1,081
Station Personnel & Train Crew	861	510	605	640	730
Track Maintenance	248	248	248	248	248
Electrical Sector	75	75	99	105	112
Total	1,753	1,362	1,616	1,756	2,171

10.1.3 Administration and Operating Cost

Administration and Operating Costs for the Section are calculated by using the same base units as the Master Plan (Table 10.1.7).

Table 10.1.7 Base Units for Administration and Operating Costs of GESR

(Unit: Syrian Pounds)

Expense Item	Base Unit	
Personnel Cost	84,500 ／person	(Number of Employees)
Lubricant & Fuel	3.65 ／km	(Car km)
Maintenance Expenses	2.70 ／km	(Car km)
Other Operating Costs	0.053 ／passenger.ton.km	(Transport Volume)

Lubricant & fuel costs for Alternative A and B are assumed to be the same as the cost of energy to bring up the same volume of objects to the same heights should be equal.

Table 10.1.8 Administration and Operating Costs

(Unit: Million Syrian Pounds)

Year	2005	2010	2015	2020
Alternative A	192	647	1,164	1,818
Alternative B	191	701	1,202	1,836

10.2 Business Improvements Plan

10.2.1 Passenger business

(1) Station Facilities, Homs 1 and Tartous Station

1) Station Facilities Relocation of waiting lounge and toilets.
2) Environmental Conditions
3) Notice Boards for Timetables and Fare Tables
4) Connection to Bus Services

(2) Coaches

Improvement of facilities, secure the comfortable conditions like repairing and cleaning of the coach.

10.2.2 Freight business

(1) Comprehensive Contract Documents

The traffic of petroleum related products are relatively in a stable condition and is applicable to a comprehensive contract. Also, if trains are either specifically designated or exclusively allocated, stabilized traffic can be secured.

(2) Freight Sales Policy. Setting up Train Diagrams

Each freight train on a time-table is a sales products in the freight sales, and sales policy should be explored based on train diagrams.

(3) Consignor owned wagons system.

Fuel tank wagon, grain hopper wagon, these consignors are Public Corporation.

(4) Regularly scheduled Train.

Phosphate ore trains are generally operated as regularly scheduled trains. As for the other major commodities, there are petroleum-related products originated from HOMS, though there is no specific effort for collective shipment for respective destinations. Bulk freight for petroleum-related products collected for respective destinations should be enhanced with close cooperation from Petroleum Corporation so that train make-up work at related

stations should be minimized.

(5) Station Facilities Tartous and Homs 2 stations

Improvement of Handling Facilities for Phosphate and the work schedules of Marshaling yard

Chapter 11 Economic and Financial Analysis

11.1 Economic Analysis

The project of this Feasibility Study (FS) is of such a large scale that 20 years are required for the completion of its construction. It is therefore unrealistic to consider that there will be no changes in the surrounding transport networks (rail and road) have during the entire design and implementation period. In addition to that, the significant increase in the GESR budget witnessed in recent years suggests the high possibility of realization of the Master Plan on time. Based on these considerations this economic analysis was carried out on the assumption that:

1) Railway network will be developed according to the schedule of the Master Plan, and
2) Road network will be improved according to the schedule of the national road development plan.

11.1.1 Rail Operating Unit Cost (ROUC), Vehicle Operating Unit Cost (VOUC) and Travel Time Unit Cost (TTUC)

ROUC, VOUC and TTUC of the Master Plan are applied to this Feasibility Study. Difference from the Master Plan in these costs is the existence of an extra ROUC for the freight train at the section of dual locomotive operation. Final results of ROUC, VOUC and TTUC are tabulated in Tables 11.1.1 to 4.

Table 11.1.1 Summary of ROUC (Train)

Items/Type of the Train	Passenger Train	Freight Train	Freight Train (Dual Loco.)
ROUC subject to Distance (SP/train km)	79.08	140.41	218.95
ROUC subject to Time (SP/train hr)	4,720.76	2,485.03	4,287.42

Table 11.1.2 Summary of VOUC

Representative Vehicles	Unit	Passenger Car	Microbus	Regular Bus	Light Truck	Heavy Truck
Make		Mazda 323	Mazda E2000	Man	Daihatsu	Mercedes
Model		2000	2000	2000	2000	2000
VOUC subject to Distance						
Speed (km/hr) 5	SP/km	5.19	1.86	17.41	2.78	13.85
10	SP/km	4.38	1.71	15.19	2.62	11.63
20	SP/km	3.99	1.64	14.11	2.55	10.56
30	SP/km	3.88	1.62	13.8	2.53	10.24
40	SP/km	3.86	1.62	13.7	2.53	10.14
50	SP/km	3.88	1.62	13.69	2.54	10.14
60	SP/km	3.92	1.64	13.75	2.55	10.19
70	SP/km	3.99	1.66	13.85	2.57	10.29
80	SP/km	4.07	1.68	13.98	2.59	10.43
90	SP/km	4.17	1.71	14.15	2.62	10.59
VOUC subject to Time	SP/hr	8.59	52.81	182.59	53.91	163.61

Table 11.1.3 Summary of TTUC (Years 2000, 2005, 2010, 2015, 2020)

Item/Year	Unit/year	2000	2005	2010	2015	2020
GDP/capita	SP/person	48,191	57,318	67,309	77,152	87,744
Index to 2000	-	1.00	1.19	1.40	1.60	1.82
Travel Time Unit Cost	SP/hr	14.5	17.2	20.2	23.2	26.4

Table 11.1.4 Freight Time Unit Costs (SP/ton/hr)

Item	Hourly Time Cost	Note
1- Crude oil	0.43829	
2- Petroleum products	0.43829	
3- Natural gas	0.99139	
4- Cement	0.39228	
5- Construction materials	0.87818	
6- Phosphate	0.10846	
7- Iron	0.67340	
8- Coal and coke	0.10846	In conformity to phosphate
9- Other minerals	0.10846	In conformity to phosphate
10- Wheat	0.98996	
11- Cereals	1.09728	
12.1- Vegetables	0.72291	
12.2- Fruit	5.04658	
13- Sugar Beet	0.14037	10% of Sugar
14- Rice	1.57193	
15- Cotton	4.14064	
16- Livestock	8.72418	
17- Animal Products	16.43593	
18- Agriculture Products	7.26608	
19- Sugar	1.40374	
20- Food Oil	3.20435	
21- Animal Fodders	1.41234	
22- Beverages	2.13663	
23- Other Food Products	0.40671	
24- Chemical Products	4.69439	
25- Metal products	3.90282	
26- Textiles and clothes	10.93954	
27- Fertilizer	0.87550	
28- Paper	2.55110	
30- Manufactured commodities	25.17220	
31- Mixed commodities	2.76144	Including house use commodities
32- Cork and wood	1.70826	

Note: MSP= Million SP in 1995 price

11.1.2 Costs

Investment costs are summarized in Tables 11.1.5 and 6. Due to the reasons described in Section 15.1.5 of the Master Plan, Economic Costs are assumed to be the same as Financial Costs.

Table 11.1.5 Annual Investments Schedule (Alternative A) (unit: MSP)

Year	Land	Buildings	Machinery	Comm-unication	Cables	Signals	Roadbed	Rails	Engineering	Total
2001	0	98	42	0	0	0	0	260	20	420
2002	0	99	43	0	0	0	0	264	20	426
2003	0	98	43	0	0	0	0	265	20	426
2004	0	98	42	0	0	0	0	268	20	428
2005	0	98	42	0	0	0	0	267	20	427
2006	30	41	26	65	97	152	273	525	58	1,267
2007	24	40	28	65	98	152	312	572	63	1,354
2008	15	40	27	65	98	152	292	637	65	1,391
2009	15	40	26	65	98	152	259	560	60	1,275
2010	10	40	26	67	102	152	251	539	58	1,245
2011	7	0	0	13	2	11	69	240	16	358
2012	7	0	0	13	2	11	62	241	16	352
2013	8	0	0	13	2	11	63	242	16	355
2014	6	0	0	13	2	11	59	244	16	351
2015	4	0	0	11	2	11	56	245	16	345
2016	3	0	0	8	3	14	56	92	8	184
2017	1	0	0	8	3	14	43	93	8	170
2018	0	0	0	8	2	14	12	47	4	87
2019	1	0	0	8	2	14	42	94	8	169
2020	0	0	0	9	2	16	11	48	4	90
Total	131	692	345	431	515	887	1,860	5,743	516	11,120

Table 11.1.6 Annual Investments Schedule (Alternative B) (unit: MSP)

Year	Land	Buildings	Machinery	Comm-unication	Cables	Signals	Roadbed	Rails	Engineering	Total
2001	0	98	42	0	0	0	0	260	20	420
2002	0	99	43	0	0	0	0	264	20	426
2003	0	98	43	0	0	0	0	265	20	426
2004	0	98	42	0	0	0	0	268	20	428
2005	0	98	42	0	0	0	0	267	20	427
2006	65	41	26	66	106	152	978	526	94	2,054
2007	61	40	28	66	105	153	1,023	573	99	2,148
2008	52	40	27	66	105	153	1,004	637	101	2,185
2009	52	40	26	66	105	153	973	562	96	2,073
2010	51	40	26	66	105	153	967	539	94	2,041
2011	7	0	0	13	2	11	69	240	16	358
2012	7	0	0	13	2	11	62	241	16	352
2013	8	0	0	13	2	11	63	242	16	355
2014	6	0	0	13	2	11	59	244	16	351
2015	4	0	0	11	2	11	56	245	16	345
2016	3	0	0	8	3	14	56	92	8	184
2017	1	0	0	8	3	14	43	93	8	170
2018	0	0	0	8	2	14	12	47	4	87
2019	1	0	0	8	2	14	42	94	8	169
2020	0	0	0	9	2	16	11	48	4	90
Total	318	692	345	434	548	891	5,418	5,747	696	15,089

As for administration and maintenance costs, difference of administration costs due to the installment of this Feasibility Study Project is to be zero (negligible if any) because of the nature of this project (improvement). Difference of maintenance costs due to the difference of

running km is calculated (maintenance costs of tracks and communication lines in MSP = passenger-ton km / year x 0.096 / 1,000,000). Needless to say the Alternatives A and B need different maintenance costs because of different values of person-ton-km they have. These differences, however, are less than one million Syrian Pounds a year. That is the reason why only one cost sequence is shown in Table 11.1.7.

Table 11.1.7 Difference of Administration and Maintenance Costs between With-F/S Project (Master Plan) and Without-F/S Project (Alternatives A and B)

(unit: MSP)

Year	Difference of No. of Employee (exc. Crew)	Difference of Salary (MSP/year)	Other Operating Exp. (MSP/year)	Difference of AOC (MSP/year)
2000	0	0	0	0
2001	5	0	0	0
2002	10	1	0	1
2003	14	1	0	1
2004	19	2	0	2
2005	24	2	0	2
2006	20	2	0	2
2007	17	1	0	1
2008	13	1	0	1
2009	10	1	0	0
2010	6	1	-1	0
2011	6	1	0	0
2012	6	1	0	1
2013	7	1	1	1
2014	7	1	1	2
2015	7	1	2	2
2016	240	20	3	23
2017	473	40	4	44
2018	706	60	5	65
2019	939	79	6	85
2020	1,172	99	7	106

11.1.3 Benefits

VOC, ROC and TTC savings contribute to the benefit of the railway improvement. These savings, needless to say, result from traffic assignment conditionss. Figures related to benefits are summarized in Table 11.1.8.

Table 11.1.8 Benefits of Alternative A and B (unit: MSP/year)

Item	With-case		Without-case Network	Alternative A Benefit	Alternative B Benefit
	Alternative A Network	Alternative B Network			
Year 2005					
VOC sum	54,165	54,165	54,165	0	0
ROC sum	2,047	2,047	2,047	0	0
TTC sum	6,014	6,014	6,014	0	0
Total	62,226	62,226	62,226	0	0
Year 2010					
VOC sum	76,581	76,581	79,909	3,328	3,328
ROC sum	3,173	3,083	1,637	-1,536	-1,446
TTC sum	6,875	6,874	7,218	343	344
Total	86,629	86,538	88,763	2,135	2,226
Year 2015					
VOC sum	113,226	113,226	120,071	6,845	6,845
ROC sum	5,383	5,086	2,241	-3,142	-2,846
TTC sum	9,987	9,959	10,400	412	441
Total	128,596	128,270	132,711	4,115	4,441
Year 2020					
VOC sum	168,097	168,097	180,852	12,754	12,755
ROC sum	8,629	7,705	2,939	-5,690	-4,766
TTC sum	15,212	15,024	15,323	111	299
Total	191,939	190,826	199,114	7,175	8,288

11.1.4 Economic Analysis

Based on the figures obtained in Sections 11.1.2 and 11.1.3, EIRR, NPV and B/C are calculated as shown in Tables 11.1.9 and 10. EIRR of 20.5% (Alternative A) or 18.2% (Alternative B) is higher than the EIRR of the Master Plan by 3.4 - 0.8% points. This indicates the economic importance of this project.

Table 11.1.9 Economic IRR, NPV, B/C of Alternative A (unit:MSP)

Year	Initial Invest.	Diff. of Maint. C.	Costs Total	Benefit	B-C	Discounted Values		
						Cost	Benefit	B-C
2001	420	1	421	0	-421	421	0	-421
2002	426	0	426	0	-426	380	0	-380
2003	426	1	427	0	-427	340	0	-340
2004	428	2	430	0	-430	306	0	-306
2005	427	2	429	0	-429	273	0	-273
2006	1,649	1	1,650	0	-1,650	936	0	-936
2007	1,725	2	1,727	0	-1,727	875	0	-875
2008	1,639	1	1,640	0	-1,640	742	0	-742
2009	1,713	1	1,714	0	-1,714	692	0	-692
2010	1,629	0	1,629	2377	748	587	857	270
2011	124	1	125	2804	2,679	40	903	863
2012	35	1	36	3231	3,195	10	929	919
2013	35	1	36	3658	3,621	9	939	930
2014	35	2	37	4085	4,047	9	936	928
2015	35	2	37	4512	4,475	8	923	916
2016	29	23	52	5160	5,109	9	943	933
2017	118	44	162	5808	5,647	26	947	921
2018	162	65	227	6456	6,230	33	940	907
2019	49	86	135	7104	6,970	17	924	906
2020	22	106	128	7752	7,625	15	900	885
R.V.	8,299			8299	8,299	0	964	964
Total						5,730	11,105	5,374
IRR: 20.5%		B/C: 1.94		NPV: 5,374		MSP under Discount Rate		12%

Note:R.V.=Residual Value

Table 11.1.10 Economic IRR, NPV, B/C of Alternative B (unit: MSP)

Year	Initial Invest.	Diff. of Maint. C.	Costs Total	Benefit	B-C	Discounted Values		
						Cost	Benefit	B-C
2001	420	1	421	0	-421	421	0	-421
2002	426	0	426	0	-426	380	0	-380
2003	426	1	427	0	-427	340	0	-340
2004	428	2	430	0	-430	306	0	-306
2005	427	2	429	0	-429	273	0	-273
2006	2,434	1	2,435	0	-2,435	1,382	0	-1,382
2007	2,520	2	2,522	0	-2,522	1,278	0	-1,278
2008	2,435	1	2,436	0	-2,436	1,102	0	-1,102
2009	2,513	1	2,514	0	-2,514	1,015	0	-1,015
2010	2,424	0	2,424	2455	31	874	885	11
2011	132	1	133	2926	2,793	43	942	899
2012	41	1	42	3397	3,355	12	976	964
2013	41	1	42	3867	3,826	11	993	982
2014	41	2	43	4338	4,296	10	994	984
2015	45	2	47	4809	4,762	10	984	974
2016	29	23	52	5609	5,557	10	1,025	1,015
2017	117	44	161	6409	6,248	26	1,045	1,019
2018	162	65	227	7209	6,982	33	1,050	1,017
2019	49	86	135	8008	7,873	18	1,041	1,024
2020	22	106	128	8808	8,680	15	1,023	1,008
R.V.	10,796			10796	10,796	0	1,254	1,254
Total						7,557	12,212	4,655
IRR: 18.2%		B/C: 1.62		NPV: 4,655		MSP under Discount Rate		12%

Note:R.V.=Residual Value

In order to evaluate the economic viability of this project, sensitivity analysis was carried out. The results are shown in Tables 11.1.11 and 12. The results show that this project is economically viable up to a cost increase of 1.8 times or a decrease in benefits of 40% in case of Alternative A, and a cost increase of 1.5 times or a decrease in benefits of 30% in case of Alternative B. These figures assure the economic viability of this project is definitely not vulnerable.

Table 11.1.11 Sensitivity Analysis Results (Alternative A)

Benefit / Cost	1	0.95	0.90	0.80	0.70	0.60	0.50
1	20.5	19.8	19.2	17.7	16.1	14.4	12.4
1.05	19.8	19.2	18.5	17.1	15.5	13.8	11.8
1.1	19.2	18.6	17.9	16.5	14.9	13.2	11.3
1.2	18.0	17.4	16.7	15.3	13.8	12.1	10.3
1.4	16.0	15.4	14.8	13.4	11.9	10.3	8.5
1.6	14.3	13.7	13.1	11.7	10.3	8.7	7.0
1.8	12.8	12.2	11.6	10.3	8.9	7.3	5.6

Table 11.1.12 Sensitivity Analysis Results (Alternative B)

Benefit / Cost	1	0.95	0.90	0.80	0.70	0.60
1	18.2	17.5	16.8	15.4	13.9	12.2
1.05	17.5	16.9	16.2	14.8	13.3	11.6
1.1	16.9	16.2	15.6	14.2	12.7	11.1
1.2	15.7	15.1	14.4	13.1	11.6	10.0
1.4	13.7	13.1	12.5	11.2	9.7	8.2
1.6	12.0	11.4	10.8	9.5	8.2	6.7

11.2 Financial Analysis

11.2.1 Objectives and Method of Analysis

The purpose of this financial analysis is to verify which alternatives (Alternative A and B) is more profitable and can contribute to improvement of financial standings of GESR. Financial Internal Rate of Return (FIRR) is used as index for the analysis.

11.2.2 Main Prerequisites

In principle the same prerequisites are applied as in the financial analysis on the master plan.

(1) Period of Analysis (Project Life)

The evaluation of the project is made for 40 years from 2001 to 2040.

(2) Demand Forecast

After 2020 the traffic demand is assumed to keep the same level as in 2040.

(3) Inflation

Inflation is disregarded in the analysis.

(4) Revenue

1) Fare Revenue

Fare revenue is calculated by multiplying unit fare price by the increase of the transport volume.

Unit fare prices per kilometer are as follows.

Freight: Syrian Pounds 0.8869/ton

Passenger: Syrian Pounds 0.1755/person

2) Miscellaneous Revenue

Miscellaneous revenue is assumed to be 3% of the fare revenue.

(5) Investment Cost

Investment cost is indicated in market price.

(6) Depreciation

GESR's rule provides that depreciation of fixed assets should be made by straight-line method. In this analysis, however, all assets are assumed to be used to the end of their physical durable years. In that case, depreciation is continued after the amount of the purchase price is fully accumulated, but the rate of depreciation is reduced to half according to the rule established by Ministry of Finance. As for signal and telecommunication facilities mostly of new type making use of the latest technology, appropriate rates of depreciation and durable years are set referring to JR's rule in Japan.

Table 11.2.1 shows the percentage of yearly depreciation and the physical durable years.

Table 11.2.1 Rates of Depreciation & Durable Years of Fixed Assets

Item	Rate of Depreciation per Year		Physical Durable Years
	Up to 100% of Purchase Price	Over 100% of Purchase Price	
Buildings & Structures	2%	1%	100 years
Machinery & Equipment	5%	2.5%	40 years
Rolling Stock			
Locomotives & Diesel Cars	7%	3.5%	28 years
Coaches, Wagons & Tankers	4%	2%	50 years
Signals & Telecommunications			
Computors & Electric Equipment	8.33%		12 years
Signals & Warnings for Crossing ets.	5%		20 years
Cables	3.33%		30 years

(7) Fund Raising

1) Financing in Foreign Currency

Foreign currency portion of the initial investment cost of the project is assumed to be financed by one of the following two types of loans from international or overseas financial institution. It has been confirmed by the lending institutions concerned that the following terms and conditions are applicable to Syria.

① Loan Condition 1

Interest: 2.2% p.a.

Grace: 10 years

Repayment: 30 years semiannual equal installment

② Loan Condition 2

Interest: 0.75% p.a.

Grace: 10 years

Repayment: 35 years from 11th to 20th year: 2.5% of total loan amount per year
from 21st to 35th year: 5% of total loan amount per year

2) Financing in Local Currency

The balance of the investment cost is covered by funds in local currency. It is assumed that Syrian Government will pay the total amount of local funds as equity.

11.2.2 The Results of the Analysis

(1) Financial Internal Rate of Return (FIRR)

The results of the analysis for the base case are in Appendix 11-2-3~6. Appendix 11-2-1~2 show the investment cost of both Alternative A and B. The sensitivity analysis is made for the following five cases.

Case 1: 5% Increase of Total Investment Cost

Case 2: 10% Increase of Total Investment Cost

Case 3: 5% Decrease of Total Revenue

Case 4: 10% Decrease of Total Revenue

Case 5: 10% Increase of Total Investment Cost and 10% Decrease of Total Revenue

Main indices of the analysis including FIRR are shown in Table 11.2.2~3.

Table 11.2.2 Main Indices of Financial Analysis (Alternative A)

(Unit: Million Syrian Pounds)

Case	Loan Condition	FIRR		Local Funds (Cumulative)
		ROI	ROE	
Base Case	1	7.3%	23.0%	1,166
	2		32.5%	721
Investment 5% up	1	6.8%	20.7%	1,408
	2		29.7%	895
Investment 10% up	1	6.4%	18.6%	1,669
	2		27.3%	1,091
Revenue 5% down	1	6.7%	19.8%	1,411
	2		28.7%	909
Revenue 10% down	1	6.0%	16.8%	1,676
	2		25.3%	1,118
Investment 10% up Revenue 10% down	1	5.1%	13.3%	2,199
	2		21.6%	1,539

Table 11.2.3 Main Indices of Financial Analysis (Alternative B)

(Unit: Million Syrian Pounds)

Case	Loan Condition	FIRR		Local Funds (Cumulative)
		ROI	ROE	
Base Case	1	6.1%	12.5%	4,589
	2		17.5%	3,967
Investment 5% up	1	5.6%	11.3%	5,023
	2		16.2%	4,370
Investment 10% up	1	5.3%	10.3%	5,456
	2		15.1%	4,772
Revenue 5% down	1	5.5%	10.9%	4,854
	2		15.8%	4,232
Revenue 10% down	1	4.9%	9.3%	5,119
	2		14.1%	4,497
Investment 10% up Revenue 10% down	1	4.1%	7.4%	5,985
	2		12.1%	5,301

In every case Alternative A shows higher FIRR than Alternative B. Even in the worst case FIRR is 4.1% that is higher than interest rate of loan condition 1 and 2. Therefore both Alternative A and B are feasible, but Alternative A is more recommendable than Alternative B.

(2) Profitability

The profit and loss accounts show surplus from the first year even in the worst case.

(3) Cash Flow

The amount of funds in local currency required for the project range from 721 to 5,985 million Syrian Pounds. In all cases the peak years of local currency funds requirement are from 2006 to 2008. As from 2011 no additional funds are required. Even in the worst case the maximum amount of local funds in the peak years is about 1,224 million Syrian Pounds that is within the limit of Government budget for railway. The rehabilitation/Modernization of Tartous, Homs and Al Sharqia Section is considered to have high priority to allotment of the funds for railway improvement.

(4) Evaluation and Recommendation

FIRR (ROI) of Alternative A and Alternative B are 7.3% and 6.1% respectively. In the worst case of the sensitivity analysis, they are 5.1% and 4.1%. Therefore both alternatives are feasible provided that foreign currency portion of the investment cost is covered by long-term loan with interest of 2.2% or 0.75% and local currency portion is covered by equity from the Government. In every case, Alternative A shows higher FIRR than

Alternative B. It is difficult to take up Alternative B without drastic cut of the investment cost.

Chapter 12 Environmental Impact Assessment

12.1 Assessment Process

The subject of this assessment is the project for "Rehabilitation/Modernization of the Tartous – Homs – Al-Sharqia Railway Section". For one section of the route, two alternatives are considered. This assessment is a first step towards implementing a comprehensive assessment, which should be completed at the time of detailed design of the project.

12.2 Environmental Setting

12.2.1 Project Location and Topography

The project route runs through two governorates; Tartous and Homs and links the seaport city of Tartous with Homs city, which is midway between Damascus and Aleppo.

The ground level of the existing railway route increases from sea level at Tartous to about 740 meters above sea level at Al-Sharqia.

12.2.2 Physical Environment

This route serves the two major phosphate mines in Khneefis and Al-Sharqia. Sands at Al-Rumeila, west of Khnefis are used in the glass industry.

The route passes through the four geographic zones characterizing the country. The Mediterranean Sea climate generally prevails; rainy winter and dry and hot summer separated by two short transitional seasons.

Rainfall intensities are over 350 mm annual in the First Zone, around 250 mm in the Third Zone, between 200 – 250 mm in the Fourth Zone and small rainfall amounts in the Fifth Zone, the desert.

The Ministry of Environment data show high levels of nitrogen dioxide and sulphur dioxide

in both Tartous and Homs cities. Although various industries are affecting air quality, the main source of air pollutants, according to a study by the Ministry of Environment in 1998 is from road vehicles emissions.

12.2.3 Protected Ecological Areas

The protected forest area of Baqsia is located southwest of Akkari station. Al Mastoura Mountain protected area is located north of the railway line between Tel Kalakh and Umm Jaamah stations.

12.2.4 Human Resources

In 1999 Homs and Tartous Governorates populations were 1,619,000 and 787,000 persons respectively. The total Syrian population was 17,938,000. 1998 population estimates for Tartous city and Homs city were 85,000 and 571,000 respectively.

The route section from Tartous to Homs is continuously populated while that from Homs to Al-Sharqia is sparsely populated at the towns along the route. Along the Homs – Al-Sharqia section Bedouin camps are observed.

The land use pattern reflects the economic activities along the project route. Agriculture activity is wide spread along the coastal area up to Akkari. The section between Akkari and Al-Khansa is mountainous and there are green areas, pastures and scenic locations. From Al-Khansa to Homs and southwards to Shinshar Sta. agriculture activity is dominant with industrial areas located at the Homs entrance. From Shinshar to south of Khnefis sta. the activity is mainly seasonal agriculture and pastures for sheep raising. Continuing eastwards the desert nature of the land restricts the economic activity to some sheep breeding by Bedouins and mining works, mainly for phosphates. There are two large mines, one near Khnefis Sta. and the second at Al-Sharqia.

Ongoing archeological excavations near to the route at Amrit, Tel Kazel, Rehaniyeh and Dirdghan may reveal new archeological findings, which may effect any future construction.

12.2.5 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 the local authority would be included within the committee established to review the assessment reports.

The project route passes through the two governorates of Tartous and Homs. The main environmental issues along the project route are as follows:

Tartous Governorate:

- Phosphate loading/unloading conditions at the seaport
- Decrease in soil fertility along the coast
- Insufficient treatment of wastewater discharged from olive oil plants
- Excessive tree cutting for use as fuel

Homs Governorate:

- Poor quality of the Qatineh lake waters
- Oil refinery on the outskirts of Homs, and along the railway line at km 5
- Informal housing sprawl

12.3 Impacts of Proposed Project

12.3.1 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 and alternatives evaluation stage. The environmental assessment in this report shall define areas for attention.

The two alternatives studied in connection with the project shall also be evaluated from the environmental viewpoint.

12.3.2 Overall Result

(1) Route component

The potential environmental impacts are summarized in Table 12.3.1.

Table 12.3.3 Overall Result

Environmental Item	Section 1	Section 2A	Section 2B	Section 3	Section 4
A. SOCIAL ENVIRONMENT					
1. Resettlement			B	C	
2. Economic Activities	C	C	B	C	
4. Split of Communities			C		
5. Cultural Property			C	C	
8. Waste	C	C	C	C	C
9. Hazards			C		
B. NATURAL ENVIRONMENT					
10. Topography and geology			C		
11. Soil erosion			B		
12. Groundwater	C	C	C		
15. Flora and fauna	C	C	B		
17. Landscape			C		
C. POLLUTION					
18. Air pollution	C	B	C	C	C
21. Noise and vibration	B	B	B	C	C
23. Offensive odor	C	C	C	C	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					

(2) Homs and Tartous Depot Rehabilitation

Some preliminary environmental concerns are identified in Table 12.3.2 hereafter.

Table 12.3.2 Environmental Considerations for Depot Rehabilitation

Environmental Item	Homs Depot: New Depot construction	Tartous Depot: Existing Depot rehabilitation
1. Workers health and safety	C The design and operation plan of the new facility should carefully consider measures to avoid recurrence of existing conditions	B In addition to the need to improve working conditions it is also necessary to consider the structural safety of the building itself.
2. Waste	C The design and operation plan of the new facility should carefully consider measures to manage construction and operation wastes.	C The rehabilitation plan should carefully consider measures to manage construction and operation wastes.
3. Water pollution	C The new underground storage tanks should be designed to avoid any potential groundwater pollution.	C The rehabilitation plan should include checking of the existing underground storage tanks and implementation of any remedial measures.
4. Noise and vibration	C The design and operation plan of the new facility should carefully consider measures to mitigate this problem and ensure the workers safety	B It is not clear to what extent mitigation measures can be included in a rehabilitation plan.
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		

12.4 Evaluation

Based on the project need, review of the potential impacts on the environment and considering the impact on the environment of greater road traffic in the absence of the project, it is considered feasible to implement the project from an environmental viewpoint. However the following points are important.

(1) Comparison of Alternatives A and B Routes

The main environmental concerns in the case Section 2B may be grouped into two issues; land appropriation and the protected area.

a. Land appropriation

It will be necessary to resettle about 10 legal households and appropriate about 150 hectares of mostly agriculture land. Concerning resettlement, the Government can easily resettle the inhabitants in such a rural area against payment of compensation. However usually value of compensation paid out is very small and the replaced homes are not suitable. In addition no social survey is done to determine the effect on the resettled persons. These problems should be resolved in order to ensure resettlement with minimum adverse effects.

b. Protected area

The Ministry of Environment report prepared in 1998 identified the Mastoura Mountain area as one of the main protected areas in the Orontes Basin for endangered trees species. The area also suffers from soil erosion due to excessive tree cutting. Therefore route selection should be carefully considered.

Selection of Alternatives B over A can be accepted from the environmental viewpoint only after mitigating the above problems.

(2) The entire project route

The main environmental issues are in Section 2 Alt. B. In the other sections concerns are related to a large extent to construction activity (waste, groundwater, flora and fauna) as well as design of track and equipment (air pollution, noise and vibration and odor). However the benefits from rail service outweigh the concerns and it is believed that under certain mitigating measures these concerns can be greatly reduced.

(3) Homs and Tartous Depot Rehabilitation

Existing Homs and Tartous depots are in very poor condition from environmental viewpoint. The detailed designs for the new Homs depot and rehabilitation plan for the existing Tartous depot should be carefully studied to confirm that sufficient consideration has been given to the safety and healthy working conditions of the workers in each depot. Environmental monitoring plan should be implemented once both depots are brought into operation. Items to be monitored include the environmentally sound management of the wastes generated during operation and avoidance of polluting the surrounding environment.

Chapter 13 Conclusion and Recommendation

13.1 Conclusion

13.1.1 Project Outline and Optimum Plan Selection

This project covers the route of about 270km running from Tartous (an important port for import and export) to Al Sharqia (with phosphate ore mines) via Homs and Mhine. For this route, the project aims at the rehabilitation and modernization of the existing track facilities, electric facilities and so forth; as well as at the additional construction of signal stations and double tracking for the smooth operation of trains which will be increased to cope with the growth of demand.

Especially, two alternative plans (Alternative A and Alternative B) were set up and studied for the section of about 40km between Akkari and Al Khansa, because this section has a steep gradient of 20‰ and many sharp curves of 300 – 400m radius at present and is becoming a bottleneck in transport.

Alternative A aims at the transport system using two locomotives of LED 3200 type and also at the track addition in parallel to the existing line. Alternative B aims at the transport system using one locomotive of LED 3200type and also at the construction of a separate line (not parallel to the existing one) with the steepest gradient of 12‰ and the minimum radius of curve of 600m. The comparative study results concerning the two alternatives from various aspects are as shown in Table 13.1. Project including Alternative A was finally selected as the optimum plan.

(1) Transport and rolling stock aspects

In Alternative A, pusher locomotives are necessary for freight trains except for the empty ore trains. In this case, coupling work at Akkari Station, uncoupling work at Al Khansa Station, and dead-head operation to Akkari Station of the pusher locomotives are also needed. In Alternative B, there is no problem of train operation handling as seen at these stations in Alternative A, because pusher locomotives are not used.

Between Akkari and Al Khansa, the number of trains, locomotive-km, number of necessary locomotives and so forth in Alternative B are smaller than the corresponding figures in Alternative A. The running time (transport time required) of passenger trains in Alternative B is almost the same as that in Alternative A. As for freight trains, the transport time required in Alternative B is larger than that in Alternative A by about 30 minutes. However, for freight trains, the clear forecast of arrival time is more important than the reduction of transport time.

In view of the above, Alternative B is estimated to be advantageous in transport and rolling stock aspects.

(2) Ground facilities aspect (track facilities, electric facilities)

Between Akkari and Al Khansa, both Alternative A and Alternative B are technically feasible. However, the total length of tracks constructed in Alternative A (about 39.4km) is shorter than that in Alternative B (about 49.4 km) by about 10km. Therefore, the necessary construction cost in Alternative A is smaller than that in Alternative B.

As for the maintenance aspect, the inspection, repair and so forth of track facilities and electric facilities are easier in Alternative A than in Alternative B. This is because while Alternative A aims at the construction of a line parallel to the existing line, Alternative B aims at the construction of a line which runs separately.

In view of the above, Alternative A is estimated to be advantageous in the ground facilities aspect.

(3) Environmental aspect

Between Akkari and Al Khansa, there are no large problem in Alternative A, because it aims at the construction of a line parallel to the existing line.

In selecting the route of Alternative B, care was taken to prevent the geographical division of villages and relocation of residents. However, detailed investigations are necessary in the stage of construction execution concerning resident relocation and so forth. Furthermore, there are environmental preservation areas in some parts of the section between Tel Kalakh and Umm Jaamah. In materializing the new line construction,

therefore, it is necessary to carry out further detailed investigations and to make efforts to prevent unfavorable effects on the environment.

In view of the above, Alternative A is estimated to be advantageous from the environmental aspect.

(4) Economic and financial aspects

The total amount of investment for the Rehabilitation/Modernization between Tarotus, Homs, and Al Sharqia (about 270km) is about 28.2 billion SP for the case including Alternative A and about 31.6 billion SP for the case including Alternative B.

The Economic Internal Rate of Return (EIRR) is 20.5% for Project including Alternative A and 18.2% for that including Alternative B. The Financial Internal Rate of Return (FIRR) is 7.3% for Project including Alternative A and for that including Alternative B 6.1 %.

From economic and financial aspects, each Project including Alternative A or Alternative B is feasible, with that including Alternative A showing higher figures in both EIRR and FIRR.

In view of the above, the Project including Alternative A is evaluated as more advantageous from economic and financial aspects.

(5) Comprehensive Evaluation

Based on the Table 13.1 the Project including Alternative A is taken up as the Project for evaluation of the feasibility study.

Table 13.1 Evaluation of Alternatives by Various Aspects

Aspects of evaluation	Transport and rolling stock aspects	Ground facilities aspect (track facilities, electric facilities)	Environmental aspect	Economic and financial aspects	Comprehensive evaluation
Alternative A	△	○	○	○	○
Alternative B	○	△	△	△	△

13.1.2 Project Evaluation (Conclusion)

The Rehabilitation/Modernization Project between Tartous, Homs, and Al Sharqia (about 270km) aims at the reinforcement of facilities on the existing line, as well as the additional introduction of rolling stock, double tracking, signal station construction and so forth to meet the increase in demand. This project with these targets is technically feasible, and does not inflict large influence on the environment.

The EIRR of the project from the national economic standpoint is 20.5 %. In view of this, and also taking into account other indirect benefits, the project is considered to be feasible from the national economic standpoint.

The FIRR of the project from the view point of enterprise of GESR is 7.3 %. This means that the Project is financially feasible, in case low interest loan from foreign countries or international organizations are used for foreign currency portion and Government finances the local currency portion without interest.

From the comprehensive standpoint, it is considered that the project is a development project for an important freight transport route of GESR and is feasible from technical, environmental, economic, and financial aspects. The execution of the project will enable smooth and stable railway transport between Tartous, Homs, and Al Sharqia, and will contribute to the promotion of economic activities in Syria.

Furthermore, if the new line is constructed between Al Sharqia and Deir el-zor to form a well-balanced railway network, the sound socio-economic activities in Syria will further develop.

In this connection, for the effective implementation of the project, it is necessary to make improvement in software aspects (such as management, transport administration, facilities maintenance, accident prevention, training, marketing) in addition to improvement in hardware aspects(such as rolling stock, ground facilities).

Lastly some comments should be made on Alternative B, namely the new line (separate route) construction plan between Akkari and Al Khansa. GESR is now planning to carry out

full-scale investigations on separate route line starting with the preparation of topographical maps by aerial survey and also including route selection, construction cost estimation, and so forth.

As described before, the Project including Alternative B is also found feasible from economic and financial standpoints, and Alternative B has various merits in train operational aspects. Therefore, when detailed study results including detailed route selection and detailed cost estimate will have been obtained later based on detailed photographical map developed from aerial survey, it may be meaningful that GESR will try to compare again Alternative A and B from overall view points.

13.2 Recommendation

In executing this project, the following recommendations are made so that the project can be further effective.

(1) Smooth construction promotion and environmental consideration

1) Consultation and coordination with the organizations concerned

① In securing land, it is necessary to promote consultations with the organizations and personnel concerned at an early stage and solve related problems so that the scheduled period of construction will not be hampered.

② Concerning the works at the two places between Umm Jaamah and Al Khansa where the railway crosses under an expressway, and also for such works as the grade separation of the level crossing at a place near the 5-km point from Homs Station, it is necessary to hold sufficient consultations and make full adjustments with the road-related organizations and the like in advance, on such matters as the construction execution methods and railway and road protection methods, in order to ensure smooth construction promotion.

2) Establishment of work execution system for construction works near tracks

As described before, this project aims at the reinforcement of the existing lines, additional construction of tracks parallel to the existing line, new construction of signal stations, and so forth. All of these construction works are carried out at places near the existing commercial line during the commercial operation time. In the construction execution, therefore, special attention should be paid to the prevention of hindrance to train operation on the existing line, injury accidents of construction workers, and so forth.

In actually implementing the project, it is necessary to establish adequate methods and systems for the construction execution, by setting up detailed work process which considers the proximity of the construction sites to the existing commercial line, and also by grasping the entire construction process.

3) Procurement of equipment and materials

It is necessary to procure equipment and materials at adequate times based on the entire construction process. Special care should be taken in procuring equipment and materials from foreign countries, by establishing reasonable procurement plans beforehand in order to ensure smooth construction execution.

4) Environmental consideration

① As for the noise and vibration entailed by the construction execution, the degree of their influence is estimated to be small in general. However, in the case where construction is executed in a place near a residential area, it is advisable to obtain the understanding of the residents concerned, by explaining to them the purpose and contents of the construction and so forth.

② As for the disposal of waste produced by the construction, it is essential to study a system of carrying the waste to an adequate place of disposal, in order to prevent social problems after waste dumping.

(2) Reduction of investment

Although this project is financially feasible, it is necessary to strive to reduce the amount of investment, in order to further enhance the investment effect.

① In procuring rolling stock, rail, electric devices and other equipment and materials, efforts should be made to secure the most inexpensive objects possible, as far as the necessary material quality is ensured.

② Since the project is implemented in places near the existing tracks, efforts should be made to reduce the period and cost of the construction, by studying efficient methods of construction execution, and also by sufficiently considering the train operation and securance of safety in construction works.

③ In procuring funds, efforts should be made to obtain money with the lowest interest possible.

(3) Maintenance

The execution of this project will enable the reinforcement of hardware aspects of rolling stock, track facilities, electric facilities, and so forth. To make the rolling stock and facilities sufficiently display their functions, it is necessary to carry out improvement of software aspects, such as their maintenance and administration, at the same time.

As for the maintenance in the future, it is necessary to conduct data-based maintenance of rolling stock and railway facilities and to establish and steadily implement rational maintenance plans.

At first, it is needed to arrange registers, such as track maintenance registers. Then, it is necessary to conduct systematic inspection and accumulate relevant data in the registers. Therefore, a reasonable maintenance plan should be established on the basis of these statistical data and from the standpoint of preventive maintenance. Lastly, the maintenance plan thus established should be steadily put into practice, in order to ensure functions of railway facilities.

At the same time, it is necessary to establish a system which can ensure early restoration after the occurrence of a trouble.

With the progress of modernization of rolling stock and railway facilities, training of staff for new technology will become necessary. In introducing new technologies, therefore, it is needed for GESR to give relevant training to the staff and also to request the suppliers of the equipment/facilities to supply teaching materials for training schools at the same time, so that employees can obtain new technologies at the training schools and adequate train operation handling and sufficient maintenance of railway facilities can be ensured.

(4) Double tracking between Akkari and Al Khansa

Concerning the double tracking between Akkari and Al Khansa, it has been found that the plan of constructing an additional line parallel to the existing line is more advantageous than the plan of constructing a separate-route line. However, the project including the latter alternative is also feasible from economic and financial standpoints and the latter alternative has various merits in train operational aspects.

In this connection, GESR is now planning to carry out full-scale investigation on a separate new line. The study includes drawing up full-scale topographical map to be developed by aerial survey, route selection, planning of structures, construction cost estimate so forth. When the detailed study results will have been obtained later, it may be meaningful that GESR may compare the Alternative B and A again based on the detailed study results mentioned above.