Chapter 5

Construction Plan of Workshop

Chapter 5 Construction Plan of Workshop

5.1 Basic policy on workshop construction

(1) There would be two alternatives in planning the modernization of Jubrin locomotive workshop to undertake the periodic inspection of DLs and DCs (M5, M6, D5, D6) and to cast brake shoes for all rolling stock in GESR. One is the expansion of Jubrin locomotive workshop and the other is the construction of new maintenance workshop.

On the two alternatives, JICA Study Team compared and examined the contents and costs of construction work, and the long range plan of GESR on rolling stock maintenance. Considering that the difference of cost is only about 15%, that case 2 matches with GESR's long term plan for rolling stock maintenance, and that the existing Jubrin locomotive workshop can be effectively utilized as locomotive depot, it was decided to adopt the construction of new maintenance workshop for F/S. The details of comparison are as follows,

1) Current situation of Jubrin locomotive workshop

- Workshop area : 1800m2

  Worker : About 390 person
  Maximum capacity of locomotive maintenance
  : 35 LDE2800s for M5 or M6 per annum with insufficient spare parts inventory

- Being narrow in work space, inefficient in layout, aged and insufficient in facilities and equipment for maintenance work, and shortage of necessary spare parts for DLs result in insufficient maintenance work as a whole.

- Layout and plan of Jubrin locomotive workshop are shown in Fig. 5.1.1 and Fig. 5.1.2.

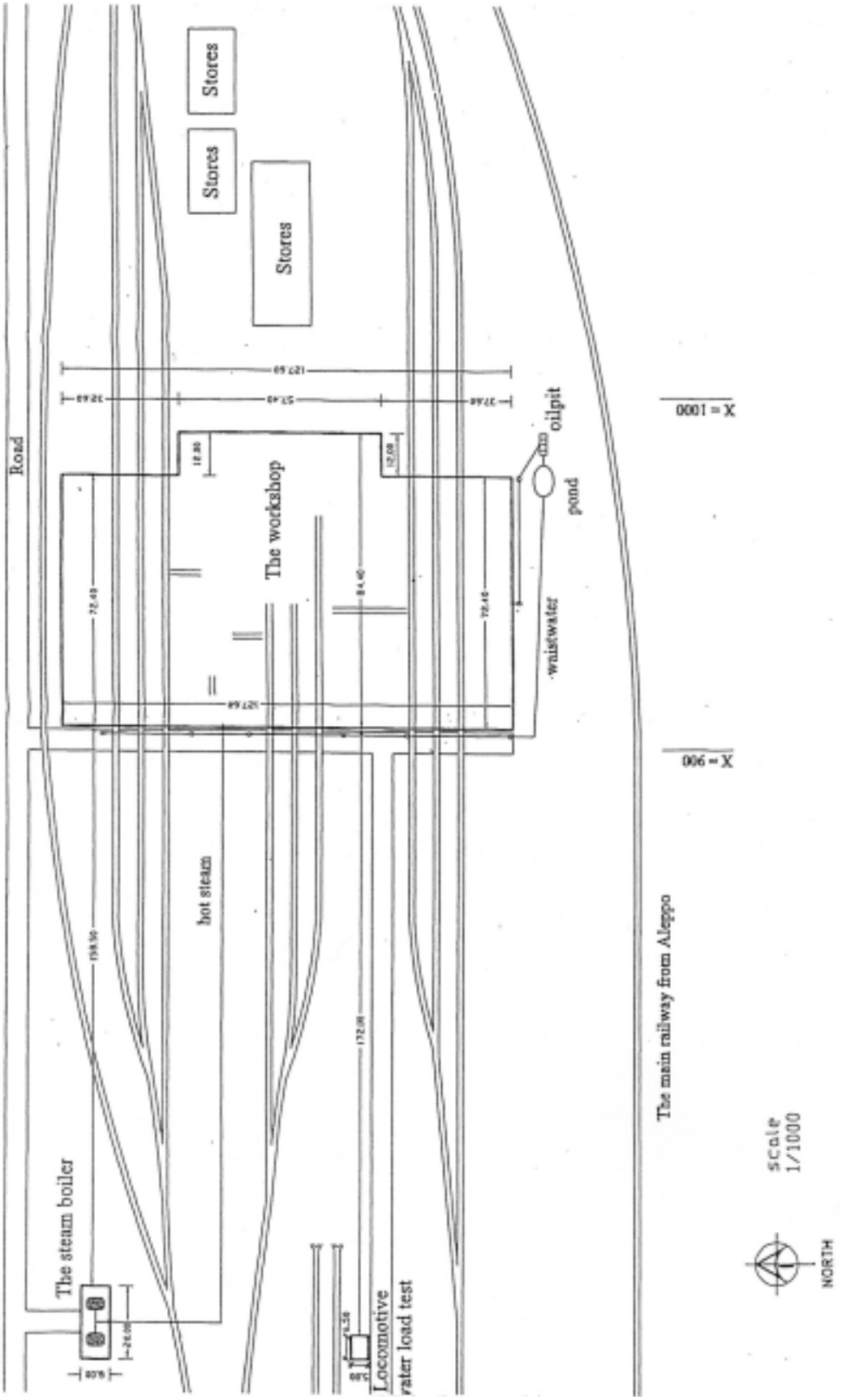


Fig. 5.1.1 Layout of Jubrin Locomotive Workshop

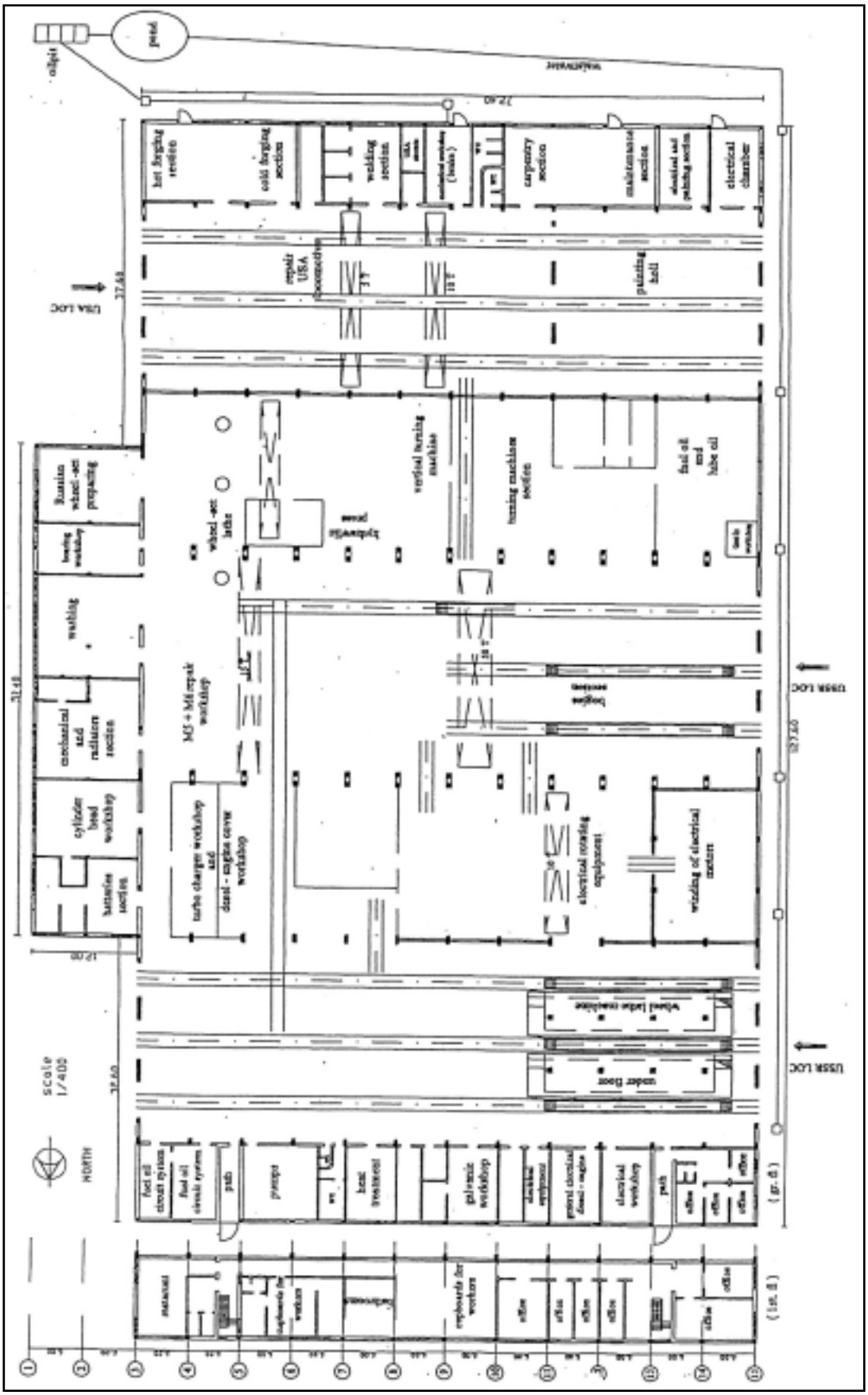


Fig. 5.1.2 Plane of Jubrin Locomotive Workshop

2) Comparison of the expansion of Jubrin locomotive workshop (Case 1) and the construction of new one (Case 2).

As shown in Table 5.1.1, construction cost for Case 2 would be estimated at 1.2 times that for Case 1, and that for Case 1 at 0.85 times Case 2's.

3) Long range plan of GESR on rolling stock maintenance

- GESR has a long range plan taking into consideration that maintenance workshops for DL, DC and FC would be concentrated in the neighboring district with Muslimia station and workers' residence would be provided in the area to form a rolling stock maintenance village in future.

- The existing Jubrin locomotive workshop would be effectively used as a locomotive depot, after the completion of new maintenance workshop.

(2) Basically the construction finish of maintenance workshop was planned in 2005, capable of practicing the periodic inspection for fleets of DLs and DCs in 2015, with brake shoes casting for necessary quantity in that year.

To avoid over investment at the beginning as much as possible, for facilities and equipment, their step-by-step installation was planned to some extent.

In 2020, the facilities and equipment for brake shoes casting will be operated on two shifts to cast their increased quantity.

Table 5.1.1 Comparison of alternatives in workshop area and construction costs

(m^2, % ,1000SP)

	JubrinL.W.	Case 1		Case 2	
Workshop area (m^2) (%)	DL maintenance	DL,DC maintenance	Brake shoes casting	DL, DC maintenance	Brake shoes casting
	10,800 (32%)	18,900	2,200	29,700	2,200
		21,100 (62%)		33,954 (100%)	
Cost for Earthworks, track work (1000SP)		351,736 (85%) Remodel 17,587 Sub total 369,323 (89%)		413,807 (100%)	
Cost for Building Building service (1000SP)		1,709,689 (90%) Remodel 85,484 Sub total 1,795,173 (95%)		1,899,654 (100%)	
Cost for Equipment, machinery for rolling stock maintenance (1000SP)	1,234,400 (23%)	4,097,912 (77%) Remodel 204,896 Sub total 4,302,808 (81%)		5,332,312 (100%)	
Total costs (1000SP)		6,467,304 (85%)		7,645,773 (100%)	

Note: 1. Estimated remodel costs in Case 1 at 5% of construction cost respectively.
2. Cost for equipment, machinery for rolling stock maintenance at Jubrin locomotive workshop was estimated for the current ones installed.
3. Neglected the acquisition cost of construction site.

5.2 Facilities of locomotive and diesel railcar maintenance

5.2.1 Basic concept

(1) Capability of inspection and maintenance facilities

Capability of inspection and maintenance facilities is so planned as to cope with number of rolling stock to be inspected in 2015. After 2015, when the inspection interval is planned to extend, reinforcement of capability of inspection and maintenance is to be considered.

(2) Foundry

1) Facility is mainly to produce brake block adopting the earth floor for floor mold to enable production of cast iron products in addition to brake block.
2) Production capacity of brake block is 3,400ton per year.
3) Facility to cast copper alloy is provided, as well.

(3) Thermal supply facility

The heat source for work and heating is by steam supplied from plural number of boiler considering periodic inspection.

(4) Related facility of pollution

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

1) Drainage is mainly containing oily drain. To decontaminate, pressurized floating is adopted to eliminate SS, oil, COD and BOD.
2) Waste such as parts of vehicle and packing material are to be incinerated.
3) Consideration is to be made to avoid the influence to outside from source of workshop noise.

(5) Acetylene gas facility

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

(6) Reuse of the facilities in Jubrin workshop

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

The layout of main building in Jubrin workshop is indicated at Fig. 5.2.1 and Table 5.2.1 indicates facilities (as the legend of Fig. 5.2.1) provided at Jubrin workshop.

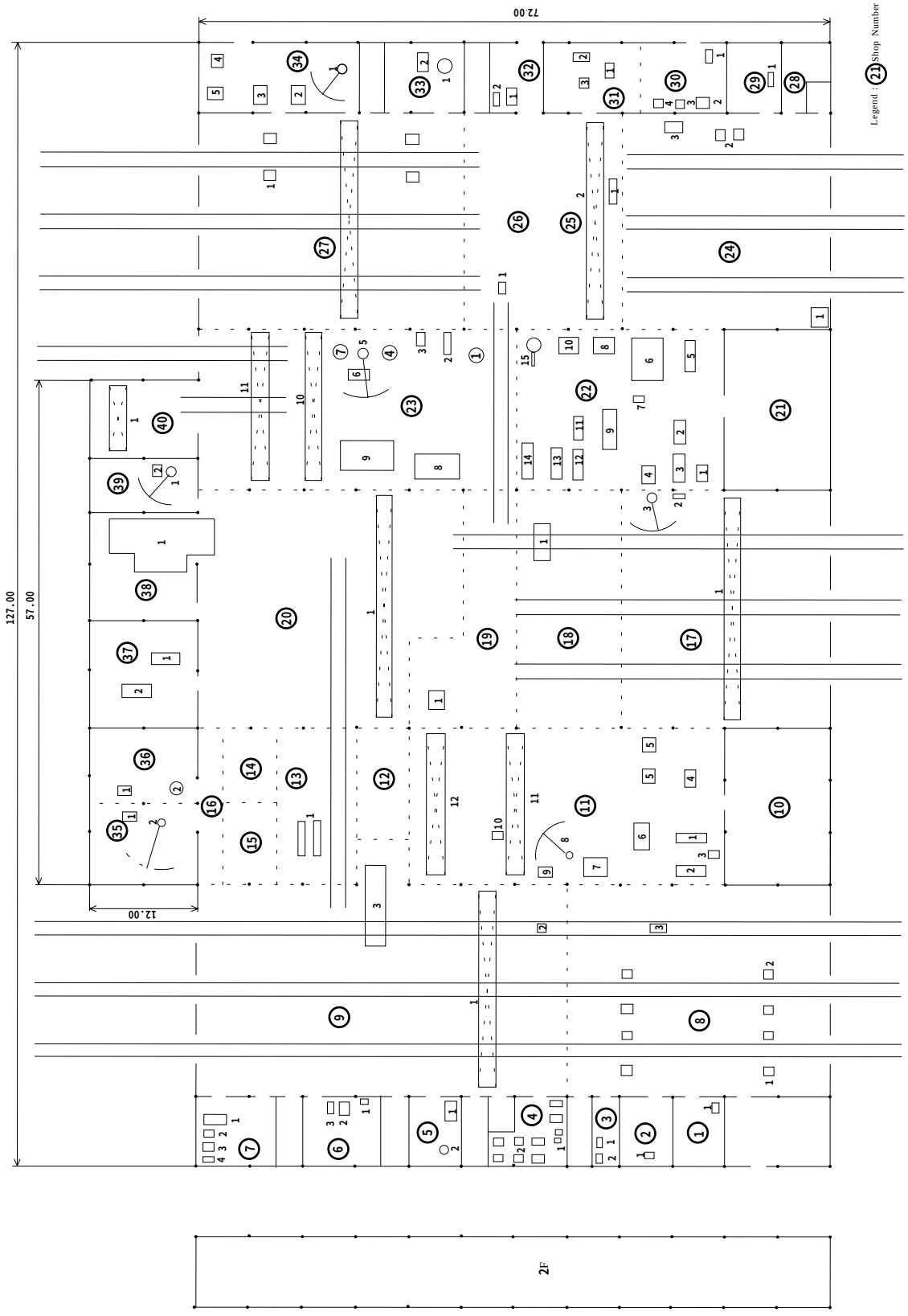


Fig.5.2.1 Layout of Main Building of Jubrin Workshop

Table 5.2.1 Facilities (as the legend of Fig.5.2.1) provided at Jubrin workshop

Machine/equipment set up place		Machine/equipment name		
No	Shop name	No	Machine/equipment name	Q'ty
1	Electric parts work-place	1	General purpose grinder	1
2	Filter work-place	1	Bench drilling machine	1
3	Relay work-place	1	Relay tester	2
4	Plating work-place	1	Hardness tester	2
		2	Electro-plating bath	8
5	Heat treatment work-place	1	Heating furnace	1
		2	Annealing furnace	1
6	Oil pump・water pump work-place	1	General purpose grinder	1
		2	Oil pump testing instrument	1
		3	Upright drilling machine	1
7	Fuel injection pump work-place	1	Fuel injection pump testing machine	1
		2	Nozzle grinder	1
		3	Nozzle grinder	1
		4	Fuel injection pump testing machine	1
8	Preliminary work-place for dismounting/mounting	1	Lifting jack	4
		2	Lifting jack	4
		3	Wheel lathe(under-floor type)	1
9	Occasional repair work-place	1	Overhead travelling crane	1
		2	Car-body draw gear	1
		3	Drop pit jack	1
11	Rotating machine shop	1	Balancing machine	1
		2	Parallel lathe	1
		3	General purpose grinder	1
		4	Armature binding machine	1
		5	No-load testing device	2
		6	Grooving machine	1
		7	Washing/air-blow equipment	1
		8	Jib crane	1
		9	Main moter disassembling/assembling equipment	1
		10	Press	1
		11	Overhead travelling crane(10t)	1
		12	Overhead travelling crane(2t)	1
13	Cylinder head work-place	1	Cylinder head assembling work bench	1
15	Air compressor work-place	1	Jib crane	1
17	Dismounting/mounting & car-body repair shop	1	Overhead travelling crane(50t/15t)	1
		2	Bench drilling machine	1
		3	Jib crane	1

Machine/equipment set up place		Machine/equipment name		
No	Shop name	No	Machine/equipment name	Q'ty
18	Bogie work-place	1	Bogie assembling equipment	1
19	Generator work-place	1	Generator disassembling/assembling equipment	1
20	Engine work-place	1	Overhead travelling crane(15t/5t)	1
22	Machining shop	1	Honing machine	1
		2	Surface grinding machine	1
		3	Surface grinding machine	1
		4	Press	1
		5	Parallel lathe	1
		6	Vertical lathe(NC)	1
		7	General purpose grinder	1
		8	Vertical milling machine	1
		9	Wheel axle grinding machine	1
		10	Vertical milling machine	1
		11	Parallel lathe	1
		12	Parallel lathe	1
		13	Parallel lathe	1
		14	Parallel lathe	1
		15	Radial drilling machine	1
23	Wheel-set maintenance shop	1	Vertical lathe	1
		2	Shaping machine	1
		3	Upright drilling machine	1
		4	Vertical lathe	1
		5	Jib crane	1
		6	Tyre heater	1
		7	Tyre tightening machine	1
		8	Wheel-set press	1
		9	Car wheel lathe	1
		10	Overhead travelling crane(3t)	1
		11	Overhead travelling crane(5t)	2
24	Car-body painting shop	1	Air compressor	1
		2	Fork-lift truck	2
		3	Air-brake valve testing machine	1
25	GE rotating machine maintenance shop	1	Shearing machine	1
		2	Overhead travelling crane (10t)	1
26	GE wheel-set maintenance shop	1	Winch	1
27	GE dismounting/mounting & car-body shop	1	Lifting jack	4

Machine/equipment set up place		Machine/equipment name		
No	Shop name	No	Machine/equipment name	Q'ty
29	Machine repair shop	1	Bench drilling machine	1
30	Metal plate work-place	1	Upright drilling machine	1
		2	Vertical milling machine	1
		3	General purpose grinder	1
		4	Crank press	1
31	Wood work-place	1	Wood planing machine	1
		2	Band sawing machine	1
		3	Circular sawing machine	1
32	Brake valve/air compressor work-place	1	Air compressor testing machine	1
		2	Air-brake valve testing machine	1
33	Welding work-place	1	Acetylene gas generator	1
		2	Press	1
34	Forge shop	1	Jib crane	1
		2	Electric furnace	1
		3	Electric furnace	1
		4	Heating furnace	1
		5	Air hammer	1
35	Battery work-place	1	Battery changing equipment	1
		2	Jib crane	1
36	Cylinder/piston work-place	1	Upright drilling machine	1
		2	Washing equipment	1
37	Radiator work-place	1	Radiator washing machine	1
		2	Leakage testing machine	1
38	Washing work-place	1	Jet washing equipment	1
39	Bearing work-place	1	Jib crane	1
		2	Bearing washing machine	1
40	Axle box work-place	1	Overhead travelling crane	1
	Boiler room	1	Boiler	2
	Wheel-set storing space		Gantry crane	1
			Gantry crane	1

5.2.2 Inspection and maintenance facilities for locomotive and diesel railcar

Inspection and maintenance facilities for locomotive and diesel railcar are planned assuming main devices provided on the locomotive and diesel railcar, as a general. Function of maintenance facilities in Appendix 5, Table 5.2.1 indicates general function of maintenance facilities classified by working site, locomotive, diesel railcar and common use.

5.2.3 Construction cost

(1) Assumption of construction cost estimation

1) Time of estimation Jan. 2001

2) Exchange rate US$=¥115

US$=46SP

3) Contract of construction is to be in 2003 and commencement of construction at site, Apr. 2004.

4) Assumptions

(a) If the estimation of cost of device is obtainable, apply this estimation.

(b) If the device was purchased in the past, the estimation is made considering past cost record and elapse of years.

(c) If the device has not been used, the estimation is made referring to the cost of the device with the same function, size and etc.

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

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

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

(2) Estimation of construction cost of maintenance machinery

Construction cost divided into foreign and domestic currencies, is indicated in Table 5.2.2 Construction cost of machinery.

Table 5.2.2 Construction cost of machinery

Unit ; Million S.P

Shop name	Foreign Currency				Domestic Currency				Total			
	DL	DL/DC	DC	Sub Total	DL	DL/DC	DC	Sub Tota	DL	DL/DC	DC	Total
Final adjustiment shop	34.4	32.0	52.4	118.8	3.2	2.9	2.2	8.3	37.6	34.9	54.6	127.1
Dismounting/mountion shop	168.1	10.8	168.1	347.0	6.5	0.8	6.5	13.8	174.6	11.6	174.6	360.8
Car-body washing & air blow shop		167.2		167.2		3.2		3.2		170.4		170.4
Car-body maintenance shop	78.0		75.1	153.1	5.2		4.9	10.1	83.2		80.0	163.2
Bogie maintenance shop	54.0	141.5	60.3	255.8	3.3	7.1	3.5	13.9	57.3	148.6	63.8	269.7
Wheel-set maintenance shop	49.3	406.2	31.1	486.6	3.2	14.8	2.0	20.0	52.5	421.0	33.1	506.6
Engine maintenance shop	90.1	383.8	71.5	545.4	6.1	10.6	4.5	21.2	96.2	394.4	76.0	566.6
Engine performance test room	21.6	67.7	12.0	101.3	1.5	3.2	0.2	4.9	23.1	70.9	12.2	106.2
Rotating machine maintenance shop	424.5			424.5	21.5			21.5	446.0			446.0
Electric parts maintenance shop	53.6	130.5	13.0	197.1	1.2	3.9	0.3	5.4	54.8	134.4	13.3	202.5
Air-brake parts maintenance shop		83.0		83.0		4.5		4.5		87.5		87.5
Iron-work/coil-spring maintenanceshop		118.8		118.8		6.4		6.4		125.2		125.2
Machining shop		212.6		212.6		9.8		9.8		222.4		222.4
Wood-work·seat cusion work-place		12.6	10.0	22.6		1.7	0.7	2.4		14.3	10.7	25.0
Car-body painting shop		296.8		296.8		7.9		7.9		304.7		304.7
Machine repair shop		52.3		52.3		3.3		3.3		55.6		55.6
Fuoundry shop		656.2		656.2		42.9		42.9		699.1		699.1
Forge shop		70.3		70.3		2.7		2.7		73.0		73.0
Boiler room		68.2		68.2		4.6		4.6		72.8		72.8
Material testing room		11.8		11.8		0.3		0.3		12.1		12.1
Transporting equipment		47.6		47.6		0.8		0.8		48.4		48.4
Material warehouse		48.0		48.0		4.4		4.4		52.4		52.4
Storehous of dangerouse articles		1.0		1.0		0.3		0.3		1.3		1.3
Piping facility		81.1		81.1		83.8		83.8		164.9		164.9
Shed for effluent treatment plant		68.6		68.6		1.7		1.7		70.3		70.3
Shed for incineration equipment		43.6		43.6		1.4		1.4		45.0		45.0
Sub Total	973.6	3,212.2	493.5	4,679.3	51.7	223.0	24.8	299.5	1,025.3	3,435.2	518.3	4,978.8
Supervisor fee		104.6		104.6						104.6		104.6
Total	973.6	3,316.8	493.5	4,783.9	51.7	223.0	24.8	299.5	1,025.3	3,539.8	518.3	5,083.4
Measuring instrument·tool & etc.		233.9		233.9		15.0		15.0		248.9		248.9
Grand Total	973.6	3,550.7	493.5	5,017.8	51.7	238.0	24.8	314.5	1,025.3	3,788.7	518.3	5,332.3

5.2.4 Process of construction

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

5.3 Maintenance system of devices for rolling stock inspection and maintenance

5.3.1 Present status of Jubrin workshop

Maintenance system of facilities in Jubrin workshop was studied. The maintenance systems of respective shops and organization were found good. However, the most of devices are from foreign countries, it can be said parts supply is not sufficient due to the budget allocation. Accordingly, the ex post facto maintenance instead of preventive maintenance is carried out.

5.3.2 Maintenance system of inspection and maintenance devices

Failure, deterioration of function or hackneyed maintenance devices affect maintenance process and quality of rolling stock maintenance.
Therefore, the maintenance devices should be maintained in good condition and managed to keep the precious property so as to be applied most effectively and economically.

Appendix 5.3 shows the example of “maintenance and management of facilities at railway workshop in Japan” for reference.

(1) Maintenance system

Maintenance work of rolling stock maintenance facilities requires preparation of continuous record, knowledge and technology. The maintenance system must be so organized. An example of railway workshop organization is indicated in Fig. 5.3.1. “Example of managing organization of facilities”. Thick line in the figure indicates the sections related with facilities. The section chief in charge of maintenance assists the workshop manager with respect to the maintenance of facilities, new installation of facilities and maintenance. The repair shop carries out maintenance work. However, maintenance of track and telecommunication devices are to be entrusted to respective shops outside of workshop but in railway, and the maintenance work of highly innovated machine which need special technique is to be entrusted to manufacturer and only management of maintenance is carried out.

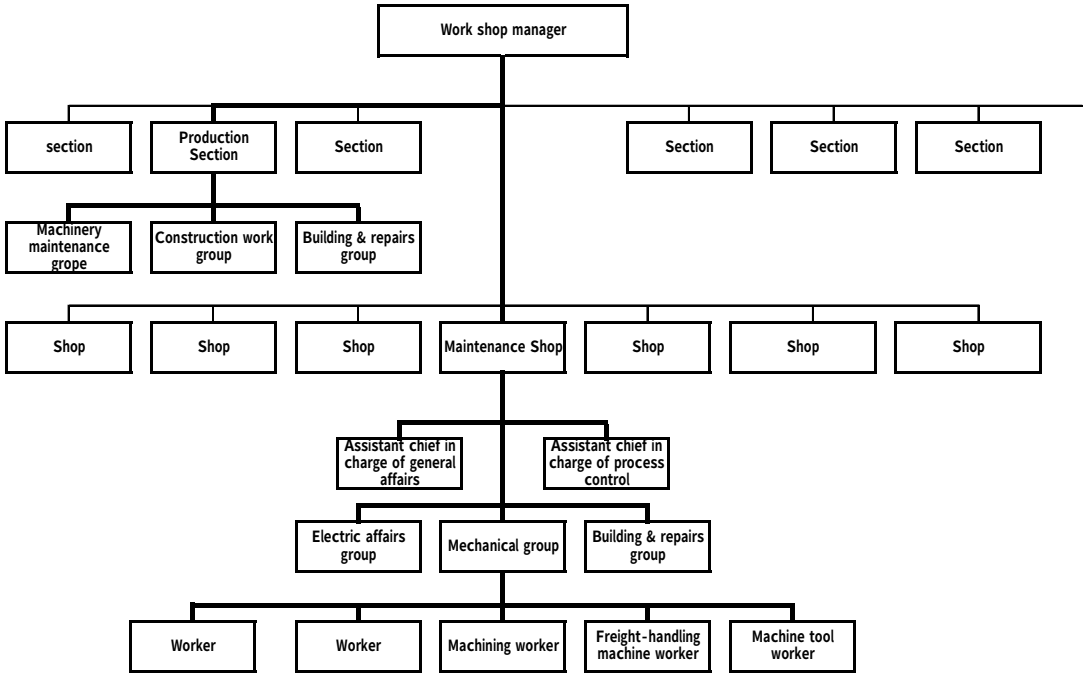


Fig. 5.3.1 "Example of managing organization of facilities

(2) Maintenance staff

Number of maintenance staff is planned as 5% of staff in charge of rolling stock maintenance and foundry in the workshop. Number of maintenance staff is indicated in the Table 5.3.1 Number of maintenance staff by year.

Table 5.3.1 Number of maintenance staff by year

Year	2006	2010	2015	2010
Number of maintenance staff	21	27	39	58

(3) Cost for material and consumables

This cost is planned as 5% of material cost and total of miscellaneous cost. Table 5.3.2 "Material and consumable cost by year" is the result of calculation.

Table 5.3.2 Material and consumable cost by year

Year	2006	2010	2015	2020
Material and consumable cost (1,000 SP)	4,746	6,331	10,832	15,942

(4) Maintenance cost by year

Yearly maintenance cost is as Table 5.3.3 “Maintenance cost by year.

Table 5.3.3 Maintenance cost by year

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

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

5.4.1 Basic concept of new workshop construction

Basic items of new workshop construction

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

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

(3) Capacity of new workshop is to be able to maintain the locomotive and diesel car fleet in 2015. Maintenance capacity of the fleet in 2020 is also studied.

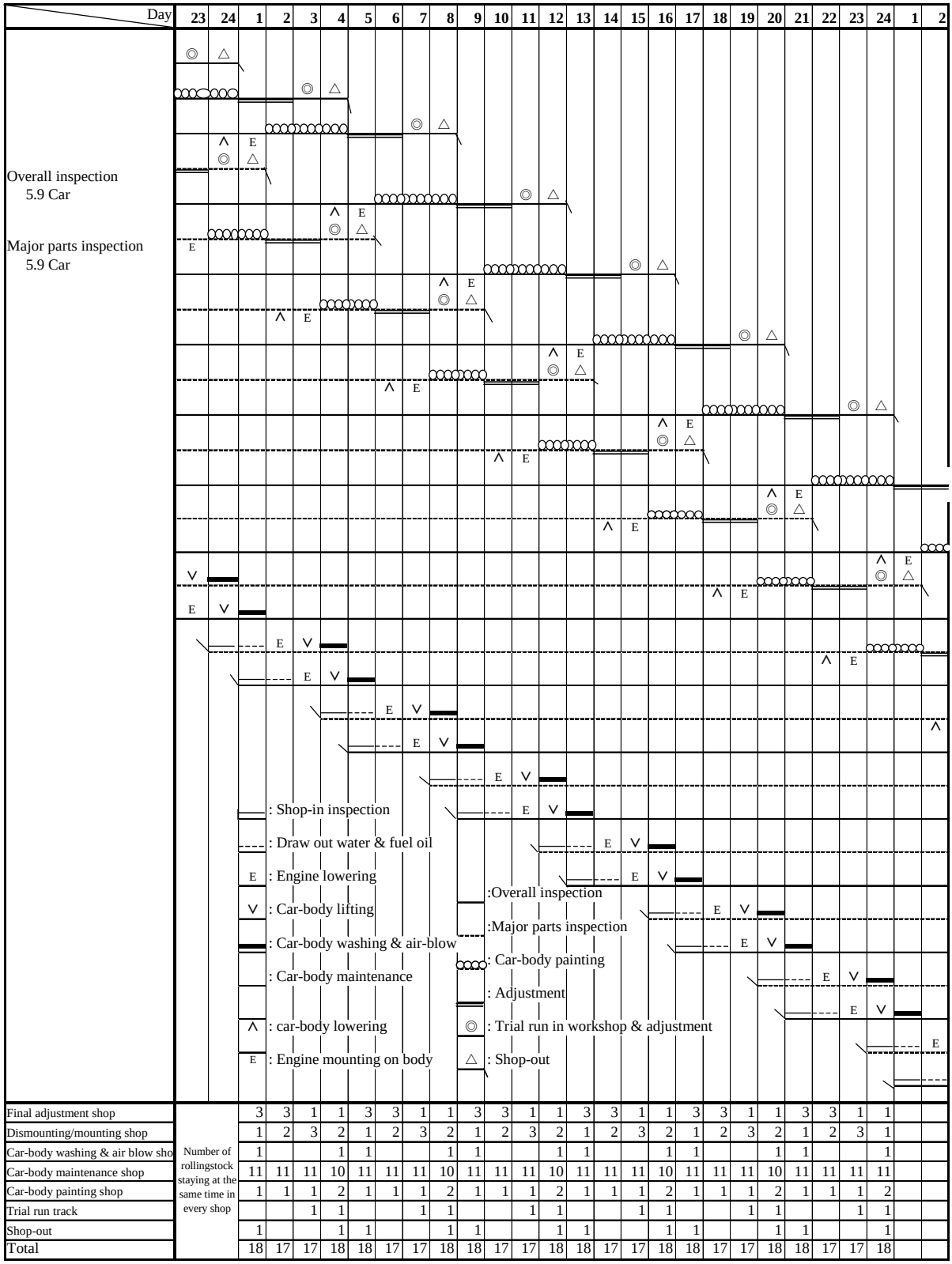
(4) Brake block manufacturing shop commences the production on Jan. 2006 with capability of 3,400tons per year.

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

5.4.2 Planning of principal working site size

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

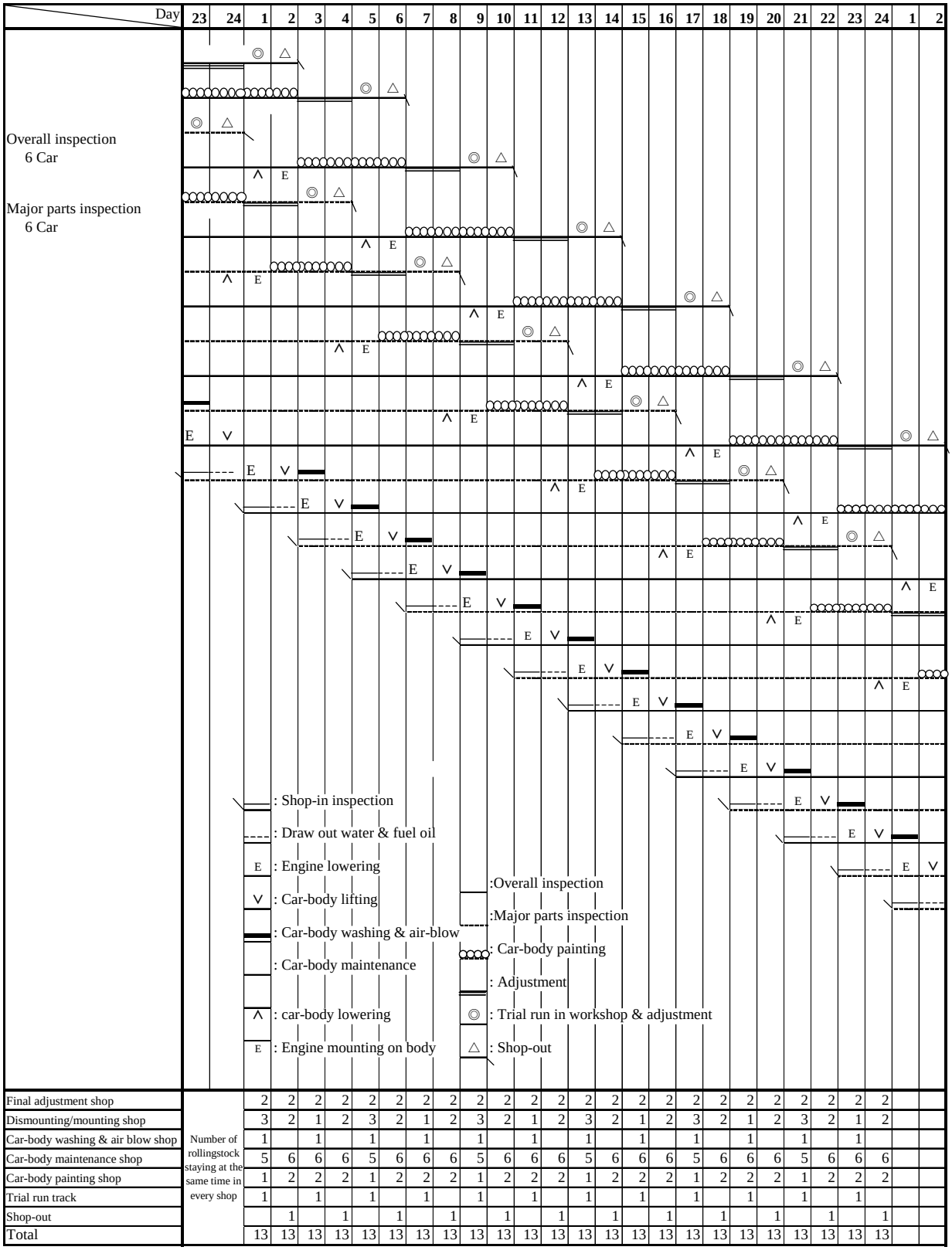
Simultaneous number of rolling stock at principal working site is one of key item to decide the size of workshop. Accordingly, simulation was made to minimize the simultaneous number of rolling stock at principal working site for 5 months. The result of simulation of a certain month is illustrated in Fig. 5.4.1 “Locomotive shop in simulation (2015) of a certain month” and Fig. 5.4.2 “Diesel railcar shop in simulation (2015) of a certain month”. And Table 5.4.1 “Simultaneous number of rolling stock at principal shop (2015)” indicates simultaneous number of rolling stock shopped into a principal working site such as final adjustment shop or dismounting/mounting shop.



Day	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2
Final adjustment shop			3	3	1	1	3	3	1	1	3	3	1	1	3	3	1	1	3	3	1	1	3	3	1	1		
Dismounting/mounting shop			1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	1		
Car-body washing & air blow sho			1			1	1			1	1			1	1			1	1			1	1			1		
Car-body maintenance shop			11	11	11	10	11	11	11	10	11	11	11	10	11	11	11	10	11	11	11	10	11	11	11	11		
Car-body painting shop			1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2		
Trial run track					1	1			1	1			1	1			1	1			1	1			1	1		
Shop-out			1			1	1			1	1			1	1			1	1			1	1			1		
Total			18	17	17	18	18	17	17	18	18	17	17	18	18	17	17	18	18	17	17	18	18	17	17	18		

Number of rollingstock staying at the same time in every shop

Fig. 5.4.1 Locomotive shop in simulation (2015) of a certain month



		23	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2
Final adjustment shop	Number of rollingstock staying at the same time in every shop			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
Dismounting/mounting shop				3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2		
Car-body washing & air blow shop				1		1		1		1		1		1		1		1		1		1		1		1			
Car-body maintenance shop				5	6	6	6	5	6	6	6	5	6	6	6	5	6	6	6	5	6	6	6	5	6	6	6		
Car-body painting shop				1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2		
Trial run track				1		1		1		1		1		1		1		1		1		1		1		1			
Shop-out					1		1		1		1		1		1		1		1		1		1		1		1		
Total		13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13		

Fig. 5.4.2 Diesel railcar shop in simulation (2015) of a certain month

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

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Final adjustment shop		DL	3	3	1	1	3	3	1	1	3	3	1	1	3	3	1	1	3	3	1	1	3	3	1	1
		DC	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		Total	5	5	3	3	5	5	3	3	5	5	3	3	5	5	3	3	5	5	3	3	5	5	3	3
Dismounting/mounting shop		DL	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	1
		DC	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2
		Total	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
Car-body washing & air blow shop		DL	1			1	1			1	1			1	1			1	1			1	1			1
		DC	1		1		1		1		1		1		1		1		1		1		1		1	
		Total	2		1	1	2		1	1	2		1	1	2		1	1	2		1	1	2		1	1
Car-body maintenance shop		DL	11	11	11	10	11	11	11	10	11	11	11	10	11	11	11	10	11	11	11	10	11	11	11	11
		DC	5	6	6	6	5	6	6	6	5	6	6	6	5	6	6	6	5	6	6	6	5	6	6	6
		Total	16	17	17	16	16	17	17	16	16	17	17	16	16	17	17	16	16	17	17	16	16	17	17	17
Car-body painting shop		DL	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2
		DC	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2
		Total	2	3	3	4	2	3	3	4	2	3	3	4	2	3	3	4	2	3	3	4	2	3	3	4
Trial run track		DL			1	1			1	1			1	1			1	1			1	1			1	1
		DC	1		1		1		1		1		1		1		1		1		1		1		1	
		Total	1		2	1	1		2	1	1		2	1	1		2	1	1		2	1	1		2	1
Shop-out		DL	1			1	1			1	1			1	1			1	1			1	1			1
		DC		1		1		1		1		1		1		1		1		1		1		1		1
		Total	1	1		2	1	1		2	1	1		2	1	1		2	1	1		2	1	1		2
Engine maintenance shop	Disassemble/ washing	DL	1		1	2	1		1	2	1		1	2	1		1	2	1		1	2	1		1	2
		DC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Total	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3
	Maintenance	DL	7	7	7	6	7	7	7	6	7	7	7	6	7	7	7	6	7	7	7	6	7	7	7	6
		DC	3	4	4	3	3	4	4	3	3	4	4	3	3	4	4	3	3	4	4	3	3	4	4	3
		Total	10	11	11	9	10	11	11	9	10	11	11	9	10	11	11	9	10	11	11	9	10	11	11	9
	Assembling	DL	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		DC	2			2	2			2	2			2	2			2	2			2	2			2
		Total	4	2	2	4	4	2	2	4	4	2	2	4	4	2	2	4	4	2	2	4	4	2	2	4
	Test	DL	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
		DC		2	2			2	2			2	2			2	2			2	2			2	2	
		Total	1	4	3	2	1	4	3	2	1	4	3	2	1	4	3	2	1	4	3	2	1	4	3	2
	Painting/drying	DL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		DC	1			2	1			2	1			2	1			2	1			2	1			2
		Total	2	1	1	3	2	1	1	3	2	1	1	3	2	1	1	3	2	1	1	3	2	1	1	3
Bogie maintenance shop	Disassemble/ washing	DL	2	1		1	2	1		1	2	1		1	2	1		1	2	1		1	2	1		1
		DC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Total	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2
	Maintenance	DL	8	8	9	8	8	8	9	8	8	8	9	8	8	8	9	8	8	8	9	8	8	8	9	8
		DC	3	3	4	4	3	3	4	4	3	3	4	4	3	3	4	4	3	3	4	4	3	3	4	4
		Total	11	11	13	12	11	11	13	12	11	11	13	12	11	11	13	12	11	11	13	12	11	11	13	12
	Painting/drying	DL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		DC	2	1			2	1			2	1			2	1			2	1			2	1		
		Total	3	2	1	1	3	2	1	1	3	2	1	1	3	2	1	1	3	2	1	1	3	2	1	1
	Assembling	DL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		DC		1	2	1		1	2	1		1	2	1		1	2	1		1	2	1		1	2	1
		Total	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2
Wheel-set maintenance shop	Disassemble/ washing	DL	1	2	1		1	2	1		1	2	1		1	2	1		1	2	1		1	2	1	
		DC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Total	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1	2	3	2	1
	Maintenance	DL	7	6	7	7	7	6	7	7	7	6	7	7	7	6	7	7	7	6	7	7	7	6	7	7
		DC	2	3	3	3	2	3	3	3	2	3	3	3	2	3	3	3	2	3	3	3	2	3	3	3
		Total	9	9	10	10	9	9	10	10	9	9	10	10	9	9	10	10	9	9	10	10	9	9	10	10
	Painting/drying	DL		1		1		1		1		1		1		1		1		1		1		1		1
		DC	1			1	1			1	1			1	1			1	1			1	1			1
		Total	1	1		2	1	1		2	1	1		2	1	1		2	1	1		2	1	1		2
	Assembling	DL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		DC	1	1			1	1			1	1			1	1			1	1			1	1		
		Total	2	2	1	1	2	2	1	1	2	2	1	1	2	2	1	1	2	2	1	1	2	2	1	1
	Rotating test	DL	1		1		1		1		1		1		1		1		1		1		1		1	
		DC																								
		Total	1		1		1		1		1		1		1		1		1		1		1		1	
Rotaing machine maintenance shop	**Air blast /disassemble**	DL		1	2	1		1	2	1		1	2	1		1	2	1		1	2	1		1	2	1
	Inspection./ Repair		5	5	4	5	5	5	4	5	5	5	4	5	5	5	4	5	5	5	4	5	5	5	4	5
	Assembleling		1		1		1		1		1		1		1		1	1	1		1		1		1	
	No-load test		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Painting/Drying			1		1		1		1		1		1		1		1		1		1		1		1

(2) Planning of principal working site size

Based on the layout and number of rolling stock to be inspected in a year which are calculated by simultaneous number of rolling stock at principal work site, the area of principal work site is planned. The size of respective shop is decided by simulation considering the size of respective rolling stock maintenance, necessary space for machine and space for spare parts storage.

Comparison is indicated in the Table 5.4.2 “Comparison of newly planned area of principal work site and one in existing Jubrin workshop”.

Table 5.4.2 Comparison of newly planned area of principal work site and one in existing Jubrin workshop

Shop name	Present situation of Jubrin locomotive workshop			Area of new workshop
	No	Shop name	Area	
Final adjustment shop	—			1,440
Dismounting/mounting shop	8	Preliminary work-place for dismounting/mounting	720	2,304
	9	Occasional repair work-place(car-body maintenance shop)	1,038	
	17	Dismounting/mounting・car-body maintenance shop	648	
Car-body maintenance shop	27	GE dismounting/mounting shop	720	4,824
	Total		3,126	
Car-body washing/air blow shop	—			360
Bogie maintenance shop	18	Bogie work-place	324	1,836
Wheel-set maintenance shop	23	Wheel-set maintenance shop	648	1,728
	39	Bearing work-place	72	
	40	Axle box work-place	108	
	26	GE wheel-set maintenance shop	216	
	Total		1,044	
Engine maintenance shop	2	Filter work-place	48	3,564
	6	Oil pump/water pump work-place	72	
	7	Fuel injection pump work-place	72	
	12	Cam shaft/timing gear case work-place	78	
	13	Cylinder head work-place	162	
	14	Cylinder work-place	54	
	16	Valve・valve spring work-place	54	
	20	Engine work-place	750	
	36	Cylinder/piston work-place	108	
	37	Radiator work-place	144	
	38	Washing work-place	144	
	Total		1,686	
Engine performance test room	—			720
Rotating machine maintenance shop	10	Armature winding work-place	216	1,188
	11	Rotating machine work-place	648	
	19	Generator work-place	222	
	25	GE rotating machine maintenance shop	216	
	Total		1,302	

Shop name	Present situation of Jubrin locomotive workshop			Area of new workshop
	No	Shop name	Area	
Electric parts maintenance shop	1	Electric parts work-place	48	972
	3	Relay work-place	24	
	35	Battery work-place	108	
	Total		180	
Air-brake parts maintenance shop	15	Air compressor work-place	54	1,080
	32	Brake valve/air compressor work-place	45	
	Total		99	
Machining shop	22	Machining shop	432	1,944
Wood-work・seat cushion work-place	—			324
Car-body painting shop	24	Car-body painting shop	576	780
Iron-work・coil-spring maintenance shop	4	Plating work-place	60	1,728
	30	Metal plate work-place	80	
	33	Welding work-place	72	
	Total		212	
Machine repair shop	29	Machine repair shop	48	864
	31	Wood work-place	64	
	Total		112	
Foundry shop	—			2,160
Forge shop	5	Heat treatment work-place	48	864
	34	Forge shop	144	
	Total		192	
Boiler room		Boiler room	217	162
Garage	—			378
Material warehouse	21	Warehouse	216	4,290
		Simplified warehouse	1,000	
	Total		1,216	
Storehouse of dangerous articles	—			144
Shed for effluent treatment plant	—			150
Shed for incineration equipment	—			150
Total			10,718	33,954

Note: “No.” corresponds to those in Table 5.2.1.

(3) Design concept of maintenance facilities

1) Arrangement of maintenance building

Considering the shifting movement of body, disassembled with heavy weight parts, maintenance shop is to be arranged at neighborhood so “the weight of the flow of disassembled parts x transporting distance” as to be the minimum, thus to increase the efficiency of parts transportation. Arrangement of building is as indicated in the Fig 5.5.2 “Facility arrangement plan of locomotive workshop”.

2) Final adjustment shop

Shop in, shop out and service are carried out in the final adjustment shop.

(a) Fuel which is consumed at final adjustment shop and engine test room is to be supplied from one fuel reservoir. Water resistor is for common use to final adjustment shop and engine performance testing room.

(b) To prevent falling from roof, the foothold is to be provided for high place work safety.

(c) The testing machine and pressure test machine are to be provided to check wiring and piping.

(d) Adequate inspection pit is to be provided for under floor and running gear inspection.

3) Dismounting/mounting shop

(a) For dismounting and mounting, the overhead traveling crane system is adopted to cope with difference of process length such as major parts inspection and over all inspection. The uncoupling, coupling and dismounting, mounting of parts are carried out on track with pit.

(b) There is a day on which dismounting and mounting are to be carried out for 4 rolling stock. This work load is exceeding the capacity. Therefore, two buildings should be assigned to dismounting and mounting work, one for locomotive and the other for railcar. But facilities in respective building are to be flexible for locomotive and railcar.

(c) 3 sets of overhead traveling crane are provided in respective building to be able to lift up and down body and engine simultaneously.

4) Car-body washing & air blow shop and car-body painting shop

(a) Exclusive booth for air blow/washing and painting is provided to improve environment and to prevent poisoning with organic solvent.

(b) Building for air blow/washing and painting is separate from main building, shifting of body is by traverser applying temporary truck.

(c) Exclusive booth is provided for painting to avoid poisoning with organic solvent.

5) Car-body maintenance shop

(a) Car-body maintenance shop is arranged in line with dismounting and mounting shop to enable direct shifting.

(b) Maintenance of body and dismounting and mounting of body parts are by the under floor dismounting and mounting machine while body is being fixed on the floor.

(c) To prevent falling from roof and to go in and out to operating cab, the foothold is to be provided for high place work safety. And if necessary, safety fence to prevent falling down is provided.

6) Engine maintenance shop

(a) Engine maintenance shop is so arranged adjacent to Disassemble shop for rigging to ease transportation of heavy engine.

(b) Engine turning device is to be adopted for disassembling and assembling of engine at proper position to prevent injury.

7) Engine performance testing room

(a) As the engine generate high temperature with excessive noise, engine test plant should be in the separate building but adjacent to engine maintenance building.

(b) Test plant should be in the room with soundproof construction with air conditioning device.

8) Track of trial run in workshop

(a) Length of test running track is to be 1.5km in the workshop yard.

(b) Test track should be arranged adjacent to the final adjustment shop.

9) Bogie maintenance shop

(a) As the bogie is heavy in weight and large in size, bogie maintenance shop should be

arranged adjacent to disassembling shop, and maintenance is to be by fixed bogie system.

(b) As for improvement of environment and grade up of inspection quality, bogie washing device and bogie frame painting booth are to be provided.

10) Wheel-set maintenance shop

(a) Wheel-set maintenance shop is arranged adjacent to bogie maintenance shop.

(b) With respect to an axle, axles for locomotive and railcar are to be maintained on the same line. Due to the amount of work, an assembly line system is adopted.

(c) As for non-destructive inspection of axle, ultrasonic flaw detection (straight beam and angle beam) and magnetic detector are to be adopted.

11) Rotating machine maintenance shop

(a) This maintenance shop is arranged adjacent to wheel-set maintenance shop.

(b) Insulation performance test and layer short-circuit test examination are to be automatized.

(c) Grooving of commutator is to be also automatized.

(d) As facilities for major and medium repair, vacuum impregnator, drying device and balancing machine are to be provided.

12) Machining shop

As the parts of engine need many machine work, this shop has to be arranged at adequate position.

13) Maintenance shop for electrical parts and air brake parts

Arranged at the adjacent positions to the bogie and the wheel set repair shops.

14) Shops for castings, forge, iron-work and springs

These items are not directly related with maintenance work of rolling stock, building of these should be arranged separated from main building.

15) Warehouse, place to put waste and scrapped metal

These items should be so arranged as easy to access by wagon and freight truck for

transportation.

16) Fuel reserve tank

(a) Install the reserve tank inside the outdoors oil embankment.

(b) Fuel reserve tank for engine and/or boiler should be so arranged as easy access by wagon and tank lorry.

5.5 Preliminary design for locomotive workshop buildings

5.5.1 Basic conditions for the preliminary design

To design the locomotive workshop buildings with an optimum size and quality so as to satisfy the needs of GESR and the site conditions, the following design concept and conditions were set up:

(1) Site conditions

The project site for the new locomotive workshop is located some 30 km north of Aleppo city, southwest of Muslimia station. The site is now vacant and seasonally cultivated for vegetables and cotton. The cultivated land extends north-south 1.5 km and east-west 1.2 km, with an area of about 180 ha. The land is presently owned by two public sector entities and GESR will expropriate the land from them for the project site of the new locomotive workshop and other facilities. Required area for the project is about 37.5 ha, north-south 750 m long and east-west 500 m long respectively.

(2) Climatic conditions

Temperature: Mean temperature 15 degrees C
Maximum temperature 40 degrees C
Minimum temperature -10 degrees C

Rainfall: Yearly precipitation 500 mm
Snowfall: Several days a year, recorded maximum snowfall in the area is about 30 cm.

Wind: Prevailing wind direction is northwest, and wind velocity sometimes reaches 33 m/s.

Earthquake: A middle class earthquake occurred in Aleppo in 1920.

(3) Topography and geology

The project site near the Muslimia station is almost flat. There are small hills west of the project site.

There are gentle slopes in the east to west and north to south directions.

There is no boring data at the project site because the site is now cultivated land and there are no buildings. The topsoil is mainly silt with small stones. The bearing capacity of the soil appears sufficiently strong to support building foundations.

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

(4) Infrastructure such as road, power supply, telephone, drinking water and drainage system

There are two cement plants, glass plant, Muslimia station and houses surrounding the project site. Therefore, it is easy to access and to connect to existing and planned infrastructure serving the existing facilities, except for the drainage system.

5.5.2 Basic concept for the preliminary design

(1) Project site layout plan

A 750m x 500m (37.5ha) area of land was selected as the project site. It is approximately 700m southward from the Muslimia station.

The main workshop building is placed parallel to the main railroad from Aleppo to the Turkish border and test run track for repaired locomotives and diesel cars. The locomotives to be repaired shall enter into the main workshop building through a branch line near the Muslimia station.

Car-body washing and air blow shop, car-body painting shop and traverse are located north of the main workshop building. Final adjustment shop is placed between the main workshop building and the test run track.

Ironwork, spring inspection and repair shop, machine repair shop, forge shop, foundry shop and storehouse are placed southward of the main workshop building. In addition to the above shops and buildings, engine performance test room, boiler room, substations, garage, canteen, storehouse for dangerous articles, elevated water tank, materials stock

yard, waste materials stock yard, soccer ground etc. are placed around the main workshop building. Administration building shall be placed near the south access road.

(2) Floor plan for main workshop building

In the main workshop building, each repair shop is located in accordance with inspection and repair workflow. Small office for foreman, rest spaces, toilets etc. are located at suitable places so as not to disturb inspection and repair works. For any other buildings, the floor plans are decided in the same manner as the main workshop building.

(3) Elevation and cross section plans

Elevation and cross section plans for each building are prepared based on Syrian architectural style and construction methods and taking into consideration the following aspects;

1) Height of crane girder for ceiling runway cranes shall be of sufficient level to lift up and down huge and heavy engines, motors, generators, etc.
2) Ground floor level shall be set higher than the ground level to prevent rainwater infiltration;
3) Openings shall be made as large as possible to allow natural lighting and natural ventilation.

(4) Structural plan

Main workshop building and other repair shops shall be steel structures. A ceiling runway crane, capacity 30 tons shall be supported by steel columns and girders. Administration office building, canteens etc. shall be reinforced concrete structures. There is no need for pile foundations because soil-bearing capacity is considered sufficient.

(5) Main finishing materials plan

Main finishing materials for the project's buildings shall be selected from locally obtained materials by taking into consideration the local construction situation, construction schedule and construction cost so as to reduce building operation and maintenance costs.

1) External finishing materials:
Roofs: Folded plate sheet
External wall: Insulated external wall
Windows: Aluminum-sash window or steel window
Doors: Steel doors or Aluminum doors

2) Interior finishing materials

Ceilings:	Paint finish on fair-faced concrete, acoustic ceiling board and plasterboard
Walls:	Paint finish on plaster base and glazed ceramic tiles
Floors:	Terrazzo tile, plastic vinyl tiles, ceramic tiles, trowelled mortar finish, hardener mortar finish and carpet

(6) Planning of procurement for building materials

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

5.5.3 Preliminary design for the locomotive workshop

(1) Building area and structure type for each building

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

Table 5.5.1 Name of each building, area and structure type

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

(2) Preliminary design drawings for general layout and main workshop building

Drawings for general layout and main workshop building are shown on Fig. 5.5.1 to Fig. 5.5.4 hereinafter.

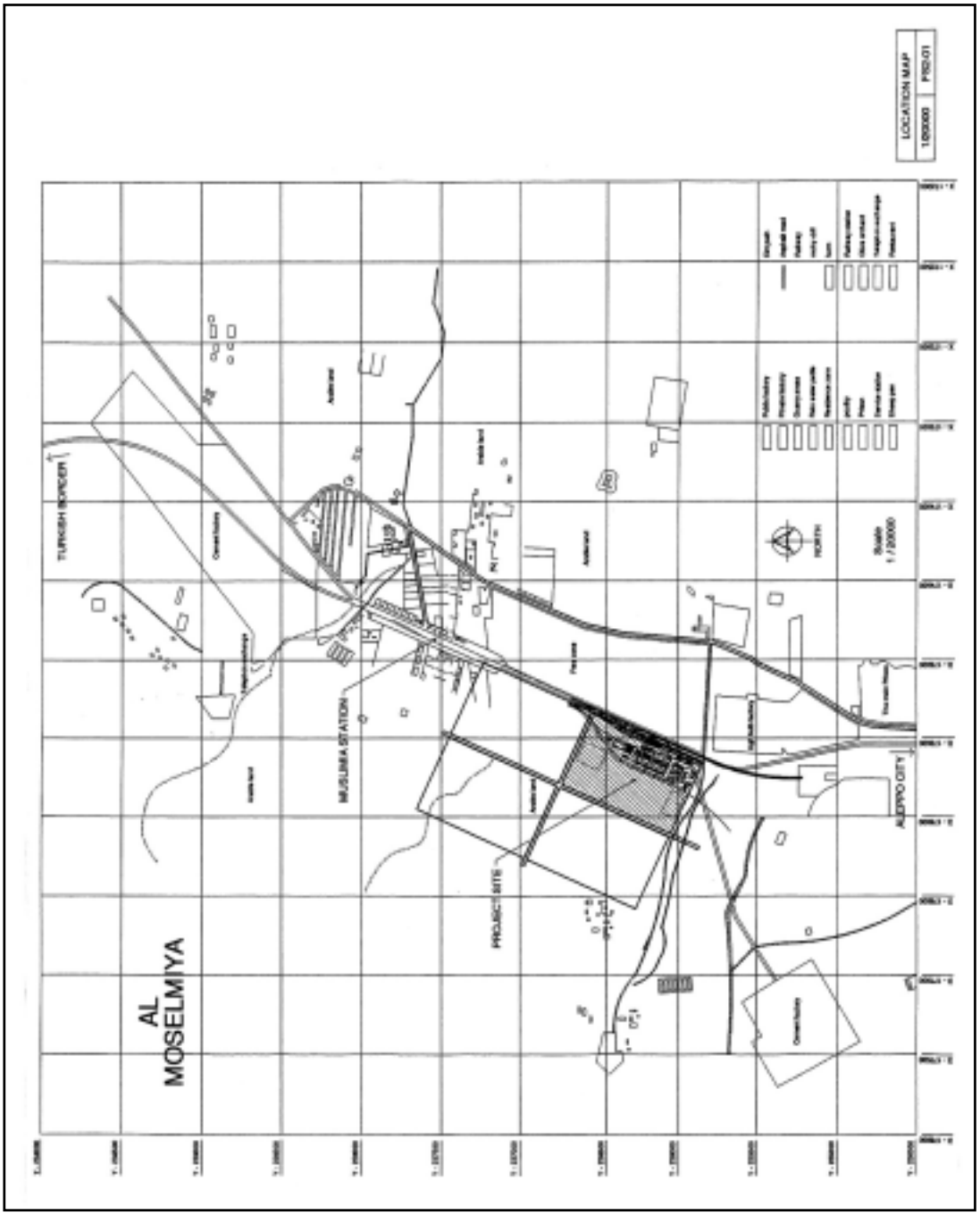


Fig 5.5.1 Location Map

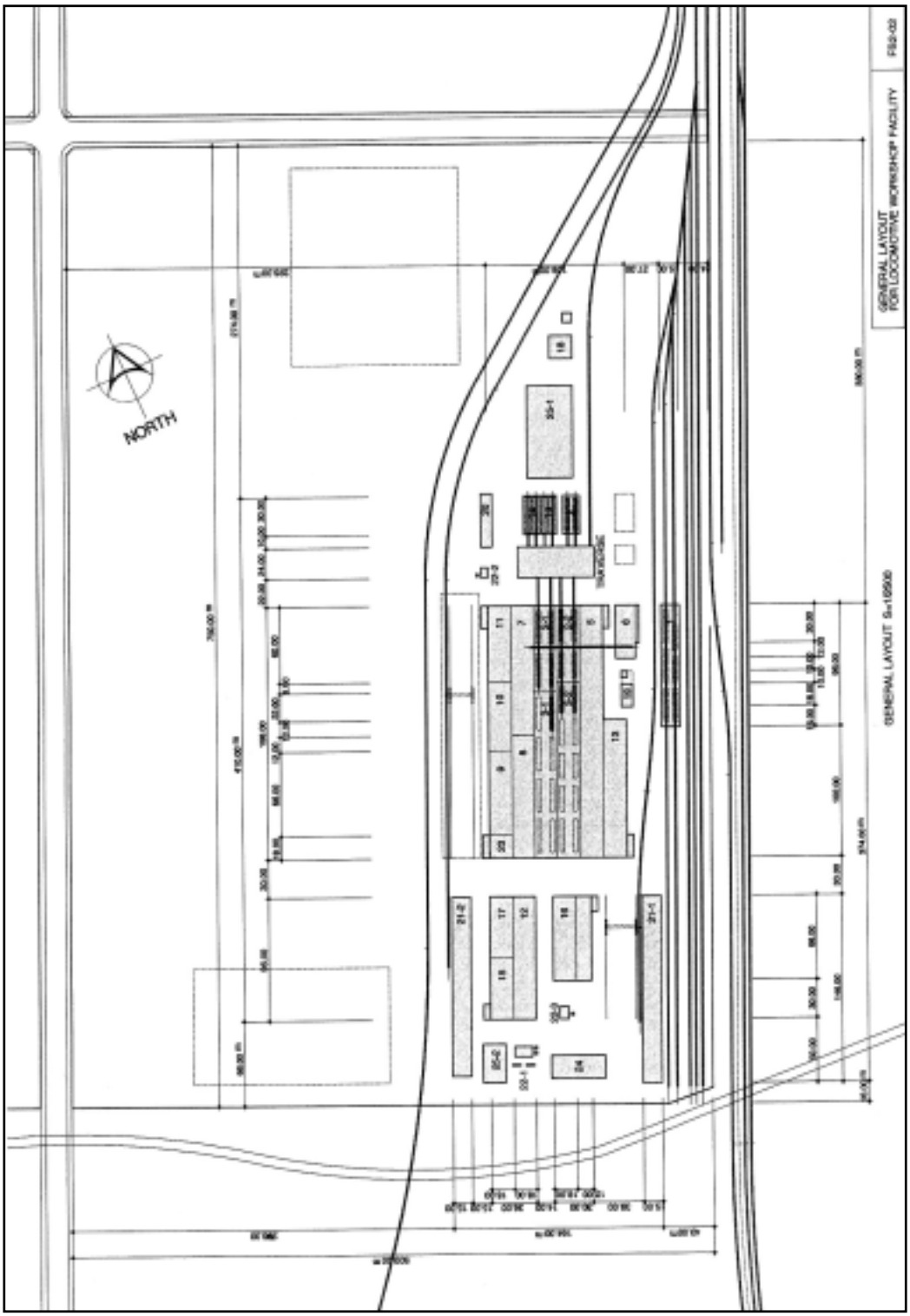


Fig 5.5.2 General Layout for Locomotive Workshop

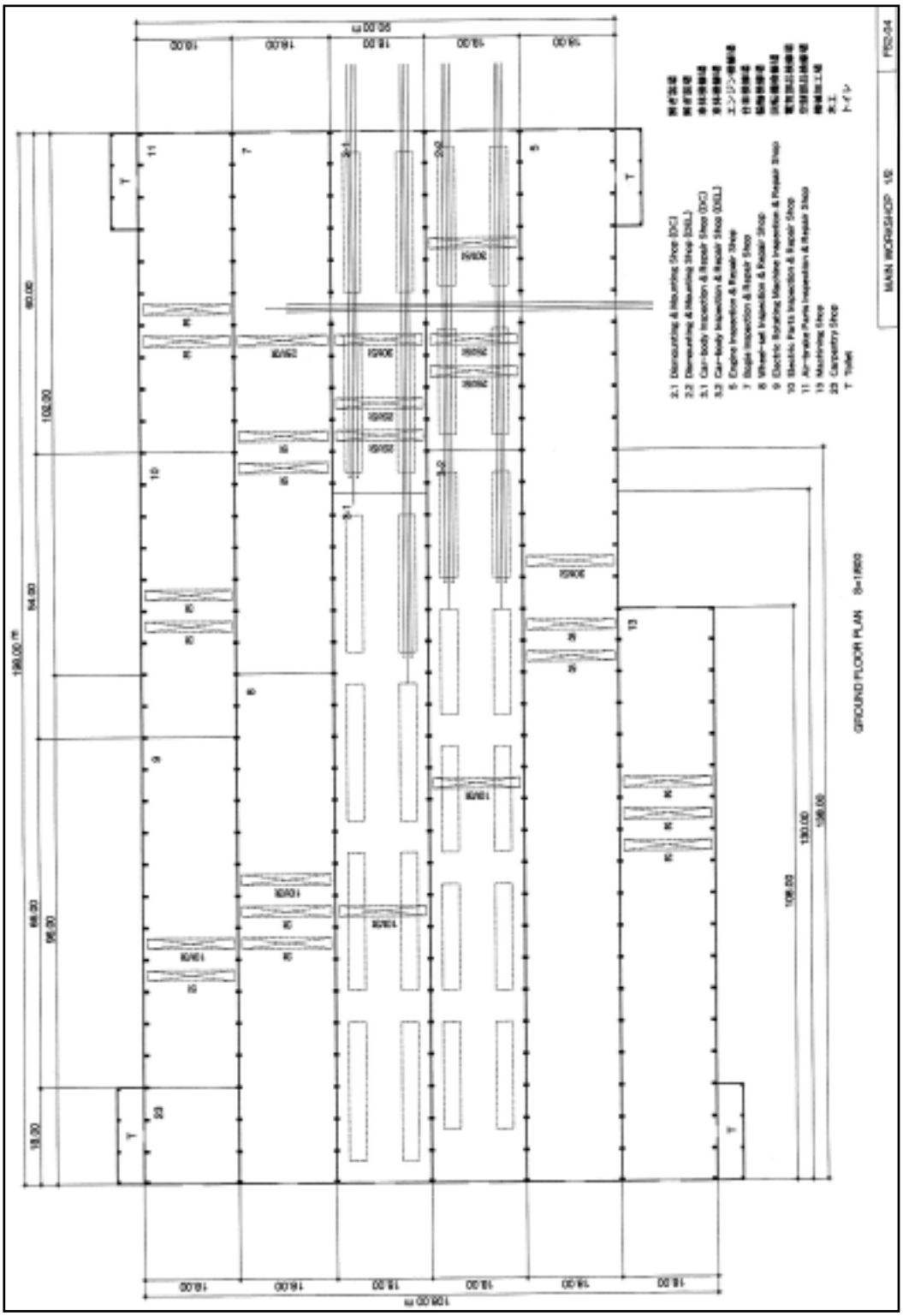


Fig 5.5.3 Main Workshop (Plan)

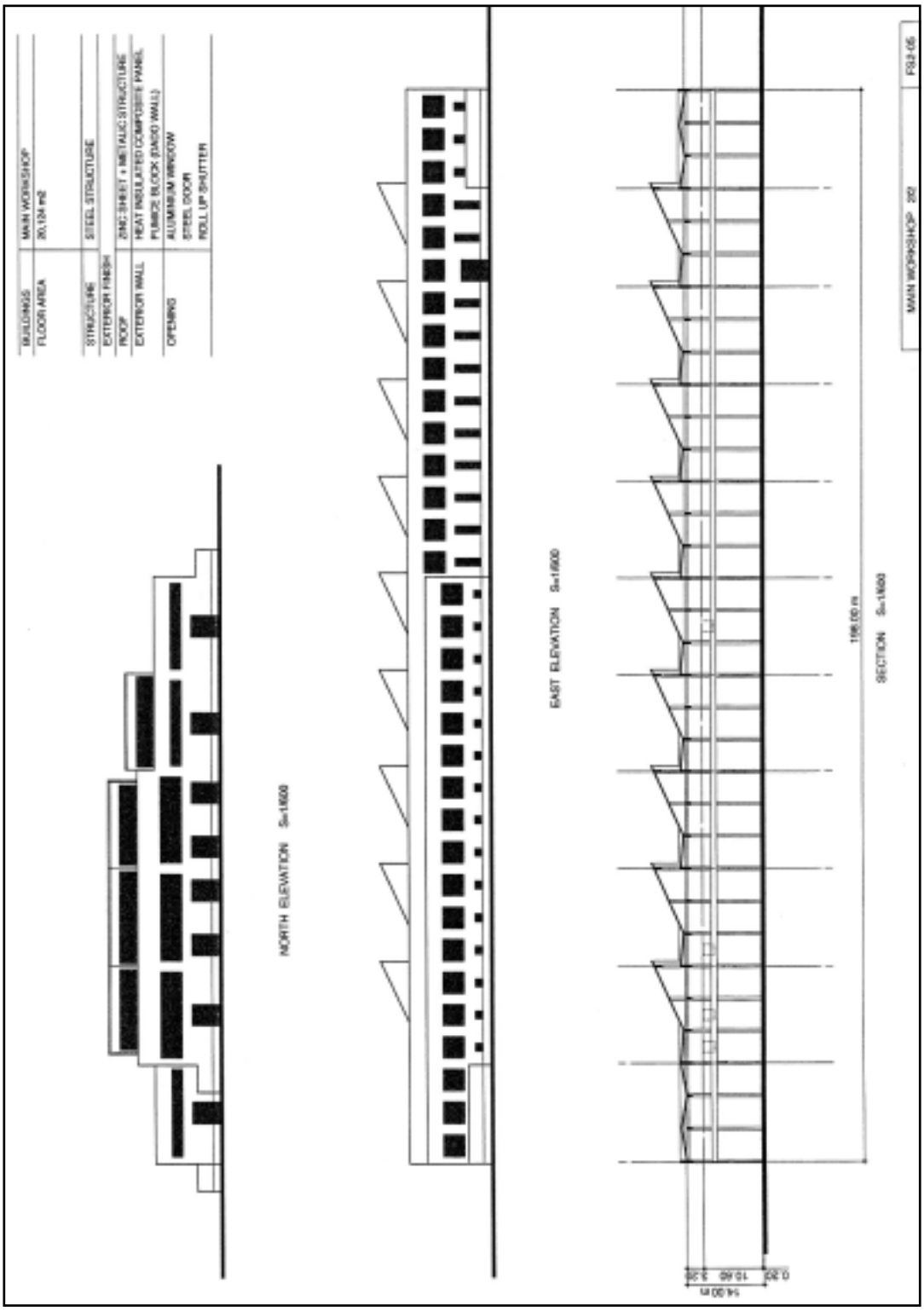


Fig 5.5.4 Main Workshop (Elevation & Section)

5.5.4 Cost estimation of structural work and finishing works

(1) Conditions for cost estimation

Conditions for cost estimation such as date of estimation, currency exchange rate, etc., are described in section 5.2.3 (1).

(2) Result of cost estimation

In this section, cost means structural works and finishing works only. The building services such as mechanical and electrical facilities for buildings are estimated in section 5.6.3.

1) Cost estimation method for structural works and finishing works.

The construction costs except for cost on the building services consist of direct construction cost and indirect construction cost as described below.

(a) Direct construction cost
- a) Architectural works (finishing work)
- b) Structural works (foundation, column, beam & girder, floor, wall etc.)
- c) External works (premise road, fence & gate, pavement, planting, etc.)

(b) Indirect construction cost
- a) Common temporary facility
- b) Supervisory and administrative expenses
- c) Field office expense
- d) Others

The indirect construction cost is assumed to be 20% to 30% of the direct construction cost.

2) Estimation method for direct construction cost

Each building and facility will be classified into Grades A, B or C taking into consideration the structure function and type. Construction cost per square meter differs according to the function of each building such as factory, administration building, storehouse etc. and structural type such as steel structure or reinforced concrete structure.

Data collection surveys were conducted on the unit costs of structural materials (such as cement, sand, reinforcing steel and structural steel, etc.), finishing materials (such as aluminum window/door frames, glass, plywood and paint, etc.), plumbing materials (such as pipes, ducts and sanitary ware, etc.) and electrical materials (such as electric wires, receptacles and lighting equipment, etc.) and also on the ongoing wages of engineers, reinforcing bar placers and tiles, etc. and their productivity using a questionnaire. In addition, reference materials were obtained from construction companies and architectural design office in Damascus city and Aleppo city. Interviews were conducted with people working for these companies. During the interviews, the construction cost was classified into three different building grades.

The cost per unit floor area includes the direct construction cost (including the cost of finishing work, structural work and exterior work), indirect construction cost, various expenses, overhead, profit and taxes, etc.

As described above, the construction cost is the sum of the direct construction cost, indirect construction cost, engineering service cost. The method used to estimate the direct construction cost, which accounts for a large part of the construction cost, is described next.

Firstly, the preliminary design was conducted for the workshop, and the plans, elevation, cross-section and finishing schedule were prepared for each building. Using these plans and finishing schedule, the estimated construction cost of each component of the planned buildings was classified into one of four grade categories (Grade A = 35,100 SP/m^2, Grade B = 27,300 SP/m^2, Grade C = 19,500 SP/m^2 and Grade D for exterior work = 3,900 SP/m^2) depending on the function of the building.

These plans were also used to calculate the area of each building and the resulting figure was multiplied by the corresponding unit cost to establish the construction cost of each building. The cost of exterior work, involving sidewalks and landscaping, etc., was estimated using the relevant unit costs and calculated area for external work. The cost of exterior work was then added to the building cost to achieve the construction cost.

The construction cost was then divided into the direct construction cost (75%) and indirect construction cost (25%). Meanwhile, the foreign portion and local portion of the financial cost was divided into 10% and 90% respectively.

The cost estimation results for the Project based on the above-described estimation conditions are given in Table 5.5.2.

The total cost for structural works and finishing works come to 1,282.4 MSP.

Table 5.5.2 Cost estimation result for each building and facility

Name of Building	Area (m^2)	Unit cost (SP/m^2)	Cost for each building (SP)	Remarks, Grade
1. Final adjustment shop	1,440	27,300	39,312,000	Steel structure, B
2. Main workshop building	19,764	27,300	539,557,200	Steel structure, B
3. Car-body washing & air-blow shop	360	27,300	9,828,000	Steel structure, B
4. Engine performance test room	720	35,100	25,272,000	Steel structure, A
5. Iron work, spring inspection & repair shop	3,456	27,300	94,348,800	Steel structure, B
6. Car-body painting shop	780	27,300	21,294,000	Steel structure B
7. Foundry shop	2,160	27,300	58,968,000	Steel structure, B
8. Storehouse of dangerous articles	144	27,300	3,931,200	Reinforced Concrete Structure (R. C. S), B
9. Boiler room	162	27,300	4,422,600	R. C. S , B
10. Garage	378	11,700	4,422,600	Steel structure, C
11. Storehouse	4,290	9,950	42,685,500	Steel structure, C
12. Substation (1)	112	19,500	2,184,000	R. C. S., C
13. Substation (2)	40	19,500	780,000	R. C. S., C
14. Substation (3)	70	19,500	1,365,000	R. C. S., C
15. Administration Building	1,512	35,100	53,071,200	R. C. S., A
16. Canteen (1)	5,184	35,100	181,958,400	R. C. S., A
17. Canteen (2)	1,080	35,100	37,908,000	R. C. S., A
18. Shed for effluent treatment plant	150	27,300	4,095,000	R. C. S., B
19. Shed for incineration equipment	150	19,500	2,925,000	R. C. S., C
20. External work	39,500	3,900	154,050,000	D
SUB TOTAL (1～19) (20)			1,128,328,500 154,050,000	
GRAND TOTAL			1,282,378,500	

Japanese Yen：3,205,946,000（1SP=JY2.50）

5.6 Building services

5.6.1 Planning principles of building services

(1) Planning of building services for each building

The kind of major building services for each building to be planned and the order of grade as A, B and C are shown in Table 5.6.1.

Table 5.6.1 Major building services for each building

Name of building	Major building service	Grade
1 Final adjustment shop	Lighting (HID lamp), ventilator	B
2 Main workshop building	〃	〃
3 Car-body washing & air-blow shop	〃	〃
4 Engine performance test room	〃	〃
5 Iron-work, spring inspection & repair shop	〃	〃
6 Car-body painting shop	〃	〃
7 Foundry shop	〃	〃
8 Storehouse of dangerous article	Lighting (Fluorescent lamp), ventilator	C
9 Boiler room	Lighting (HID lamp), ventilator	B
10 Garage	Lighting (Fluorescent lamp), ventilator	C
11 Storehouse	〃	〃
12 Substation (1)	〃	〃
13 Substation (2)	〃	〃
14 Substation (3)	〃	〃
15 Administration building	Lighting (Fluorescent lamp), air-conditioner, ventilator, communication and water/sewage	A
16 Canteen (1)	〃	〃
17 Canteen (2)	〃	〃
18 Shed for effluent treatment plant	Lighting (Fluorescent lamp), ventilator	C
19 Shed for incineration equipment	〃	〃

(2) Planning of external facility services

The external facility services to be planned are as follows:

1) Electricity incoming and supply facilities
   a) 66/20kV substation (to be extended to the existing 66kV substation which is located about 7 km south of the Project Site)
   b) 20/6.6kV substation (receiving substation)
   c) 6.6kV/400-230V substation (for Main Workshop)
   d) 6.6kV/400-230V substation (for Foundry Workshop)
   e) 20kV transmission lines (2 circuits)
2) Outdoor Lighting Facility
3) Telephone Incoming Facility
4) Water Supply, Water Drainage and Fire Fighting Facility

a) Water supply facility

b) Water drainage facility

c) Fire fighting facility

(3) Planning of procurements for building services

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

5.6.2 Outline design of building services

(1) Planning of building services for each building and external facility services

1) Electricity incoming and supply services

(a) Applicable standard

For planning of electricity incoming and supply facilities, the following international standards such as IEC and ISO are used in Syria.

a) International Electro Technical Commission (IEC): applied to the main functions of electrical goods in general

b) International Organization for Standards (ISO): applied to evaluate the performance of industrial products in general

(b) Condition of electrical system

For planning of electrical system, the following standards used in Syria are applied.

a) Voltage and wiring method

66kV	(3 phase 3 wire)	50Hz
20kV	(3 phase 3 wire)	50Hz
6.6kV	(3 phase 3 wire)	50Hz
380/220V	(3 phase 4 wire)	50Hz
100V	(direct current)	50Hz

b) Neutral earthing method

66kV	: direct earth
20kV	: direct earth
6.6kV	: non earth

380/220V : direct earth

(c) Incoming and supply system

a) Incoming system

The 66kV and 20kV substation equipment are additionally installed in the existing 66kV substation, which is located about 7 km south of the Project Site.

The electricity is supplied by two (2) circuits of 20kV transmission line from the said existing 66kV substation to the 20/6.6kV receiving substation in Muslimia Workshop.

According to the electricity supply code in Syria, 20kV-incoming voltage is applied to less than 5MVA of maximum demand and 66kV incoming voltage is applied to over 5MVA of maximum demand. Since the maximum demand in Muslimia Workshop is estimated as 5MVA, the incoming voltage is applied to 20kV in accordance with the said code.

b) Supply system

The 20kV and 6.6kV indoor type metal-enclosed switchgear cubicles are installed in the 20/6.6kV receiving substation. Also, DC 110V batteries for the control and operation of switchgear cubicles are installed in the battery room in the said substation.

The step-down transformers from 22kV to 6.6kV are installed outside of the 20/6.6kV receiving substation. On the said transformer, on-load tap changer (OLTC) is furnished to keep rated voltage adjusting fluctuation automatically due to changeable load demand.

These two (2) transformers are operated in parallel and their capacity meets the demand of this workshop until the year 2020. A new transformer will be provided for the future demand after 2020.

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

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

(d) Main line facility

The interconnection cables among substations are armored cables and directly buried in the ground.

(e) Emergency power generation unit

The emergency power generation unit is not provided since the incoming and supply of electricity is reliable. Even if power failure occurs, as a safety precaution, the employees are able to escape from the building since the emergency lighting lamps are equipped with batteries.

2) Lighting facility

a) Indoor lighting facility

The expected average luminous intensity is given below for the main rooms, which is generally used in Syria.

- Workshop, electrical room : 30～150 lux
- Office : 150～300 lux
- Locker room, toilet : 30～150 lux
- Storage : 30～75 lux

Generally, the fluorescent lamps mounted on the wall or ceiling are provided in the room. However, the HID (high intensity discharge) lamps such as mercury vapor lamps are provided in the workshop where the ceiling is high. For the maintenance and changing of bulbs, the manual operated unloading and/or lifting facility is provided in the workshop. The on/off switch circuit is provided as much as possible in order to improve energy saving.

b) Indoor emergency lighting facility

The fluorescent lamps equipped with battery turn on at the instant of power failure. After power failure is restored, the battery is automatically charged. The emergency fluorescent lamp is provided in the room, corridor and stairs from the room to outside. The expected average luminous intensity is about 1 lux.

c) Emergency guiding lamp facility

The emergency guiding lamp is provided at the emergency doors in the room. The fluorescent lamps equipped with battery turn on at the instant of power failure. After power is restored, the battery is automatically charged.

d) Outlet facility

The allocation of outlets mounted on the wall in the room is two (2) for about every $25m^2$ area. An outlet with earthing is provided for the shower room and kettle room. The waterproof type outlet is provided for toilet.

e) Outdoor lighting facility

For crime prevention, the pole mounted mercury vapor lamp is provided for about 30 ～50m pitch in the premises. The photocell switch of automatic on/off is provided for each lighting pole in order to save manpower.

3) Communication and fire prevention facility

(a) Telephone facility

The telephone line is incoming from the exchange station located about 1.2 km north of the Project Site, which will start operation in 2001. The subscriber lines for this workshop are provided in the said station. The main distribution frame and private branch exchanger are installed in the office room. The numbers of telephone lines are as follows:

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

(b) Electrical clock facility

A master and secondary electrical clock system, which is easily maintained and managed, is provided. The master clock is installed in the office room and the second clock mounted on the wall is provided in the major rooms.

(c) Paging facility

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

(d) Automatic fire detection and alarm facility

Each building is split into 500m^2 floor area, and each building is equipped with heat detector or smoke detector in relation to the room height. A main fire alarm panel is installed in the office room. A fire alarm panel with a bell, red lamp and push button is installed in each building.

4) Lightning protection facility

The lightning protection is designed in accordance with the Japanese Architectural Standard. Lightning rods are installed on the building and elevated water tank. Also installed are test terminal box, signboard showing the location of earth electrode.

5) Water supply, water drainage and fire fighting facility

(a) Water supply facility

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

Water shall be supplied from the said pumping station to the underground water tank in the premises of the Project Site by main zinc coated steel piping of 150mm diameter. Water will be supplied from the elevated water tank to the building services and workshop equipment by gravitation.

Water demand for building services and workshop equipment use is estimated as 100m^3 per day, and accordingly the capacity and type of underground water tank and elevated water tank is designed as follows: (In addition, for drinking water, 20 liters of bottled mineral water is provided in the office room and workshop.)

a) Underground water tank

A 300m^3 reinforced concrete underground water tank, which is capable of supplying water for three (3) days, is provided in the ground.

b) Elevated water tank

A 100m^3 stainless water tank, which is capable of supplying water for one (1) day, is provided on the top of the steel tower, which is 10 m above the ground.

(b) Water drainage facility

The water drainage system is separate for the building services and industrial wastewater containing used oil. Wastewater from the building services directly flows into the sewage tank. On the other hand, industrial wastewater is divided into wastewater and used oil at the oil/water separator, and after that the wastewater flows to the sewage tank.

Wastewater flows inside concrete pipe and is buried in the ground from the said sewage tank to the existing main sewage pipe, which is located about 1.5km south of the Project Site.

(c) Sanitary facility

Arabic and European type sanitary fixtures are provided in the toilets. The capacity of the septic tank is estimated as 50m^3/day based on some 1,000 persons (1,000 persons × 50 liters/day ＝ 50m^3/day).

(d) Fire fighting facility

When a fire breaks out, employees in the vicinity of the fire origin shall put out the fire quickly using fire extinguishers (ABC powder type) provided in the rooms. In addition, the following water fire fighting facility is provided in order to check the spread of fire in the buildings.

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

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

The design criteria for HVAC is as follows:

The room temperature (dry bulb) is designed based on outdoor temperature (dry bulb) as follows:

(a) Design condition

Summer season:	Indoor temperature	(27℃ DB)
	Outdoor temperature	(35℃ DB)
Winter season:	Indoor temperature	(20℃ DB)
	Outdoor temperature	(7℃ DB)

(b) Design criteria

a) Air conditioning facility

For cooling during the summer and heating during the winter, air-conditioning facility is provided in the managers' rooms and office rooms. The type of air-conditioner is air-cooled, heat pump and packaged type.

b) Ventilation facility

The design criteria for the ventilation facility for each building or room is as follows:

Name of building or room	Method of air intake	Method of air exhaust
Workshop Building	Louver	Ventilator
Substation Building	Supply fan	〃
Storehouse	Door louver	〃
Office	〃	〃
Canteen	〃	〃
Toilet	〃	〃
Rocker	〃	〃

7) Hot water supply facility

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

(2) Basic design drawings

Single line diagram showing incoming/supply of electricity and water supply/drainage which are most important for building services in this Project are attached hereinafter.

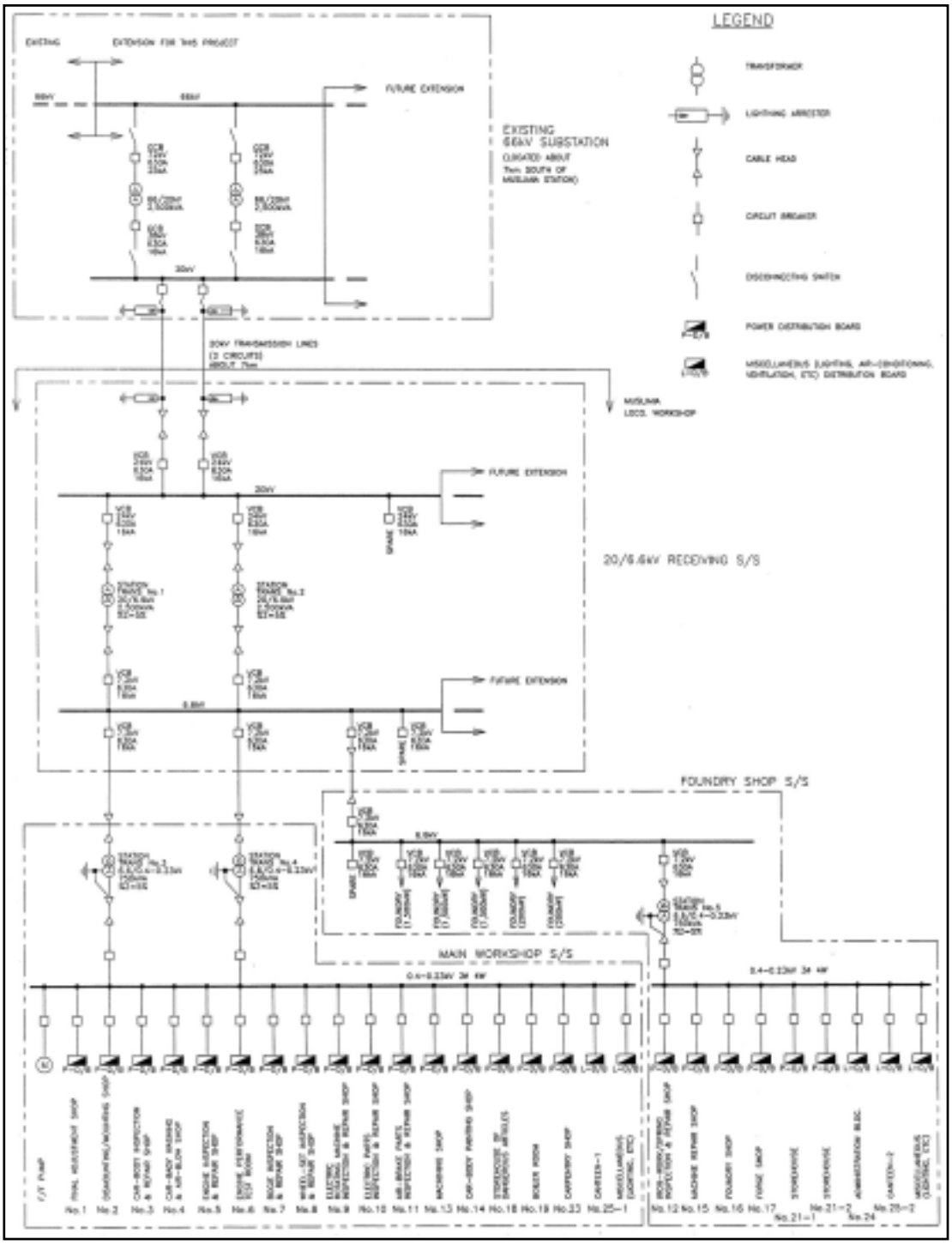


Fig. 5.6.1 Single Line Diagram

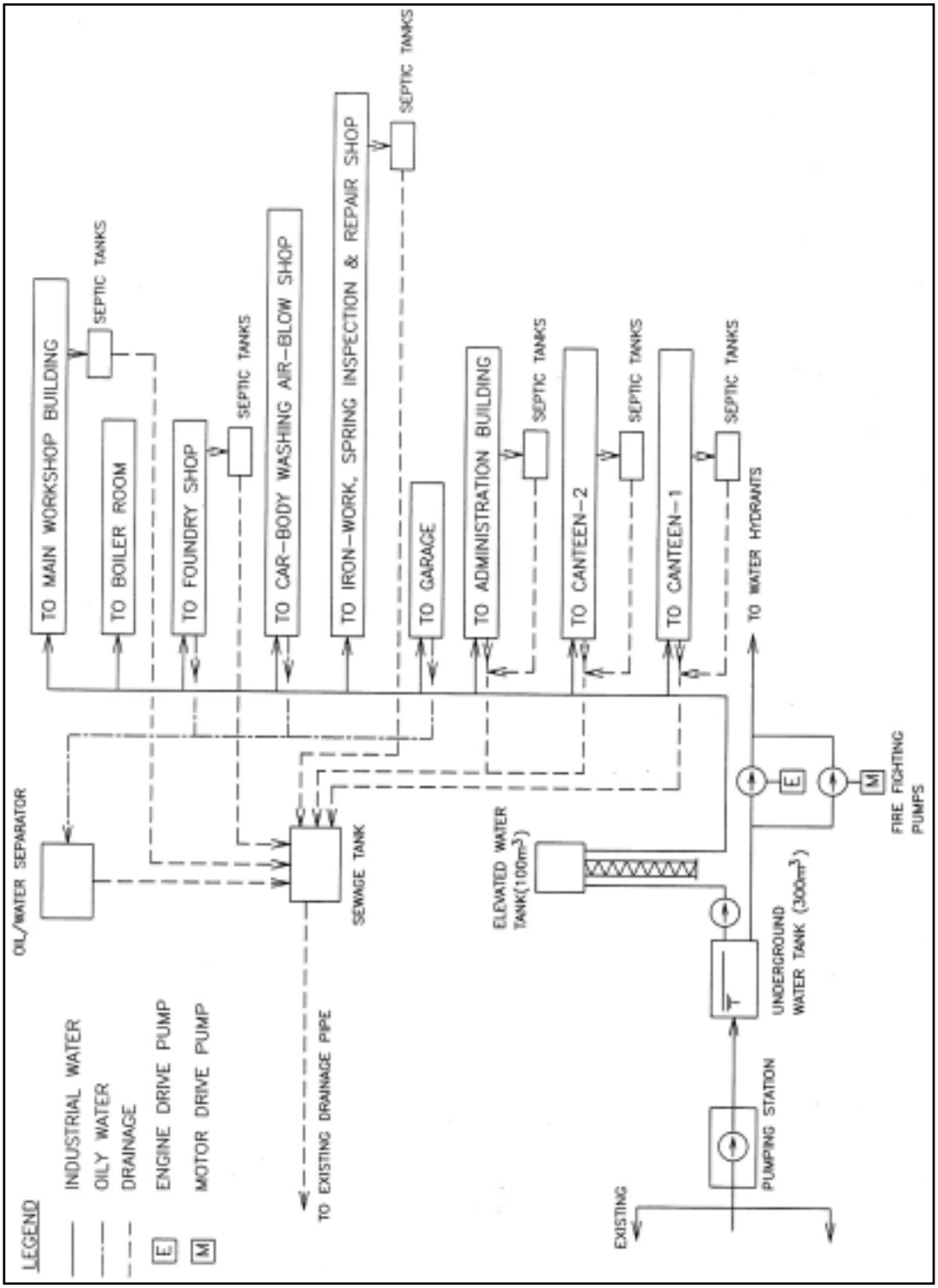


Fig. 5.6.2 Water Supply/ Drainage System

5.6.3 Construction cost estimation

(1) Condition of cost estimation

The conditions for the cost estimation are described in section 5.5.4.

(2) Result of cost estimation

The cost of building services is estimated in this section.

The cost of building services is classified into the building services for each building and the external facility services as follows:

1) Cost of building services for each building

The cost of building services for each building is estimated by the unit price construction cost per floor area classified into grades A, B and C multiplied by floor area.

2) Cost of external facility services

The cost of external facility services except substation equipment is estimated on the basis of use of local products.

The cost of substation equipment is estimated on the basis of use of European products.

The installation cost of external facility services is estimated based on personnel expenses surveyed in Syria.

Thus, the cost of building services and external facility services is shown in Table 5.6.2.

The total cost is SP 617,254,000 (Japanese Yen 1,543,135,000).

Table 5.6.2 Cost estimation result for building services and external facility services

Name of building	Area (m^2)	Unit cost per m^2 (SP/ m^2)	Cost for each building (SP)	Grade
1 Final adjustment shop	1,440	8,000	11,520,000	B
2 Main workshop building	19,764	8,000	158,112,000	〃
3 Car-body washing & air-blow shop	360	8,000	2,880,000	〃
4 Engine performance test room	720	8,000	5,760,000	〃
5 Iron-work, spring inspection & repair shop	3,456	8,000	27,648,000	〃
6 Car-body painting shop	780	8,000	6,240,000	〃
7 Foundry shop	2,160	8,000	17,280,000	〃
8 Storehouse for dangerous articles	144	4,000	576,000	C
9 Boiler room	162	8,000	1,296,000	B
10 Garage	378	4,000	1,512,000	C
11 Storehouse	4,290	2,042	8,760,000	〃
12 Substation (1)	112	4,000	448,000	〃
13 Substation (2)	40	4,000	160,000	〃
14 Substation (3)	70	4,000	280,000	〃
15 Administration building	1,512	12,000	18,144,000	A
16 Canteen (1)	5,184	12,000	62,208,000	〃
17 Canteen (2)	1,080	12,000	12,960,000	〃
18 Waste water treatment room	150	4,000	600,000	C
19 Incinerator	150	4,000	600,000	〃
20 External facility services	-	-	280,270,000	-
Sub Total (1～19) (20)			336,984,000 280,270,000	
Grand total			617,254,000	

5.7 Operation and maintenance for the workshop facility

5.7.1 Required manpower and maintenance cost for workshop buildings

The required manpower for maintenance of workshop buildings (excluding building services mentioned in 5.7.2) is two (2) persons.

(1) Estimated annual maintenance cost for workshop buildings

1) Personnel expenses
(75$/M x 46SP) x12M x 2 ＝ 82,800SP

2) Building repair cost (including material procurement)
(500$/M x 46SP) x 12M ＝276,000SP

Total 358,800SP

The annual maintenance cost mentioned above is applied for the period between years 2006 year (commencement of operation) to 2009. In addition, taking into consideration inflation in the future, the annual cost will increase two (2) times during the period of 2010 and 2014 and three (3) times from 2015 to 2020.

5.7.2 Required manpower and cost for building services

The basic organization of operation and maintenance for building services is as follows:

(1) Organization of operation and maintenance

The building services are classified into the following electrical and mechanical facilities. Two (2) experts in cooperation with electrical and mechanical experts execute the operation and maintenance work.

The said experts execute daily and periodical inspection in accordance with the operation and maintenance manual issued by each manufacturer. However, in case of operation and maintenance beyond the technical level of the said experts or major equipment troubles, engineers from the manufacturer are called in order to solve these problems.

1) Electrical facility
(a) Electricity incoming and supply facilities

(b) Lighting facility
(c) Communication and fire prevention facility
(e) Lightning protection

2) Mechanical facility
(a) Water supply, water drainage and fire fighting facility
(b) Heating, Ventilation and Air conditioning facility
(c) Hot water supply facility

(2) Spare parts procurement plan

Availability of spare parts to replace aged parts are required in order to safely operate facilities of building services. The cost for procurement of the spare parts should be appropriated in the budget every year.

(3) Estimated annual operation and maintenance cost for building services

After completion of the workshop construction in 2005, annual operation and maintenance cost should be allocated as follows:

1) Personnel expenses

The annual personnel expenses for two (2) persons are estimated as follows:

(75$/M x 46SP) x 12M x 2 ＝ 82,800SP

2) Expense of utilities

The annual expenses of utilities (electricity and water) are estimated as follows:

(a) Electricity
5,000kW x 2.4SP/kWh x 7hours x 317days ＝26,628,000SP
(b) Water
100m^3/day x 5SP/ m^3 x 317days ＝158,500SP
(c) Telephone
1,000SP/M x 12M ＝12,000SP

3) Repair cost of building services

The annual repair cost including procurement of spare parts is as follows:

(2,000$/M x 46SP) x 12M ＝1,104,000SP

Total 27,985,300SP

The annual maintenance cost mentioned above is applied in the period of 2006 (commencement of operation) to 2009 year. In addition, taking into consideration the inflation in the future, the annual cost will increase two (2) times during the period of

2010 and 2014 and three (3) times from the year to 2015 to 2020.

5.8 Track plan of workshop

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

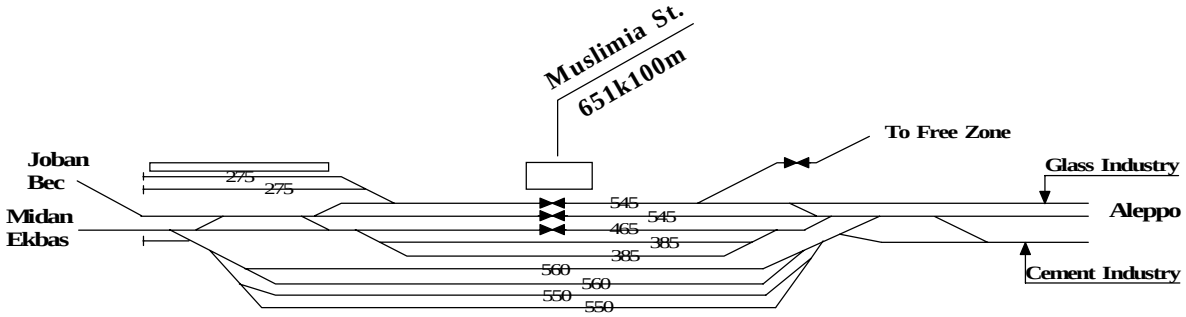


Fig. 5.8.1 Sketch of Musulimia station track layout

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

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

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

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

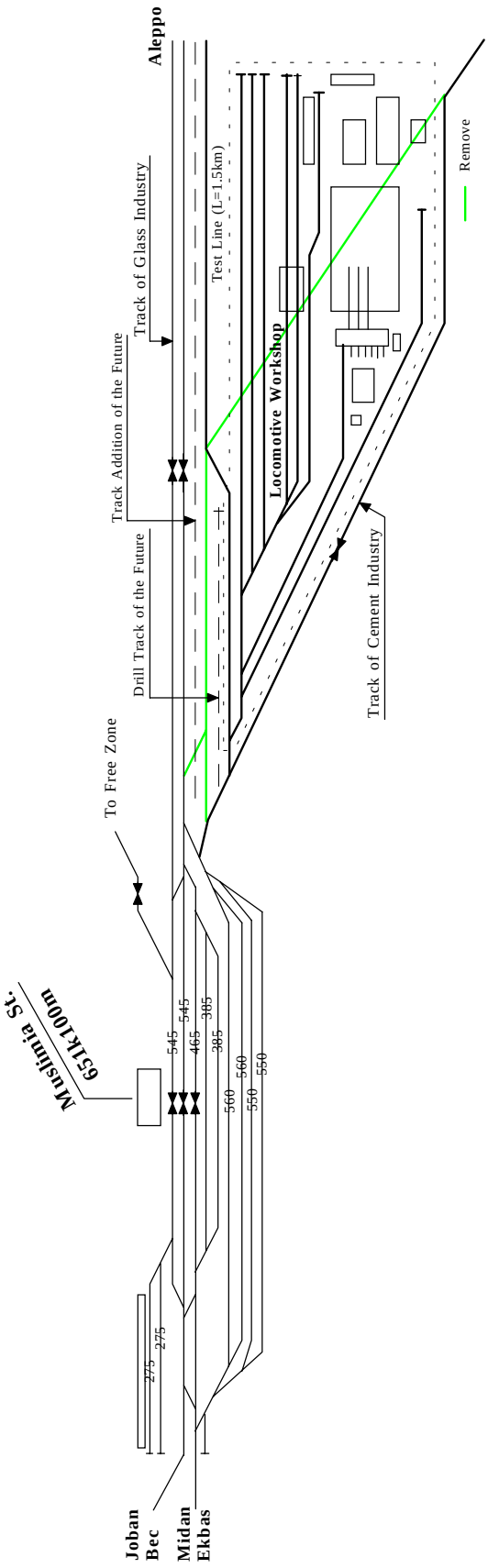


Fig.5.8.2 Sketch of Muslimia St. and Loco. Work shop Layout

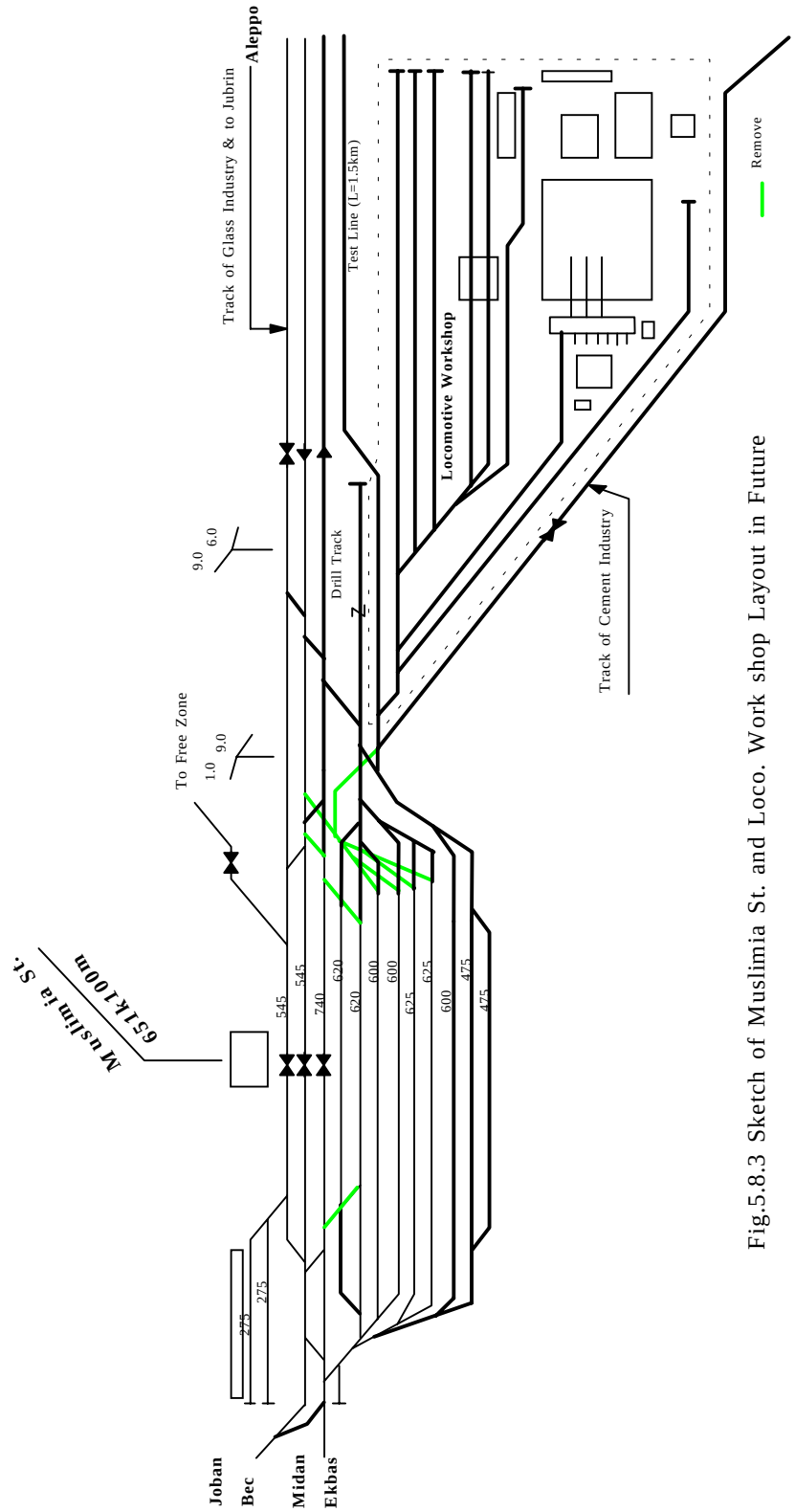


Fig.5.8.3 Sketch of Muslimia St. and Loco. Work shop Layout in Future

5.9 Construction cost

The construction cost is as in Table 5.9.1 “Construction cost estimation”.

Table 5.9.1 Construction cost estimation

Unit;1,000SP

Item		Construction cost		
		FC	LC	Total
Construction of new work shop	Land		37,500	37,500
	Civil works	106	228,249	228,355
	Track work	118,449	67,003	185,452
	Building	112,835	1,015,513	1,128,348
	Building services	44,127	353,600	397,727
	External work	15,405	138,645	154,050
	Substations	205,138	14,391	219,529
	Mechanical work	4,783,867	299,504	5,083,371
	Measuring instrument・tool work	233,966	14,975	248,941
	Sub total	5,513,893	2,169,380	7,683,273
Engineering fee (5%)		384,164		384,164
Contingency (5%)		294,903	108,469	403,372
Total		6,192,960	2,277,849	8,470,809

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

The study team took several items discussed with them during the site study and in the document in succession, into consideration in preparing the Final Report.

5.10.1 Extension of the inspection cycle for main line locomotives and the increase in number of shunting locomotives.

(1) The study team examined whether the workshop planned in the Draft Final Report which is capable to execute the periodic inspection of DL fleet shown in Table 4.1.3 could cover those of the increased number of DLs shown in Table 5.10.2.

1) With respect to the extension of the inspection cycle for main line DLs, Case 3 in Table 5.10.1 and Fig. 5.10.1 was assumed in consideration of, for example, M6 in 1,200,000 km and 1,400,000 km or so. The inspection cycles in Case 1, Case 2 and Case 3 are shown in Table 5.10.1 and Fig. 5.10.1, designating those in Fig. 4.1.1 as Case 1 and Case 2.

Table 5.10.1 Inspection cycle for main line DLs

M / Case	M5	M6	Remark
Case 1	300,000	600,000	Fig 4-1-1 (2006～2019) Cycle in M6, M5, M6, M5, ------
Case 2	450,000	900,000	Fig 4-1-1 (2020～) Cycle in M6 M5, M6, M5, ------
Case 3	450,000	1,350,000	Cycle in M6, M5, M5, M6, M5, M5 ------ (2015～)

Not; Case 1 and Case 2 are same as those in Draft Final Report, respectively.

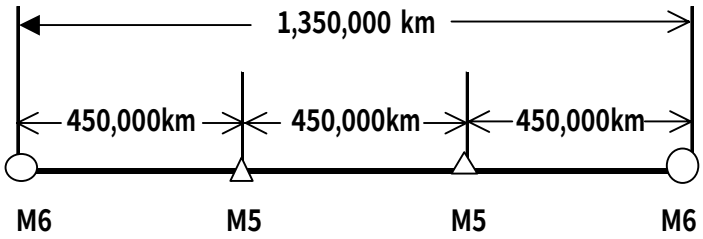


Fig. 5.10.1 Inspection cycle (Case 3)

2) With respect to the increase in number of shunting DLs, the study team estimated them at 30% of main line Dls rounded by unit five, and the necessary number of shunting DLs are shown in Table 5.10.2.

Table 5.10.2 Number of DLs (Increased in shunting Dls)

(unit Car)

DL \ year	2005	2010	2015	2020
Main line	80	115	185	285
Shunting	25	35	55	85
Total	105	150	240	370

Note; The number of shunting DLs is increased in 2015 and 2020, compared with those in Fig 4.1.1, and in 2005 and 2010, opposite.

3) In case that the inspection cycle in Table 5.10.1 and Fig. 5.10.1 are applied to the DL fleets in Table 5.10.2, the number of DLs to be inspected which correspond to those in Table 4.1.3 and Table 4.1.4(1)～(3) are shown in Table 5.10.3 and Table 5.10.4, respectively .

Only the numbers in 2015 and 2020 were examined, since the total number of DLs in Table 5.10.2 will be larger than those in Table 4.1.3 in these years.

Table 5.10.3 Number of DLs to be inspected

(For planning of workshop building, facilities and equipment)

	Case 1	Case 2,3	
	2015	2015	2020
Main line (M5+M6)	122 (128)	81	125
Shunting (M5+M6)	21	21	33
Total	143 (149)	102	158
Total/144	1 (1.03)	0.71	1.10

Note; 1) 144 is the total number of DLs to be inspected in 2015 in Table 4.1.3. (The base for capacity)

2) Figures in parentheses correspond to 128 in 2015 in Table 4.1.3.

Table 5.10.4 Number of DLs to be inspected

(For planning of maintenance system in workshop)

	Case 1	Case 2,3	
	2015	2015	2020
Main line (M5+M6)	58	49	65
Shunting (M5+M6)	15	15	32
Total	73	64	97
Total/144	0.51	0.44	0.67

Note: The same as 1) of the above table

4) The workshop capacity of building, facilities and equipment etc. for DL repairs are planned, based on the yearly 144 DLs to be inspected, and consequently the ratio of total number of DLs to be inspected to 144 in Table 5.10.3 and Table 5.10.4 will show the capability which could cover those in respective years.

Judging from those in the tables, it would be possible for the planned workshop to

cover the inspection of DLs with some allowance, even in case that inspection cycles for main line DLs are extended to those in Case 3, and the number of shunting DLs is increased as those in Table 5.10.2.

(2) According to the increase in number of shunting DLs in 2015 and 2020, the necessary brake shoes to be cast will increase by about 9 % in 2015 and 15% in 2020.
On the contrary, they will be decreased by about 9 % in 2006. In 2010, they will result in no difference.

(3) Staffing in the workshop will be changed, due to the above change in the inspection cycles and the numbers.
Detailed examination will be recommended to be carried out at the implementation stage of the project.

5.10.2 Enforcement of two-day off per week

In case that the system of two-day off per week will be enforced, the standard process in Fig. 4.1.3 and Fig. 4.1.4 will have to include one day off a week within them, and staffing or working hours per day will have to be changed for that purpose.

5.10.3 Extension of rails in Dismounting/mounting shop for DLs

The rails of the dismounting / mounting tracks in the shop will be extended by the length for DLs staying, for repair of two broken DLs by accidents or so.

Chapter 6

Project Implementation Schedule

Chapter 6 Project Implementation Schedule

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

6.1 Implementation schedule

Implementation schedule is shown in Fig 6.1.1.

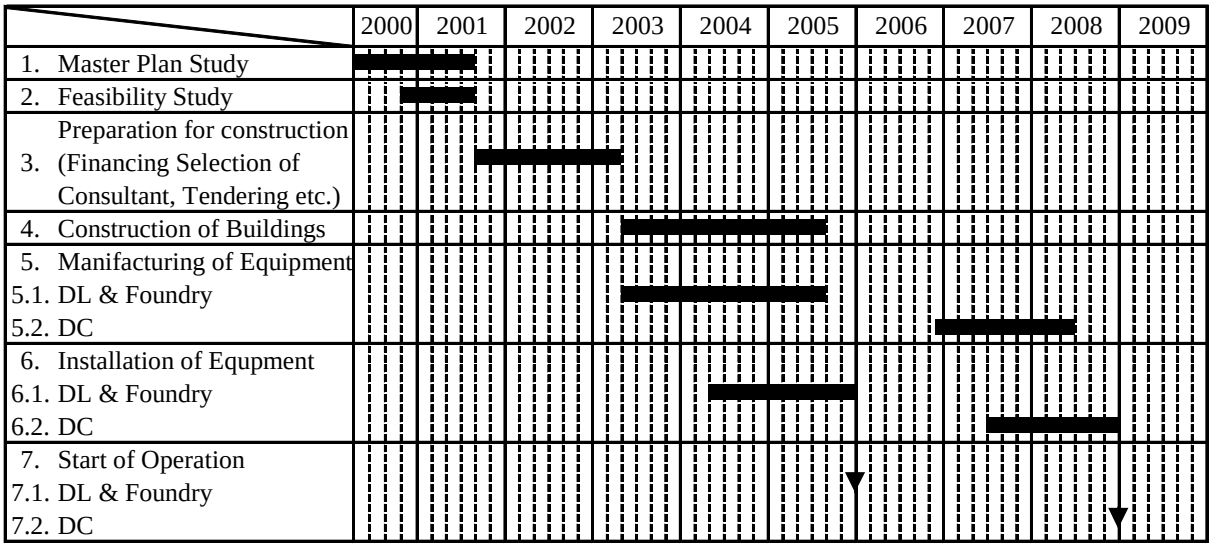


Fig 6.1.1 Implementation schedule

6.2 Amount of investment

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

Table 6.2.1 Annual cost of construction work (Excluding contingency)

Unit: million SP

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

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

Chapter 7

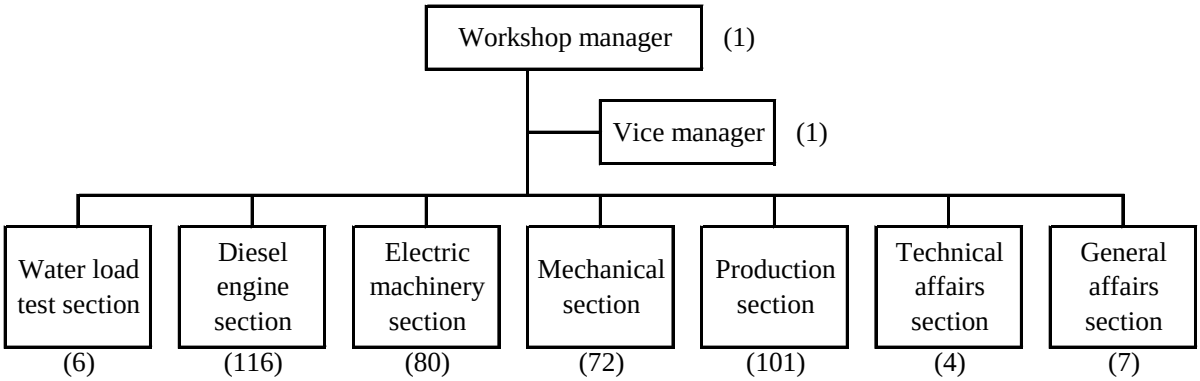
Management and Operation Plan of Workshop

Chapter 7 Management and Operation Plan of Workshop

7.1 Organization and personnel

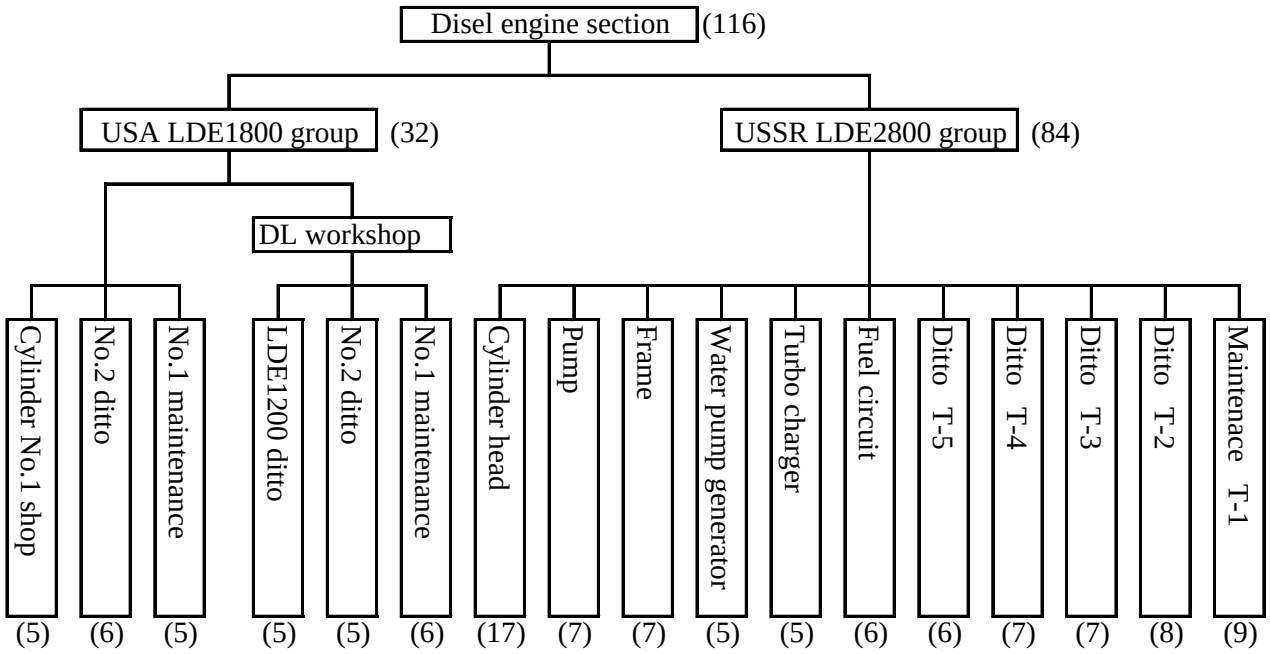
(1) Current situation of Jubrin locomotive workshop (As of Dec. 2000)

1) Organization and personnel are shown in Fig. 7.1.1 (1)~(5).



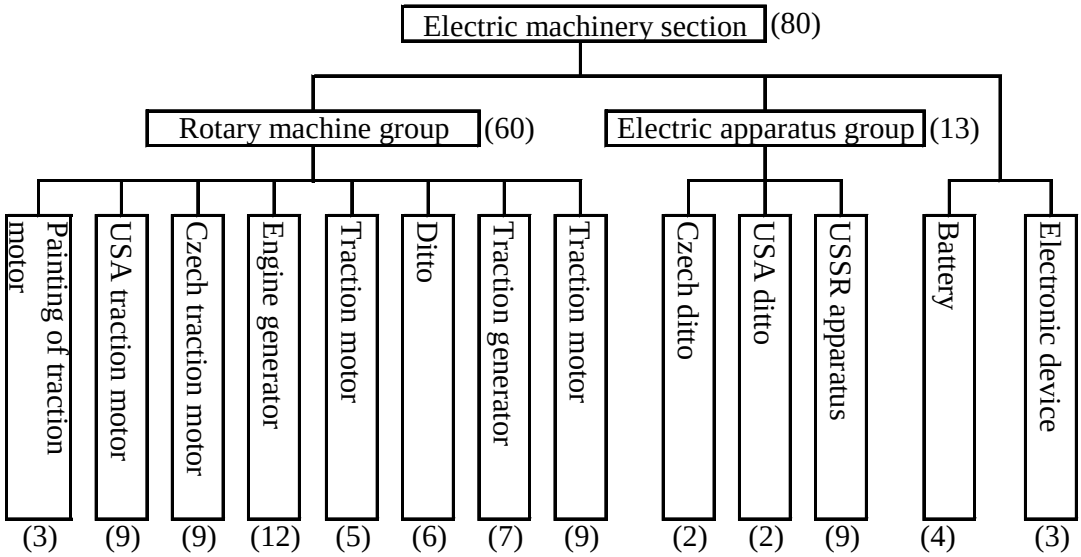
Note: Number of personnel in parentheses, total 388.

Fig. 7.1.1 (1) Organization and personnel of Jubrin locomotive workshop



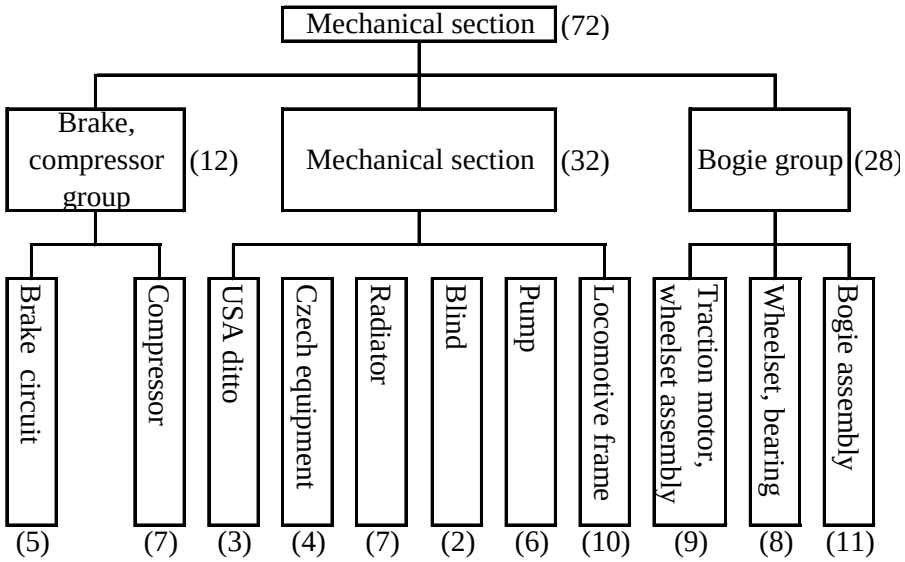
Note: Number of personnel in parentheses, total 116

Fig. 7.1.1 (2) Organization and personnel of Diesel engine section



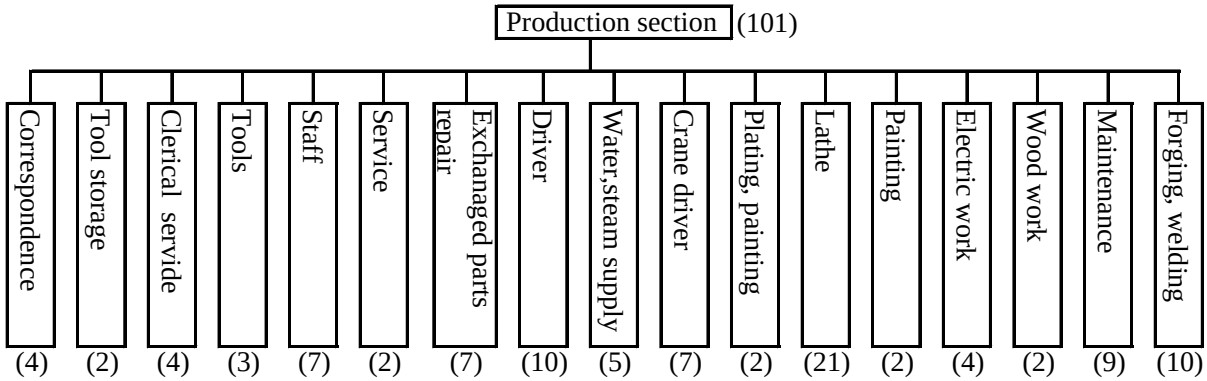
Note: Number of personnel in parentheses, total 80.

Fig. 7.1.1 (3) Organization and personnel of electric machinery section



Note: Number of personnel in parentheses, total 72.

Fig. 7.1.1 (4) Organization and personnel of mechanical section



Note: Number of personnel in parentheses, total 101.

Fig.7.1.1 (5) Organization and personnel of production section

2) Working hours

Daily working hours on one shift are shown in Table 7.1.1.

Table 7.1.1 Daily working hours.

	Start of work	Breakfast break	Finish of work	Shop-out	Daily working hours
Ordinary period	8:00	10:00～10:30	12:45	13:30	4hours 15minutes
Ramadan	8:00	－	11:45	12:30	3hours 45minutes

Note: In ordinary period, 20 to 60 workers work until 15 o'clock if necessary, and number of workers are up to the situation of work.

(2) New maintenance workshop

1) Organization and division of duties

Organization and division of duties would be as shown in Fig.7.1.2, referring to those of Jubrin locomotive workshop. In their planning, the following items would be stressed.

- Two workshop vice managers are allocated, one in charge of DL, and the other DC and brake shoes casting.

- Although sections are not divided into small groups here, it would be desirable to divide them into the groups as large as possible, under the consideration of the layout of facilities and equipment, flow of parts maintained, help to busy groups, training workers to multi-skill, increase of working rate, and the past experiences on work situation.

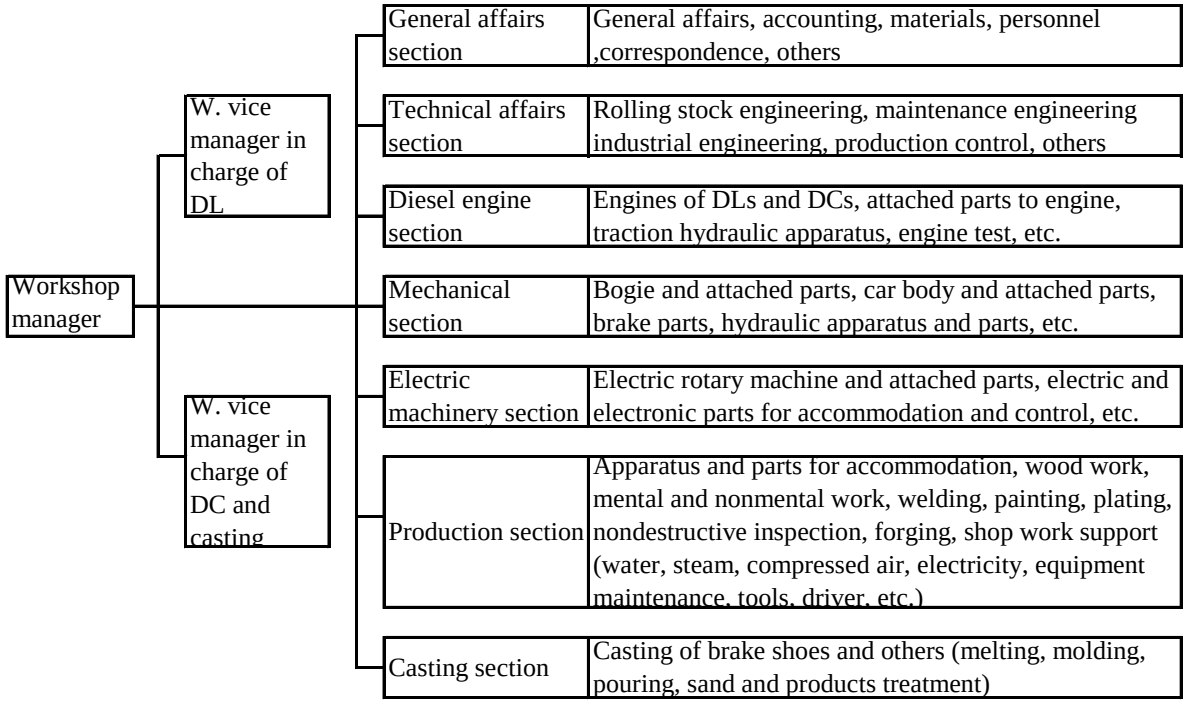


Fig. 7.1.2 Organization and duties division of the new workshop

2) Working hours

As for rolling stock maintenance work, assumed the same working hours as the one of Jubrin locomotive workshop.

For casting work, assumed the following hours on one shift, referring to the casting shop of Aleppo PC workshop and of tractor manufacturing workshop.

Table 7.1.2 Working hours for casting work

	Start of work	Breakfast break	Finish of work	Daily working hours
Ordinary period	7:15	9:00～9:30	14:45	7hours
Ramadan	7:15	－	13:45	6hours 30minutes

Note: In 2020, two shifts would be adopted to cope with the increase of casting quantity, if necessary.

7.2 Work volume and personnel

(1) Work volume of rolling stock maintenance

Estimated volume of periodic and temporary maintenance work for DLs and DCs, derived from Table 4.1.4, 4.3.5 and 4.3.6, are shown in Table 7.2.1.

Table 7.2.1 Work volume of rolling stock maintenance

(Man-hour/year)

		2006	2010	2015	2020
DL	Periodic	281,000	341,000	381,000	627,000
	Temporary	4,000	5,000	8,000	12,000
	sub total	285,000	346,000	389,000	639,000
DC	Periodic	59,000	92,000	235,000	326,000
	Temporary	700	1,000	2,300	3,500
	sub total	60,000	93,000	237,000	330,000
Total		345,000	439,000	626,000	969,000

Note: Although work volume of first periodic inspection of newly introduced rolling stock would be smaller than the others, here, assumed them with no difference.

(2) Casting quantity of brake shoes

Casting quantity of brake shoes are shown in Table 4.2.5.

(3) Personnel

1) Assumed the following items.

- Rolling stock maintenance work

  Annual working hours per person : 1240hours

  Numbers of indirect personnel : 11% of direct one

  Absentee rate : 15%

- Brake shoes casting work

  One hundred direct personnel for 3000t/year casting, referring to the foundry shop of tractor manufacturing workshop.

  Number of indirect personnel : 20% of direct one

  Absentee rate : 15%

  Additional personnel on two shifts in 2020 : 40 persons

2) Estimated personnel

Table 7.2.2 Personnel

(person)

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

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

(4) Personnel allocation

Assumed the personnel allocation, referring to Jubrin locomotive workshop in rolling stock section and the foundry shop of tractor manufacturing workshop in casting section.

Table 7.2.3 Personnel allocation

(person)

Section / Year	General affairs section	Technical affairs section	Diesel engine section	Mechanical section	Electric machinery section	Production section	Casting section	Total
Share (%)	2	3	30	20	25	20	-	100
2005	7	13	110	70	90	70	60	420
2006	7	13	110	70	90	70	60	420
2010	9	14	134	90	113	90	80	530
2015	10	20	190	125	160	125	140	770
2020	20	30	290	195	240	195	180	1150

7.3 Management and operation plan

Increase of productivity and improvement of quality on rolling stock maintenance and brake shoes casting, and their costs decrease at the new workshop would be necessary in its management and operation, to contribute to the accomplishment of transport business in GESR.

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

(1) Yearly planning of rolling stock maintenance and its execution.

It would be necessary to make a yearly schedule of rolling stock periodic inspection, not to merely plan but to accomplish it. In addition, the management cycle should be moved around to compare the effect with the plan.

(2) Settlement and execution of standard process for rolling stock periodic inspection

Maintenance work of rolling stock should be carried out, in accordance with the standard process of M5, M6, D5 and D6 mentioned in Chapter 4. The above said execution of yearly plan and standard process are actually one thing and indivisible. The former couldn't be hoped without the latter, and vice versa.

(3) Improvement of maintained rolling stock quality

Make an effort to improve the quality of maintained rolling stock mentioned in 4.3 not to disturb the train operation.

(4) Increase of productivity

1) The new workshop would play an important role in GESR, as a management unit, and be expected to contribute to GESR management.

Indexes of productivity should be suitable selected among various alternatives, and reflect the betterment of the present situation on them.

Some examples of productivity indexes are shown as follows,

- Achievement ratio of rolling stock maintenance plan
- Average staying period at workshop per car
- Average man-hour per car
- Number of maintained rolling stock per 100 persons
- Average maintenance cost per car, etc.

2) It would be recommended that the new workshop would be specified as a model case on a market mechanism, profit and loss account, to raise its productivity.

(5) Increase of labour density

Make use of break off time caused by intermittent shop-in of rolling stock, to maintain spare parts in accordance with the plan, to get OJT (On the Job Training), etc.

(6) Training for workers

Besides the training on the hardware, the training on the soft ware of management and operation, such as planning, productivity, quality control, labour density, multi-skill, work safety, etc. would be necessary for workers.

7.4 Management and operation cost

Table 7.4.1 shows management and operation cost of the new workshop.

Table 7.4.1 Operation costs of the new workshop

(1000SP/year)

year / Item	2005	2006	2010	2015	2020
Personnel	4,347	17,388	21,942	31,878	47610
Buildings and building service		28,180	29,560	30,940	30,940
Facilities and equipment for maintenance work		4,746	6,311	10,832	15,942
Total	4,347	50,314	57,813	73,650	94,492

Note: 1. Monthly salary : 75$/person
Actual amount of monthly salary of middle class workers are 60$ for contract workers and 80~100$ for fixed workers. (1$=46SP)
Assumed the median amount in planning at 75 $.
2. For the fourth quarter of 2005, 420 personnel would be allocated to the new workshop to get ready for its operation in next year.

Chapter 8

Economic and Financial Analysis

Chapter 8 Economic and Financial Analysis

8.1 Economic analysis

8.1.1 Fundamental concept of the analysis

(1) Outline of the project

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

The overhaul periods of locomotives at present will be changed to those shown in Fig. 4.1.1 (Chapter 4). This overhaul period is also applied to D5 and D6. Volume of works, explained in other chapters of this report is summarized in Table 8.1.1.

Table 8.1.1 Number of Overhauls (with project case)

Year	Diesel Cars		Diesel Electric Locomotives	
	Number of Cars	Number of Overhauls	Number of Cars	Number of Overhauls
2006	55	22	116	44
2010	85	34	151	55
2015	195	89	221	66
2020	290	122	321	107

(2) Major difference of with and without project

Without the new locomotive workshop project of this feasibility study, no capability for DC and DL repair/maintenance is expected other than the limited repair/maintenance capability provided by the existing Jubrin workshop of 35 diesel locomotives (DL) per year.

Based on the fact that while there are many DL units being operated in neighboring countries there are only a few DC units operated there, the Study Team therefore assumed that DC could not be utilized by GESR without the new locomotive workshop and in that case would be substituted by DL (LDE3200). Tables 8.1.2, 3 and 4 show number of cars necessary by type, number of DL units to be repaired or maintained in total and by model,

respectively.

Table 8.1.2 Number of cars necessary by type (with and without project case)

	2006		2010		2015		2020	
	W/	W/O	W/	W/O	W/	W/O	W/	W/O
DL								
Trunk Line	80	100	115	132	185	201	285	302
Shunting	36	36	36	36	36	36	36	36
Total	116	136	151	168	221	237	321	338
W/O-W/	20		17		16		17	
DC	55	0	85	0	195	0	290	0
PC	190	272	190	255	140	257	140	259
W/O-W/	82		65		117		119	

Note: W/; with project case
W/o; without project case
Number of FC for W/ case is same as that for W/O case

Table 8.1.3 Number of DL units to be repaired or maintained (with and without project case)

DL (M5+M6)	2006		2010		2015		2020	
	W/	W/O	W/	W/O	W/	W/O	W/	W/O
Trunk Line	32	36	43	50	58	64	94	96
Shunting	12	12	12	12	8	8	13	13
Total	44	48	55	62	66	72	107	109
W/O-W/	4		7		6		2	
Outside works	-	13	-	27	-	37	-	74

Note: Outside work = total repair/maintenance – 35 (repair/maintenance in Jubrin W/S)

Table 8.1.4 Number of DL units to be repaired or maintained by model (without case)

	2006	2010	2015	2020
LDE 2800 (Jubrin works)	18*	18*	16	16
LDE 3200, 3500, N	20	34	48	80
Jubrin workshop	7	7	11	6
Outside workshop	13	27	37	74
LDE 1500, 1200, N (Jubrin works)	10	10	8	13
Total	48	62	72	109
Jubrin works	35	35	35	35
Outside works	13	27	37	74

Note: * Two (2) shunting DL units are included

8.1.2 Benefits

(1) Type of benefits

Benefits are classified into two types. The first type comprises VOC (Vehicle Operating

Cost), ROC (Rail Operating Cost) and TTC (Travel Time Cost) savings. These are considered as the contribution of the operation of the new workshop to the realization of the benefits expected from the Master Plan.

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

1) Shortening of the period of overhaul work (due to execution of all overhauls in Syria)
2) Shortening of the period of overhaul work (due to difference in productivity between the Jubrin workshop and the new workshop)
3) Extension of the interval between overhauls
4) Decrease of extra repair works
5) Decrease of overhaul costs
6) Decrease of wheel adjustment cost (due to use of brake shoes made by GESR)
7) Decrease of brake shoe costs (due to use of brake shoes of made by GESR)
8) Decrease of reserved cars

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

(2) VOC, ROC and TTC

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

In the “without project” case, diesel electric locomotives can be maintained by workshops located in adjacent countries but diesel cars cannot be maintained, considering that diesel locomotive commonly used in all the adjacent countries, while on the contrary use of diesel cars is very limited in those countries. The difference in ROUC for the “without project” and “with project” cases is that the “with project” case will make it possible to substitute diesel electric locomotives for diesel cars.

ROUC, VOUC and TTUC of the Master Plan (MP) are applied to this Feasibility Study (FS) with some modification as follows.

- Currency Exchange Rate: FS rate is different from that used in the MP

- Representative Train: From LDE2800 to LDE3200 in “with workshop project” case

Final results of ROUC, VOUC and TTUC are tabulated in Tables 8.1.5 to 8.1.8.

Table 8.1.5 Summary of ROUC (Train)

Items/Type of the Train	Master Plan		Without FS Project	
	Passenger Train	Freight Train	Passenger Train	Freight Train
ROUC subject to Distance (SP/train km)	79.08	140.41	111.42	138.79
ROUC subject to Time (SP/train hr)	4,720.76	2,485.03	9,243.51	2,736.06

Table 8.1.6 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 8.1.7 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 8.1.8 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

2) ROC, VOC and TTC

ROC, VOC and TTC savings are calculated from traffic assignment results. Values related to benefits are summarized in Table 8.1.9.

Table 8.1.9 ROC, VOC and TTC Savings

(unit: MSP/year)

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

(3) Direct benefit from workshop operation

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

1) Shortening of the period of overhaul work (due to execution of all overhauls in Syria)

Periods of overhaul works are estimated as 30 days for M5 and 40 days for M6 in the new workshop in Syria. In the “without project” case, it is reasonable to consider that these overhaul works, excluding the parts of M5 and M6 that the Jubrin work shop can handle, shall be executed in a neighboring country such as Turkey. Period in days to be required for overhaul in Turkey is assumed as shown in Table 8.1.10.

Table 8.1.10 Extra days in average in case of overhaul in Turkey

Type of Car	Actual Work Days for Overhaul	Days for Transport	Extra Days due to Difference of Actual Work Days*	Total of Extra Days required
Diesel Electric Locomotives	60	14	20 + 3	37

Note: *Actual workdays in Turkey, 60 Days – overhaul days in Syria 40 days x 7/6 = 23
It is assumed that overhauls in Turkey would take 60 days for both of M5 and M6, and that extra days due to difference of actual workdays would be the same for both of M5 and M6.

Necessary number of cars is calculated assuming that the new workshop starts operation on schedule. If that workshop is not constructed, extra cars corresponding to extra days required for maintenance have to be purchased. This number of cars is named as type 1 “extra necessary cars”. It is shown in Table 8.1.11. Saving of this expense is considered as a benefit of the new workshop construction.

Table 8.1.11 Type 1: Extra necessary cars

Year	Diesel Electric Locomotives		
	Cars overhauled in Turkey	Extra Days Necessary	Extra Necessary Cars
2006	13	481	1
2010	27	999	3
2015	37	1,369	4
2020	74	2,738	8

2) Shortening of the period of overhaul work (due to difference in productivity between the Jubrin workshop and the new workshop)

Shortening of the period of overhaul work is calculated as explained below:

(a) Past records show that the average period of overhaul works for LDE2800 is 9 months, while that of other LDE units is estimated as 2 months. Both periods include Sundays and Holidays.

(b) The average period of overhaul work after the new workshop starts to operate is estimated as 34 days for M5 and 46 days for M6. As M5 and M6 always follow each other the average period for each is taken as 40 days. Both periods include Sundays and Holidays.

(c) Differences in overhaul periods are summarized by type of locomotive and divided by 365 to obtain the number of locomotives economized (hereafter named type 2: Extra necessary cars). The results are shown in Table 8.1.12.

Table 8.1.12 Number of the Type 2: Extra necessary cars

LDE 2800				
Difference in Days for Overhaul Work: 230 Days				
Price of Locomotive: 13 MSP				
Year	Cars to be inspected	Difference in days	Difference in cars (converted)	Amount of savings (MSP)
2006	18	4140	11	143
2010	18	4140	11	143
2015	16	3680	10	130
2020	16	3680	10	130
LDE 3200, 3500				
Difference in Days for Overhaul Work: 20 Days				
Price of Locomotive: 92 MSP				
Year	Cars to be inspected	Difference in days	Difference in cars (converted)	Amount of savings (MSP)
2006	7	140	-	-
2010	7	140	-	-
2015	11	220	1	92
2020	6	120	-	-
LDE 1200, 1500				
Difference in Days for an Overhaul Work: 20 Days				
Price of Locomotive: 8 MSP				
Year	Cars to be inspected	Difference in days	Difference in cars (converted)	Amount of savings (MSP)
2006	10	200	-	-
2010	10	200	-	-
2015	8	160	-	-
2020	13	260	1	8
Total				
Year	Amount of savings (MSP)			
2006	143			
2010	143			
2015	222			
2020	138			

3) Decrease of extra repairs

There were 319 extra work items in year 2000 performed on the 89 diesel electric locomotives in operation, an average of 3.8 extra works a year per car. This figure is extraordinarily high. The Study Team assumes this figure can be reduced to 0.5 extra works a year per car should there be more effort on the part of the workshop staff even if they continue to use the Jubrin workshop. In case the new workshop commences operation, the Study Team expects this figure can be reduced to 0.2. Savings in repair costs due to the decrease in extra works are considered as benefit. This value is shown in Table 8.1.13. In this calculation the average expense of an extra work item is assumed to

be 3% of the overhaul expenses (58,000 SP/extra-work/car).

Table 8.1.13 Extra work/year/car and repair cost/car

Type of car	Extra work/year/car		Extra repair cost/car (SP)
	W/	W/o	
DL	0.2	0.5	58,000
PC	0.15*	0.15*	16,000**
DC	0.2	-	21,000

.Note: * Assumed based on the actual figures in 1999
** Estimated at 28% of DL extra repair cost

Similarly, repair cost savings of passenger car (PC) in "without project" case and extra repair costs of DC in "with project case" are calculated. These savings are considered as benefit. Basic figures for calculation are shown in Tables 8.1.13, 14 and 15. Decrease of extra repairs of diesel electric locomotives is shown in Table 8.1.16.

Table 8.1.14 Number of cars

Year	Number of cars					
	DL		PC		DC	
	W/	W/o.	W/	W/o.	W/	W/o.
2006	116	136	190	272	55	0
2010	151	168	190	255	85	0
2015	221	237	140	257	195	0
2020	321	338	140	259	290	0

Table 8.1.15 Number of extra repairs

Year	Number of extra repairs					
	DL		PC		DC	
	W/	W/o.	W/	W/o.	W/	W/o.
2006	23	68	29	41	11	0
2010	30	84	29	38	17	0
2015	44	119	21	39	39	0
2020	64	169	21	39	58	0

Table 8.1.16 Decrease of extra repairs of diesel electric locomotives

year	Difference* of extra repairs (number of cars)			Difference* of extra repairs (amount, MSP)			
	DL	PC	DC	DL	PC	DC	Total
2006	45	12	-11	2.61	0.19	-0.23	2.57
2010	54	9	-17	3.13	0.14	-0.36	2.91
2015	75	18	-39	4.35	0.29	-0.82	3.82
2020	105	18	-58	6.09	0.29	-1.22	5.16

Note: * w/o case - w/ case

4) Decrease in overhaul costs

Overhaul cost in Turkey is assumed to be double the overhaul cost in the workshop, which means overhaul saving for a diesel electric locomotive is 2.1 MSP. Decrease in overhaul costs are calculated and summarized in Table 8.1.17.

Table 8.1.17 Savings in overhaul (OH) costs

Year	Diesel Electric Locomotive	
	Overhauls in Turkey	Savings by Overhauls in the Workshop (MSP)
2006	13	27.3
2010	27	56.7
2015	37	77.7
2020	74	155.4

5) Decrease in Wheel Adjustment Cost (due to use of brake shoes made by GESR)

Decrease in wheel adjustment cost due to use of brake shoes made by GESR is expected. This decrease is estimated as follows:

(a) Probabilities of 15% for diesel cars/passenger cars and 20% for freight cars that the groove of 5mm depth will break out after running 50,000 km.

(b) Cost of adjusting by machining is 44,160 SP/car.

Decrease of wheel adjustment cost is shown in Table 8.1.18.

Table 8.1.18 Decrease in Expense of Adjustment of Wheels

	Passenger Car	Freight Car	Total
Year 2006			
Car km/day	72,307	280,415	-
Number of Cars broken out	79	409	489
Adjustment Cost (MSP)	3.5	18.1	21.6
Year 2010			
Car km/day	67,882	468,979	-
Number of Cars broken out	74	685	759
Adjustment Cost (MSP)	3.3	30.2	33.5
Year 2015			
Car km/day	78,925	806,202	-
Number of Cars broken out	86	1,177	1,263
Adjustment Cost (MSP)	3.8	52.0	55.8
Year 2020			
Car km/day	79,556	1,314,467	-
Number of Cars broken out	87	1,919	2,006
Adjustment Cost (MSP)	3.8	84.7	88.6

Decrease of wheel replacement is estimated as follows;

(a) A wheel is replaced at the time of the fourth adjustment of that wheel. Times of replacement, therefore, become one fourth of times of adjustment.

(b) Replacement cost is 0.23 MSP/car.

Decrease in wheel replacement is summarized in Table 8.1.19.

Table 8.1.19 Decrease in Wheel Replacement

	Passenger Car	Freight Car	Total
Year 2006			
Number of Cars broken out	20	102	-
Adjustment Cost (MSP)	4.6	23.5	28.1
Year 2010			
Number of Cars broken out	19	171	-
Adjustment Cost (MSP)	4.4	39.3	43.7
Year 2015			
Number of Cars broken out	22	294	-
Adjustment Cost (MSP)	5.1	67.6	72.7
Year 2020			
Number of Cars broken out	22	480	-
Adjustment Cost (MSP)	5.1	110.4	115.5

6) Decrease in Reserved Cars

Booked cars are composed of assigned cars and reserved cars. Reserve rate is defined as

the number of reserved cars over the number of booked cars. The rate of reserve of the Master Plan is 0.1 but those at present range between 0.2 and 0.7 due to poor maintenance (refer to Table8.1.20).

Table 8.1.20 Rates of Reserves (RR)

Type of Locomotive	Without Project Case	With Project Case
LDE2800	0.70	0.10
LDE3200, 3500 *	0.25	0.10
LDE1200, 1500	0.20	0.10

Note: *RR of newly introduced locomotives is 0 in the first four (4) years.

Decrease in reserved cars caused by "with project" is calculated based on the assumptions shown in Table 8.1.20 and the result is shown in Table 8.1.21.

Table 8.1.21 Decrease in Reserved Cars

Year and Item	For Line Transport		For Shunting	
	LDE2800	LDE3200, LDE3500	LDE1200, LDE1500	LDE2800
Purchased Price	13 MSP/Car	92 MSP/Car	8 MSP/Car	13 MSP/Car
Dif. of RR	0.60	0.15	0.10	0.60
Year 2006				
Assigned Cars	32	-	31	5
Reserved Cars*	19	-	3	3
Money Saving (MSP)	247	-	24	39
Year 2010				
Assigned Cars	32	68	31	5
Reserved Cars*	19	10	3	3
Money Saving (MSP)	247	920	24	39
Year 2015				
Assigned Cars	32	100	6	-
Reserved Cars*	19	15	1	-
Money Saving (MSP)	247	1,380	8	-
Year 2020				
Assigned Cars	32	169	30	-
Reserved Cars*	19	25	3	-
Money Saving (MSP)	247	2,300	24	-

Note: * "without project" case

7) Direct Benefit Summary

Direct benefits are summarized in Table 8.1.22. Extra necessary cars are converted to monetary terms using the following prices: DC, 46 MSP; LDE 3500 and 3200, 92 MSP each; LDE 2800, 13 MSP; and LDE 1500 and 1200, 8 MSP each.

Table 8.1.22 Direct Benefits Summary

(unit: MSP)

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

Note: *Benefits are categorized as follows

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

8.1.3 Investment and operation costs

(1) Investment

An estimate of the investment of this project is discussed in section 5.9. The investment and the residual values are reproduced in Table 8.1.23.

Table 8.1.23 Investments and Residual Values

(unit: MSP)

Investment								
Year	Land	Building	Facilities	Track Bed	Track	Equipment	Engineer'g	Total
2001	0	0	0	0	0	0	48	48
2002	0	0	0	228.3	37.1	0	90.5	355.9
2003	37.5	427.5	205.7	0	148.3	0	151.2	970.2
2004	0	427.5	205.7	0	0	2259	143.3	3035.5
2005	0	427.4	205.9	0	0	2505.2	143.3	3281.8
2006	0	0	0	0	0	0	32	32
2007	0	0	0	0	0	256.9	80	336.9
2008	0	0	0	0	0	288.6	80	368.6
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	6	0	6
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	16.6	0	16.6
2016	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0	0
2026	0	0	0	0	0	0	0	0
2027	0	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0
2029	0	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0	0
Total	37.5	1282.4	617.3	228.3	185.4	5332.3	768.3	8451.5
Residual Values								
Life		100	100	100	100	40	58	
Year	Land	Building	Facilities	Track Bed	Track	Equipment	Engineer'g	Total
2001	0.0	0.0	0.0	0.0	0.0	0.0	4.1	4.1
2002	0.0	0.0	0.0	85.5	13.9	0.0	8.2	107.7
2003	37.5	165.9	79.8	0.0	57.5	0.0	14.6	355.4
2004	0.0	171.8	82.7	0.0	0.0	231.2	14.8	500.4
2005	0.0	177.9	85.7	0.0	0.0	279.9	15.7	559.2
2006	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7
2007	0.0	0.0	0.0	0.0	0.0	34.2	9.9	44.1
2008	0.0	0.0	0.0	0.0	0.0	41.9	10.5	52.4
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0	0.0	4.5	0.0	4.5
2016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2022	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2024	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2025	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2027	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2028	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2029	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
R.V.	37.5	515.5	248.2	85.5	71.4	592.8	81.5	1,632.5

(2) Operation Cost

An estimate of the operation costs of the workshop is summarized in Table 8.1.24.

Table 8.1.24 Operation Cost

(unit: MSP)

Year	Personnel Cost	Building/Facility	Equipment	Total
2005	4.3	0	0	4.3
2006	17.4	28.2	4.7	50.3
2010	21.9	29.6	6.3	57.8
2015	31.9	30.9	10.8	73.6
2020	47.6	30.9	15.9	94.4

8.1.4 Economic analysis

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

EIRR, B/C and NPV are calculated on equity basis and shown in Table 8.1.25. The EIRR obtained (21.0%) shows the economic viability of this project.

Table 8.1.25 EIRR, B/C, NPV

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

Note: *R.V.=Residual Value

(2) Sensitivity analysis

Sensitivity analysis shows that the 12% of EIRR is assured up to the point where benefits decrease to 0.5 times of the standard case or costs increase by 2.0 times of the standard case (Table 8.1.26).

Table 8.1.26 Sensitivity analysis results

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

8.2 Financial Analysis

8.2.1 Method of the Analysis

Financial analysis is required only for the projects with revenue. In this project, modernization of locomotive workshop is expected to contribute to reliability of train operation through higher availability of rolling stock. As a result GESR will acquire confidence of customers and revenues from both freight and passenger business will increase to some extent. However, it is almost impossible to estimate accurately how much the revenue will go up by modernization of the workshop. Therefore additional revenues cannot be taken into consideration in calculation of FIRR. In this financial analysis we take up the following items, which contribute to improvement of profit and loss status.

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

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

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

(1) Savings of Costs

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

1) Overhaul Cost

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

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

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

Table 8.2.1 Savings of Overhaul Cost (DL)

	2006	2010	2015	2020
Number of Rolling Stock	9	20	31	72
Overhaul Cost (Overseas)	$90,000	$90,000	$90,000	$90,000
ditto (in Syrian Pounds)	4,140,000	4,140,000	4,140,000	4,140,000
Overhaul Cost (Domestic, in SP)	1,931,000	1,931,000	1,931,000	1,931,000
Difference of Overhaul Cost (in SP)	2,209,000	2,209,000	2,209,000	2,209,000
Savings of Cost (in Million SP)	20	44	68	159

2) Temporary Repair Cost

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

Table 8.2.2 Savings of Temporary Repair Cost

	2006	2010	2015	2020
Number of Locomotives in Operation	116	151	221	321
Temporary Repair at Old Workshop (0.5/year)	58	76	111	161
Temporary Repair at New Workshop (0.2/year)	23	30	44	64
Difference	35	45	66	96
Temporary Repair Cost (in SP)	58,000	58,000	58,000	58,000
Savings of Cost (in Million SP)	2	3	4	6

3) Wheel-Shaving Cost

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

Table 8.2.3 Savings of Wheel Shaving Cost

	2006	2010	2015	2020
P C				
Car Km ('000 Km/year)	18,611	18,263	15,250	15,250
Number of Wheel Shaving Works per Year	56	55	46	46
Unit Cost of Wheel Shaving	$960	$960	$960	$960
Savings of Wheel Shaving Cost	$53,600	$52,598	$43,920	$43,920
Savings of Wheel Shaving Cost (in M. SP)	2	2	2	2
F C				
Car Km ('000 Km/year)	102,351	171,177	294,264	479,780
Number of Wheel Shaving Works per Year	409	685	1,177	1,919
Unit Cost of Wheel Shaving	$960	$960	$960	$960
Savings of Wheel Shaving Cost	$393,030	$657,321	$1,129,973	$1,842,357
Savings of Wheel Shaving Cost (in M. SP)	18	30	52	85
D C				
Car Km ('000 Km/year)	7,781	12,616	29,212	44,062
Number of Wheel Shaving Works per Year	23	38	88	132
Unit Cost of Wheel Shaving	$960	$960	$960	$960
Savings of Wheel Shaving Cost	22,410	36,333	84,132	126,898
Savings of Wheel Shaving Cost (in M. SP)	1	2	4	6
Total Savings (in Million SP)	22	34	58	93

4) Wheel Replacement Cost

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

Table 8.2.4 Savings of Wheel Replacement Cost

	2006	2010	2015	2020
PC				
Car Km ('000 Km/year)	18,611	18,263	15,250	15,250
Number of Wheel Replacement per Year	14	14	11	11
Unit Cost of Wheel Replacement	$5,000	$5,000	$5,000	$5,000
Savings of Replacement Cost	$69,791	$68,487	$57,188	$57,188
Savings of Replacement Cost (in M. SP)	3	3	3	3
FC				
Car Km ('000 Km/year)	102,351	171,177	294,264	479,780
Number of Wheel Replacement per Year	102	171	294	480
Unit Cost of Wheel Replacement	$5,000	$5,000	$5,000	$5,000
Savings of Replacement Cost	$511,757	$855,887	$1,471,318	$2,398,902
Savings of Replacement Cost (in M. SP)	24	39	68	110
DC				
Car Km ('000 Km/year)	7,781	12,616	29,212	44,062
Number of Wheel Replacement per Year	6	9	22	33
Unit Cost of Wheel Replacement	$5,000	$5,000	$5,000	$5,000
Savings of Replacement Cost	$29,179	$47,309	$109,547	$165,232
Savings of Replacement Cost (in M. SP)	1	2	5	8
Total Savings (in Million SP)	28	45	75	121

(2) Savings of Investment on Rolling Stock

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

1) Savings by Implementation of All Overhauls in Syria

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

2) Savings by Shortening of Staying Period for Overhaul

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

3) Savings by Decrease of Spare Rates of Locomotives

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

(3) Savings of investment cost on the old workshop

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

Table 8.2.5 Savings of Diesel Locomotives

	2006	2010	2015	2020
Locomotives for Main Lines				
By Implementation of All Overhauls in Syria	1	1	2	4
By Shortening of Staying Period for Overhaul	11	0	0	0
By Decrease of Spare Rates of Locomotives	19	7	5	11
Total Number of Locomotives	31	8	7	15
Unit Price (in Million SP)	92	92	92	92
Amount (in Million SP)	2,852	736	644	1,380
Shunting Locomotives				
By Shortening of Staying Period for Overhaul	0	0	0	1
By Decrease of Spare Rates of Locomotives	6	0	0	0
Total Number of Locomotives	6	0	0	1
Unit Price (in Million SP)	55.2	55.2	55.2	55.2
Amount (in Million SP)	331	0	0	55
Total Savings of Locomotives (in Million SP)	3,183	736	644	1,435

8.2.2 The Results of the Analysis

(1) Project Life

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

(2) Sensitivity Analysis

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

Case 1: Increase of Workshop Construction Cost…… 5%

Case 2: Increase of Workshop Construction Cost……10%

Case 3: Decrease of Savings……..5%

Case 4: Decrease of Savings…….10%

Case 5: Increase of Workshop Construction Cost……10%

Decrease of Savings…….10%

(3) Financial Internal Rate of Return (FIRR)

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

Table 8.2.6 Financial Internal Rate of Return (FIRR)

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

(4) Evaluation

FIRR is 6.4 % for the base case and 4.0 % for the worst case of the sensitivity analysis (Case 5). Financial institutions for international economic cooperation usually fix terms and conditions of their loans based upon the developing stage of the borrowing countries. Two of these organizations have confirmed to us that their interest rates applicable to the countries in the same developing stage as Syria are 2.20 % and 0.75 % respectively once the loan on the project is approved.

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

Chapter 9

Environmental Impact Assessment

Chapter 9 Environmental Impact Assessment

9.1 Assessment process

The subject of this assessment is the project for "Modernization of the Locomotive Workshop". The project calls for the construction of a new workshop for maintenance of diesel locomotives, diesel cars and brake blocks. The objective is to determine the potential environmental impacts that may be generated from the project construction and operation. This assessment is a first step towards implementing a comprehensive assessment, which should be completed at the time of detailed design of the project.

The project description and the need for the project have already been described elsewhere in this report. This chapter shall outline the environmental conditions within the project area in section 9.2 and determine the potential impacts on the environment in section 9.3. Section 9.4 summarizes the evaluation result, and the further studies are discussed in section 9.5.

9.2 Environmental setting

9.2.1 Project location

(1) Location

The new workshop shall be constructed in the northeastern part of Aleppo city, in Muslimia area. The new workshop shall be attached to the existing Muslimia station. Figure 9.2.1 shows the location of the project.

(2) Topography

The ground levels of the site where the workshop shall be constructed range from 413 to 423 meters above sea level. The ground level gradually increases from the railway line in the east towards the western direction.

9.2.2 Physical environment

(1) Soil condition

Soil investigation data has been collected for 5 boreholes in the surrounding area of the project site. The data is summarized in Table 9.2.1.

Table 9.2.1 Soil Investigation Data

Layer	Borehole 1	Borehole 2	Borehole 3	Borehole 4	Borehole 5
	Just adjacent to the south-west point of the station	Southeast of the station, adjacent to the northeast side of the Free Zone area	South of the station in the light bulb factory site	Northeast of the station in the housing complex	Northeast of the station near the cement factory.
1	Silt (1m)	Silt (2.5m)	Silt (2m)	Silt (1.5m)	Silt (3m)
2	Limestone (12m)	Limestone (10m)	Basalt crushed (7m)	Limestone (10m)	Limestone (20m)
3	Chalk (40m)	Chalk (50m)	Basalt hard (30m)	Basalt (50m)	Basalt (100m)
4	Marl dark gray (260m)	Basalt hard (70m)			
Note: Limestone bearing capacity 1.5 kg/cm^2					

The top layer of soil, known locally as red soil and mostly silt is suitable for agriculture and extends to a depth of about 2.0 meters. In general, under this layer there is a limestone layer of about 10 – 20 meters, with a bearing capacity of about 1.5 kg/cm^2.

(2) Climate

The climate at the project site can be defined within the context of the climate condition in the city of Aleppo. Temperatures peak to 38 – 40^{o}C in July and August and fall to 0 - 5^{o}C in December and January. During these two months over 80 mm of rainfall have been recorded. There is hardly any rainfall during the hottest months of the year; July and August.

(3) Water resources and quality

The main source of water in the area is groundwater drawn from wells, which is used for drinking water as well as agriculture. Presently wells are at depths of more than 100 meters and wells become dry during the summer. Although it is legally necessary to register wells and pumping equipment, most of the wells are not registered. Water samples were collected from three wells in the area and the analysis results are shown in the appendix.

According to the standards of the Syrian draft water quality law all the samples were unsuitable for drinking, both from chemical as well as biological viewpoints.

(4) Air quality

There is no continuous air-monitoring program in the project site or anywhere else in Syria. This is an ongoing concern of the Ministry of Environment and strong efforts are being made to introduce such a program. Data was collected from various materials available at the ministry and the results are shown in Table 9.2.2 for Aleppo city. The major sources of air pollution at the project site are the two cement plants nearby.

Table 9.2.2 Air Quality in Aleppo City

Pollutant	Aleppo	Sources
1) Nitrogen dioxide (NOx)	Average daily concentrations of 0.5 ppm (Syrian draft standard is 0.1 ppm). In 1995 number of days exceeding daily average standards during 90 days continuous monitoring was 60%.	Power station is the main source, followed by traffic and the cement factories
2) Sulphur dioxide (SO_2)	Estimated to be double permissible standards. In 1995 number of days exceeding daily average standards during 90 days continuous monitoring was 68%, the largest figure in the three cities of Damascus, Homs and Aleppo..	Main source is the power station.
3) Carbon monoxide (CO)	1995 monitoring results show urban concentrations of 2 – 12 ppm for average 8 hrs (9 permissible)	
4) Suspended particulate matter (TSP)	(1993 data) City center: 318 mg/m3 Industrial: 1730 mg/m3	Highest concentration at industrial zone due to the cement plants. At the project location there are two large cement plants.

Source: Ministry of Environment Reports, 1998 and 1999

9.2.3 Human resources

A field survey was done in an area of radius 2 kilometers surrounding the project location site. The results of that survey are used in this section.

(1) Demography

Five inhabited areas of which three are villages surround the project site. Total population

in these areas is estimated at around 9,000 to 10,000 persons. Housing in the three villages, accommodating about 4,500 to 5,000 persons is mainly formal, while that in the two more recently established housing areas is informal. Based on an interview survey of 49 households in the area the average household size was 13.4 persons. This high figure is due to different generations living under one roof, families and relatives sharing the same household and workers living in the same house together.

In summary the majority of people in this area live in informal housing under crowded conditions.

(2) Land use

The land use activities have been surveyed within an area of 26.4 km^2, with the station located almost in the center. Figure 9.2.2 and Table 9.2.3 show the survey result.

Table 9.2.2 Land Use surrounding the Project Site

Land Use		Area (m2)	Share (%)
1) Agriculture land (seasonal cultivation)		15,761,683	59.54
2) Grapes cultivation		1,575,703	5.95
3) Vacant land		5,253,895	19.85
4) Industrial plants (public and private)		2,359,569	8.91
4) A	Muslimia Cement plant	(976,010)	(3.69)
4) B	Housing Co. Cement plant	(272,395)	(1.03)
4) C	Poultry farms	(18,500)	(0.07)
4) D	Glass fabrication plant	(279,374)	(1.06)
4) E	Free Zone Area	(698,840)	(2.64)
4) F	Private sector workshops	(90,475)	(0.34)
4) G	Private sector poultry farms	(23,975)	(0.09)
5) Central prison (portion within study area)		125,533	0.47
6) Reform prison		38,375	0.14
7) Railroad tracks (including ROW)		314,250	1.19
8) Railway station		99,250	0.37
8) A	Housing area	(1,000)	(0.003)
8) B	Sheep herding area	(10,750)	(0.04)
8) C	Remaining area	(87,500)	(0.33)
9) Housing area		636,952	2.40
9) A	Formal housing	(337,202)	(1.27)
9) B	Informal housing	(299,750)	(1.13)
10) Restaurants		32,950	0.12
11) Roads		273,090	1.03
11) A	Paved roads	(160,918)	(0.61)
11) B	Unpaved roads	(112,172)	(0.42)
Total		26,471,250	100.00

The project site will be located on agricultural land used for seasonal cultivation, which

accounts for almost 60% of the total land use. The major industrial activities in the area are the two cement plants and the free zone area, which account for about 4 and 3% respectively.

(3) Economic Activity

The household survey showed that 18% of the surveyed population is working, and of that figure 83% work in the Muslimia area. By work category laborers in plants, farms and construction account for 50%, while those working on farms are 18%. Nine (9%) percent are government employees. Many children are working on family owned farms.

Most of the work in the area is connected to the farms there, cement plants, and free zone area. Most of the workers in the station live there with their families in 15 houses inside the railway station grounds.

(4) Cultural and historic assets

Although the villages near the station date back 200 years there are no significant historic buildings located there. There is one site where archaeological excavation was conducted some time ago, called Tel Muslimia, located about 2 kilometers east of the station but there are no signs of excavation there at present.

The station building itself was constructed around 1910 and it has some Ottoman architectural significance. However the building, in use by the stationmaster as an office and for residence is in poor condition.

9.2.4 Environmental regulations, institutions and issues

(1) Regulations and institutions

Regulations and institutions related to the environment have been discussed in the master plan report. It is sufficient to repeat here that to date 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.

As the draft law now stands, it would be the responsibility of GESR, as the project developer to implement the assessment. The Ministry of Environment would be included within the committee established to review the assessment reports as well as the local authority (Governorate) where the project shall be implemented.

Within the working regulations of GESR the importance of environmental protection is reflected, particularly in the section discussing work safety conditions. However to date GESR has never implemented an environmental assessment for its new projects.

(2) Building codes

Considering there are no sufficient environmental regulations related to this project, the building codes were collected and studied in order to determine the extent of their coverage of environmental concerns. The Syrian Syndicate of Engineers, Aleppo branch publication "Building Codes in Aleppo City" (1999) lists the following articles, of relevance to the project.

- Article 2: Before entering into construction it is necessary to apply for, and receive a permit. Articles 3 to 9 define the documents that must be attached to the application. No documents pertaining to environmental impact study are required. (It is hoped that this will change in the near future!).

- Article 119: Mechanical Studies Required: Sub-article 7 discusses the studies required for Industrial, Storage and Workshop Areas. Studies are listed as items (a) through (l). Items of concern to the environment are:
    - Item (g): Water sources and treatment systems before and after production processes
    - Item (h): Quality control system governing production
    - Item (i): Fire fighting and industrial safety measures.
    - Item (j): Determination of internal health conditions for the workers as authorized by the Syndicate of Engineers
    - Item (k): Treatment of waste and environmental pollutants (solid, liquid, gas) based on international standards

- Article 155: According to the city master plan, Aleppo city is divided into zones. Railway projects are included in the industries zone. It should be noted however that Muslimia is not within the area covered by the city master plan.

- Article 158: The industrial areas are classified by industry type and railway related facilities are included in section e. This article states that industrial plants are

not allowed to discharge their wastewater in wells or directly into rivers. Any attached chimneys should be not less than 6 meters in height from the building roof and filters should be installed. Ventilation and illumination requirements should be met.

While these articles are general in nature, they reflect some concern for the environment. It should be noted however that Muslimia area is out of Aleppo's master plan area and buildings there may not be subject to all these conditions. Furthermore a review of the conditions of existing workshops and stations of GESR shows that many of these stipulations are not actually enforced.

(3) Environmental issues

Based on site visits and the interview surveys in the project area, the major environmental issues are as follows:

1) Water quality: Based on the draft Syrian potable water standards all the samples collected from drinking wells and tested did not meet those standards. Furthermore during the dry season the well water was reported to become very scarce.

2) Wastewater system: The area is not served by a wastewater drainage system and most houses have septic tanks. However service of these tanks is not regular and bad odor and insects problems are common.

3) Cement plants: There is a strong complaint from the residents about the dust from the plants. Farmers also complain that their crops are affected.

4) Sheep holding area: Inside the station a facility has been constructed some years ago for holding sheep scheduled to be exported to other countries by rail. However at present the sheep are brought to this facility by truck, checked by the customs and health officials at the neighboring free zone area and then shipped off by truck. Rail transport is not used. Residents in the station and its surroundings complain of the smell and odor generated by this activity.

5) Inadequate road network: There is a main road from Aleppo, passing through the area in front of the free zone area (to its east). During certain hours of the day (08:00 to 09:30 and 13:00 to 14:00) there is huge traffic congestion along this road because of the trucks parked in front of the free zone area waiting for their turns to load and unload goods.

9.3 Impacts of proposed project

9.3.1 Sequence for environmental consideration

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

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

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

The procedure for environment assessment required at the detailed design of the project is outlined in the appendix attached to the Volume I report.

9.3.2 Screening and scoping procedure

The screening of the project in order to identify whether any impact is expected (Y) or not (N) is shown in Table 9.3.1.

Table 9.3.1 Screening of project alternatives

Environmental Item and Description	Y/N	Remarks
Social Environment		
1. Resettlement		
Resettlement due to occupancy of proposed land	N	The site allocated for construction already belongs to the public sector.
2. Economic Activities		
Loss of productive opportunity such as land or nearby market	N	Although the original plan for the allocated site will be altered and this may result in economic loss, the new workshop will provide increased working opportunities in the area.
3. Traffic and public facilities		
Influence on existing traffic system such as congestion, and other public utilities.	Y	Present road network capacity is limited and new workshop construction, and operation will generate considerable traffic. Other public services are also underdeveloped and cannot meet the present demand.
4. Split of communities		
Split of communities by obstruction of railway line	N	No potential impact
5. Cultural property		
Loss of cultural property and falling of values	N	No potential impact
6. Water rights and rights of common		
Obstruction of fishing rights, water rights, and common rights of forest	N	No potential impact
7. Public health condition		
Deterioration of hygienic environment and poor working areas	Y	There is a potential because of the large number of workers in the new workshop.
8. Waste		
Occurrence of waste dumps and solid waste	Y	Waste will be generated during construction and operation.
9. Hazards (risks)		
Increase of possibility of danger of landslide, structure failure and accidents	N	Soil and topography conditions are not severe in this area.
Natural Environment		
10. Topography and geology		
Change of valuable topography and geology by excavation or filling works	N	No large scale excavations in the project.
11. Soil erosion		
Surface soil erosion by rainwater after land development (vegetation removal)	N	No potential impact expected.
12. Groundwater		
Interference with groundwater characteristics by large scale excavation	N	No large scale excavations in the project.
13. Hydrological situation		
Changes in river discharge and river bed conditions due to landfill and drainage inflow	N	No potential impact expected.
14. Coastal zone		
Coastal erosion and sedimentation due to landfill or change in marine condition	N	No potential impact expected.
15. Flora and fauna		
Obstruction of breeding and extinction of species due to change of habitat condition	N	No potential impact expected.

16. Meteorology		
Change of temperature, precipitation, wind, etc. due to large development	N	No potential impact expected.
17. Landscape		
Change of topography and vegetation by land development and harmonious obstruction by structural objects	N	No potential impact expected.
Pollution		
18. Air pollution		
Pollution caused by exhaust gas or toxic gas from vehicles and factories	Y	Potential impact from workshop construction, operation and increased train traffic.
19. Water pollution		
Pollution by inflow of silt and effluent into rivers and groundwater	Y	Potential impact from discharge of untreated wastewater generated at the workshop.
20. Soil contamination		
Contamination of soil by dust and chemicals	N	No potential impact expected.
21. Noise and vibration		
Noise and vibration generated by railway	Y	Potential impact from workshop construction, operation and increased train traffic.
22. Land subsidence		
Deformation of land and land subsidence due to lowering of groundwater	N	No potential impact expected.
23. Offensive odor		
Generation of exhaust gas and offensive odor by facility construction and operation	Y	Potential impact from workshop activity and increased train traffic.
Overall Evaluation		
Environmental Impact Assessment (EIA) required (Y/N)	Y	EIA is required for the project.

The screening result shows that potential impacts on the natural environment are not expected. On the other hand the potential for environmental pollution through waste generation, untreated wastewater discharge, air quality and noise and odor generation needs to be studied in more detail.

The scope of the expected impacts is examined in Table 9.3.2.

Table 9.3.2 Scooping of master plan GESR project groups

Project	Remarks
I. SOCIAL ENVIRONMENT	
1. Resettlement	**D**
Two public sector entities; the Free Zone Authority and cement factory already own the land on which the new workshop will be constructed. GESR has obtained the understanding of both entities to buy the land from them. Presently some farmers are cultivating part of the site with the owners' permission but nobody lives there.	
2. Economic Activities	**D**
GESR reports that the Free Zone Authority agreed to give up its land because it has plans to construct a new free zone area in another area of the city. If this plan goes smoothly then the authority's economic activity should not be affected by this project. This point needs to be discussed in detail between both GESR and the Authority. The field survey showed that many of the area residents work at the Free Zone Authority. A move by the Authority to another area will impact these people. On the other hand the new workshop is expected to generate jobs and this may have a positive impact on the area. Therefore effort during recruiting should be made to include the residents in this area.. In this way any economic loss resulting from the Free Zone area's transfer to another area may be recovered by the economic gain to be generated from the new workshop operation.	
3. Traffic and public facilities	**B**
Present condition: Only mini buses running on one main road presently serve the traffic to and from the area. During visiting hours to the two prisons along the main road and loading-unloading hours at the free zone authority the traffic congestion on this road becomes very severe. Concerning other public facilities, the project area lacks water supply and wastewater drainage system. Electric power and telephone service is limited. During construction a plan needs to be made concerning the movement of heavy equipments and materials to the site in order that these activities minimize traffic congestion. However at the time of operation it is expected that about 1,000 personnel will be working in the workshop during one shift. With the absence of any road improvement plans in the area there will be a negative impact on traffic there.	
4. Split of communities	**D**
The site location will not cause any split of communities.	
5. Cultural property	**D**
There are no structures at all on the site and the Ministry of Culture does not designate it as an archaeological excavation area.	
6. Water rights and rights of common	**D**
The project will not interfere in any water rights and rights of common.	
7. Public health condition	**C**
It is important to take sufficient measures to safeguard the health of the large working force expected at the workshop. These measures include hazard communication system, fire extinguisher and evacuation system, personnel protective equipment, securing safe working/walking surfaces, minimizing occupational noise exposure, safe materials handling, etc.	
8. Waste	**B**
Waste will be generated during both construction and operation periods. A system should be planned to manage the waste generated at the construction site. During operation there are various sources from which solid and liquid wastes shall be generated. These include sanitary wastes from kitchens and washrooms, and industrial wastes from maintenance area floors washing, parts cleaning, painting, oils and lubricants, equipment washing, wash bay operations, scrap, etc. It is necessary to introduce an integrated solid waste management system comprising waste separation and storage at the workshop, collection, recycling, treatment and disposal. Inspection of GESR facilities shows that at present no such system is applied. That is why the potential for generation of impact on the environment from this activity is rated highly.	

9. Hazards (risks)	**D**
The construction site is relatively flat and no large excavations are planned. Therefore no impact is expected.	
II. NATURAL ENVIRONMENT	
10. Topography and geology	**D**
The construction site is relatively flat and no large excavations are planned. Therefore no impact is expected.	
11. Soil erosion	**D**
A system for rainwater collection and drainage is incorporated in the design. This will act as a countermeasure against erosion of surrounding area after the new workshop is constructed.	
12. Groundwater	**D**
No large excavations are planned and the groundwater table is very deep in the project site.	
13. Hydrological situation	**D**
There are no rivers in the vicinity of the project construction site.	
14. Coastal zone	**D**
The project is not located in the coastal area and therefore no impact is expected.	
15. Flora and fauna	**D**
The environmental quality in the project area is already poor because of the dust from the two cement plants, poor sanitary drainage and poultry farms. In that sense most of the damage has already been done. Furthermore data collected does not show that there are any endangered flora and fauna in the project area.	
16. Meteorology	**D**
The project is not of the scale to generate significant climatic changes.	
17. Landscape	**D**
The surroundings landscape of the project area is already heavily industrial land use. The new workshop will therefore not introduce a new element to the area's landscape.	
III. POLLUTION	
18. Air pollution	**C**
During operation there is a serious potential for air pollution. This condition may result from inadequate ventilation, contamination from inside the building (CO_2 from improper combustion, human respiration; CO from tobacco smoke, fossil-fuel engine exhausts; Nitrogen oxides from combustion products, tobacco, welding fumes, gasoline & diesel engines exhaust; and volatile organic compounds (VOC; from paints, glue), microbial contamination, contamination from sources outside the building as well as contamination from the building materials. The building materials and ventilation inside the building are carefully considered within the design. Dust from the cement plants remains a serious problem and it is necessary to rectify the problem at the plants directly. Preventive measures during operation include operation and preventive maintenance of the heating, ventilation and air-conditioning (HVAC), ensuring that intake air is clean, ensuring that contaminated air is removed from the HVAC system and not re-circulated, and prevention of water accumulation and dampness within the building.	
19. Water pollution	**C**
The potential wastewater pollution sources are outlined in Item 8 of this table. The residents of the area are heavily dependent on groundwater, although there is a plan to extend water supply in the near future. Improper disposal of the generated wastewater at the workshop during operation will lead to contamination of the groundwater source. The design includes an oil separator tank and wastewater treatment system. Therefore under proper operation of the workshop this impact may be overcome.	

20. Soil contamination	**D**
It is feared that the soil in the project site is contaminated by the dust from the cement plants. The waste management system during operation of the workshop will insure that there will be no contamination from wastes generated at the workshop. This is already discussed in Item 8 of this table.	
21. Noise and vibration	**C**
Noise and vibration shall be generated by the workshop operation and increased train traffic to the station. However measures shall be taken in the design to limit the impact. But it may not be possible to completely offset it.	
22. Land subsidence	**D**
The project does not call for large excavations and pumping up of groundwater and therefore no impact is expected on land subsidence.	
23. Offensive odor	**C**
The operation and increased train traffic in the area may generate offensive odors. Measures discussed in Items 8 and 18 of this table are expected to mitigate some of the impact.	
Overall Evaluation	
Comprehensive EIA is required for the project.	
Notes: Evaluation categories: A: Serious impact is predicted, B: Some impact is predicted, C: Extent of impact is not expected to be significant, but further examination is required, D: No impact is predicted, EIA is not necessary	

9.3.3 Overall result

The results of the scoping exercise are summarized in Table 9.3.3. The table shows only the environmental items where impact is expected.

Table 9.3.3 Overall result

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

9.4 Evaluation

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

(1) Muslimia Area Development Plan

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

In order to mitigate some negative environmental impacts the new workshop may have on the surrounding area, the development of these services is necessary. In that sense impacts of the project on traffic and public facilities and waste have been rated as B (some impact is predicted, refer to Table 9.3.2). Although the design and operation plans will incorporate measures to mitigate these impacts, if development in the area continues to lag behind than impact may not be totally avoided.

(2) Workshop Preliminary Design

The workshop preliminary design incorporates wastewater treatment plant and incineration. Ventilation and lighting facilities are included. Storehouses are prepared for storage of dangerous materials. Access to the site will be controlled by fence and gates. Restrooms and canteens are included. The final design should include detailed measures the adequacy of which may then be evaluated.

(3) Workshop operation plan

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

9.5 Impact mitigation considerations

As explained in section 9.1, this is a first step in the process of environmental evaluation that should continue through the detailed design and construction planning stages.

The Environmental Impact Assessment process must be reinforced by institutional, regulatory, technical and public measures. The importance of each is briefly reported in Table 9.5.1.

Table 9.5.1 EIA Process Reinforcement

Reinforcement Measure	Importance
1. Institutions	Institutions assigned responsibility for: • EIA implementation and review • Environmental monitoring • Arresting environmental pollution and punishment of violators • Developing environmental standards
2. Regulations	Laws and regulations for: • EIA implementation procedure • Punishment of polluters and violators • Enforcement of environmental standards
3. Technical	Technological development for: • Implementation of a scientific and sound EIA • Integrating technical solutions to the design, construction, and manufacturing in order to mitigate environmental problems • Implementation of environmental monitoring, collection and analysis of data and identification of present problems and prediction of future ones
4. Public awareness	Develop public awareness to involve the public in: • Public hearings in the course of EIA implementation • Understanding the consequences of environmental mismanagement and monitoring the activities of potential violators • Reporting on environmental violations

It is noted that much remains to be done to strengthen these measures in order to implement a comprehensive EIA for this and other projects of similar significance. Appendix 9 outlines the recommenced measures required. The impact mitigation considerations, which are of relevance to this project and may be adopted during the design, construction and operation stages, are also outlined in the Appendix.

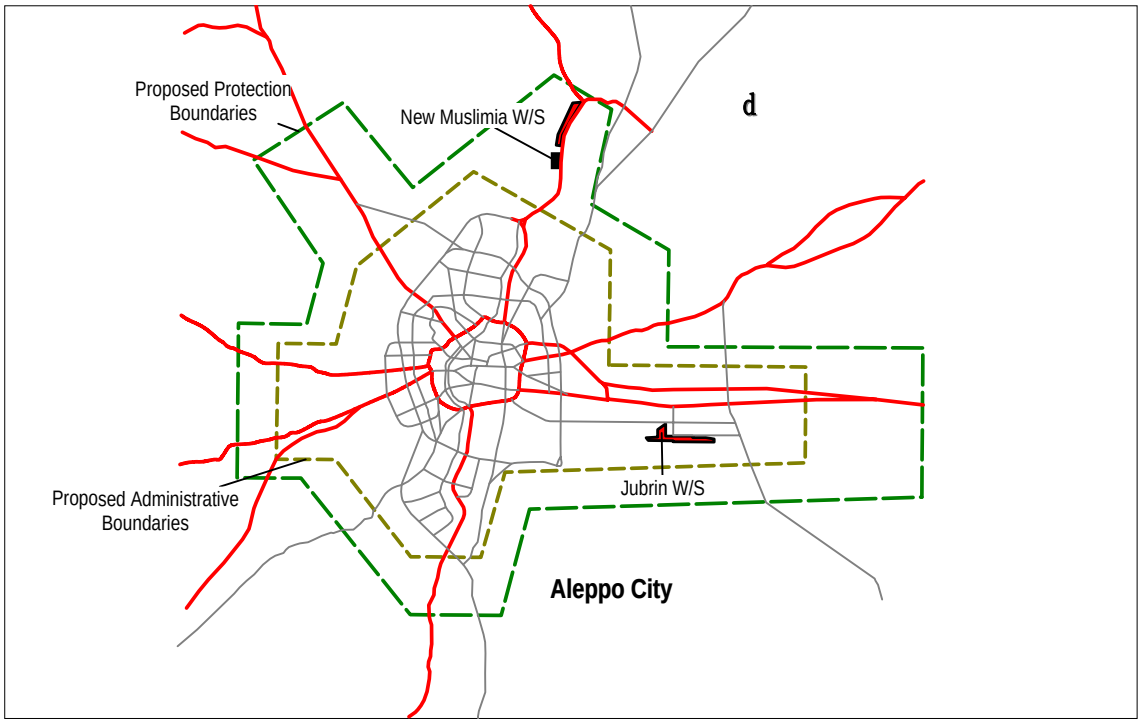


Figure 9.2.1 Project Location

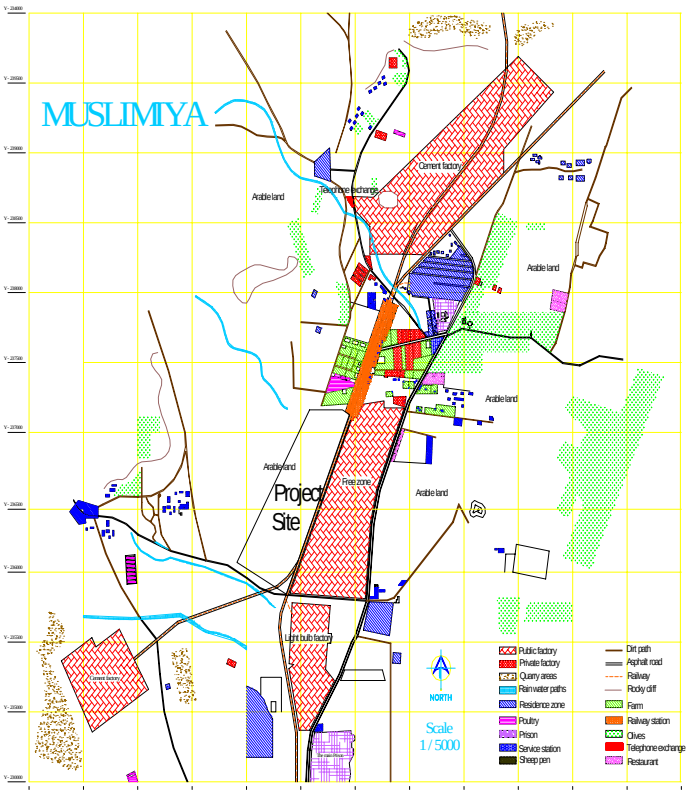


Figure 9.2.2 Land Use

Chapter 10
Conclusion and Recommendation

Chapter 10 Conclusion and Recommendation

10.1 Conclusion

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

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

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

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

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

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

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

reasonable interest loan.

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

10.2 Recommendation

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

(1) Effort for decrease of staying days at the workshop for rolling stock inspection to be continued.

(2) Effort for improvement and enrichment of rolling stock maintenance work and brake shoes casting to be continued.

(3) Effort for raising of workers' net working rate to be continued.

(4) Management and operation of workshop based on some kind of profit and loss account. (To be designated as a special model case for management improvement in GESR)