CHAPTER 10 ORGANIZATION, PERSONNEL, AND TRAINING

CHAPTER 10 ORGANIZATION, PERSONNEL, AND TRAINING

10-1 Organization and Personnel

10-1-1 Train Operation and Electric Locomotive Maintenance

(1) Train operation

a. Electric locomotive crew

Number of locomotive crew will be estimated based on the following conditions:

(a) Locomotive crew will consist of one driver and one assistant.

(b) Current working conditions of the engine crew will be adopted.

(c) The percentage of reserve personnel will be 15%.

(d) The average driving distance will be 160 km/day for passenger train and 85 km/day for freight train.

The number of electric locomotive crews required is shown in Table 10.1.1. Most of them are assumed to be converted from diesel locomotive crews.

Table 10.1.1 Number of Electric Locomotive Crew

Occupation \ Year	1992	1997	2002	2007
Driver	202	21	8	8
Assistant driver	202	21	8	8

In this project, it is presumed that electric locomotive will be manned by two persons. However, if single driver system is to be put into effect, it would be necessary, as practised in JNR, to centralize the control switches in the driver's cab,

and provide backup safety equipment such as dead man's device, one touch operative emergency devices, and automatic train stop devices at the least. Also, such other pertinent matters as training of drivers, revision of applicable regulations and maximum duty distance as determined by physiological limitations must be addressed.

b. Train dispatcher

Organization and personnel will be kept intact, but its efficiency and quality will be improved by providing modern facilities such as CTC system, selective dispatching telephone, teleprinter, etc.

(2) Electric locomotive maintenance personnel

The personnel required will be estimated based on the following conditions.

(a) Two persons per locomotive are allocated at a depot.

(b) Inspection at workshop will take 14 days.

The number of maintenance personnel is shown in Table 10.1.2. Most of them are assumed to be converted from diesel locomotive maintenance personnel.

Table 10.1.2 Number of Electric Locomotive Maintenance Personnel

Year / Occupation	1992	1994	1997	2002	2007
Depot personnel	116	-	12	10	6
Workshop personnel	-	70	-	-	-

10-1-2 Ground Facilities

(1) Electrification

a. Maintenance personnel

The number of maintenance personnel required for substations and overhead line equipment will be estimated considering the manpower required for routine maintenance service as well as that to minimize the trouble restoration time as follows.

(a) The standard staffing of each maintenance base will be 17 persons.

(b) One base will be in charge of a service area of approximately 50 km.

The number of maintenance personnel is shown in Table 10.1.3.

b. On-duty personnel

Each substation requires on-duty personnel for monitoring/controlling the equipment.

Consequently, they must be on 24-hour duty in a two-person team.

The number of on-duty personnel is shown in Table 10.1.3.

Table 10.1.3 Number of Maintenance and On-duty Personnel

Personnel	Number of bases	Number of personnel
Maintenance	6	102
On-duty	3	27

c. Administrative personnel

Administrative personnel in change of AC electrification will be allocated at Head Office, Western Regional Office and Inspections I-III.

d. Organization

The plan of organization related to the electrification facilities is shown in Fig. 10.1.1.

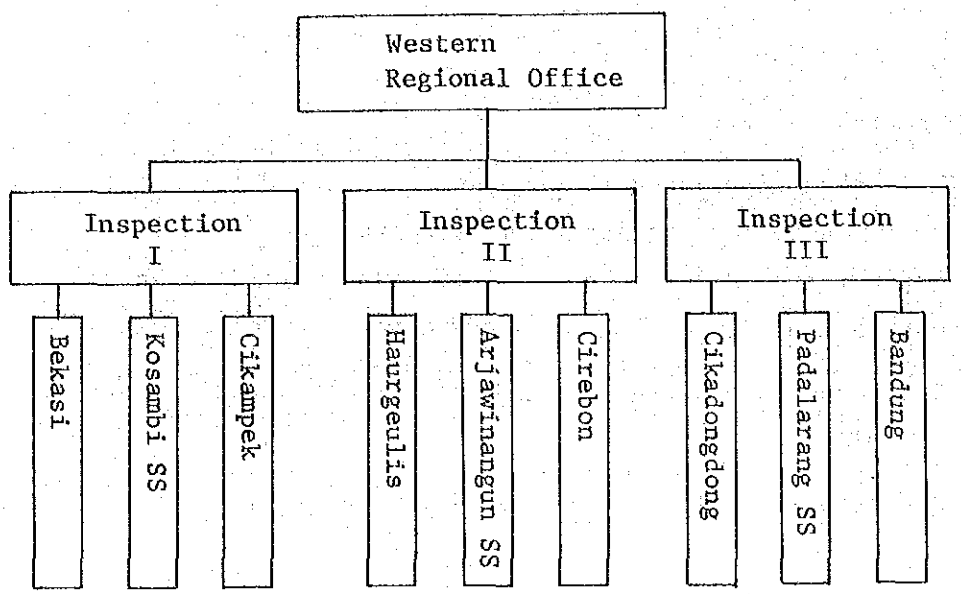


Fig. 10.1.1 Organization Plan Related to the Electrification Facilities

(2) Signalling and communications

a. Maintenance personnel

The current number of maintenance personnel will be kept intact. Although the technical level of the maintenance personnel must be upgraded to cope with the new equipment, such as relay interlocking device, automatic block instrument, CTC, etc.

b. On-duty personnel

Due to increase in speed and density of train operation, troubles/malfunctions of the signalling and communications facilities will seriously hamper the train traffic.

Considering this situation, two-person, 24-hour on-duty system will be adopted. The number of maintenance and duty personnel is shown in Table 10.1.4.

Table 10.1.4 Number of Maintenance and On-duty Personnel

Personnel	Number of bases	Number of personnel
Maintenance	3 inspections	Current
On-duty	3 inspections	27

10-2 Training

10-2-1 Training Scheme

Training will be conducted systematically in two levels at the training center, keeping pace with the improvement of the existing training system and facilities as well as implementation of electrification works. The general training schedule is shown in Table 10.2.1.

Table 10.2.1 Training Schedule

Item	1986	1987	1988	1989	1990	1991	1992	1993
Instructor technical supervisor								
(Training curriculum & instruction manual)								
Skilled worker								
Remarks			New R.T.C. ▼				Commissioning ▼ ▼	

Note: R.T.C. Railway Training Center

10-2-2 Training of Instructor/Technical Supervisor

The quality of instructor/technical-supervisor and training facilities exert decisive influence on the results of the overall training program. Therefore, level-up of instructors/technical supervisors either by dispatching overseas for training or training by foreign experts, as well as the establishment of appropriate training center, must be given priority. The number of instructors required is estimated as follows.

Tale 10.2.2 Number of Instructors

Occupation	No. of personnel
Driver	8
Maintenance (Depot, Workshop)	3
Substation	2
Overhead line equipment	2
Signalling	2
Communications	2

10-2-3 Training of Driver and Locomotive Maintenance Personnel

The locomotive crew training will consist of lecture and practical training on inspection and driving. Maintenance personnel training will consist of lecture and practical training. The training schedule of each course, prepared by assuming 40 persons per class at most, is shown in Table 10.2.3.

A part of the electrification facilities should be put into use at least 8 months before the commissioning in order to enable the driving training.

Table 10.2.3 EL Driver and Maintenance Personnel Schedule

Occupation	Training term	1991	1992	1993
Driver	Lecture and practice 4 months	———	——	
	Driving 4 months	———	———	
Assistants driver	Lecture and practice 2 months	———	——	
	Driving 2 months	——	———	
Maintenance personnel (Depot)	Lecture and practice 2 months	——	—	
Maintenance personnel (Workshop)	Lecture and practice 3 months			———

10-2-4 Training of Ground Facilities Maintenance Personnel

Maintenance personnel for ground facilities will be trained in the training center to acquire basic knowledge and techniques and then engage in the construction work to get practical skill.

The training schedule is shown in Table 10.2.4.

Table 10.2.4 Training Schedule of Ground Facilities Maintenance Personnel

Occupation	Training term	1989	1990	1991	1992
Substation	Lecture and practice 2 months		—	—	
	Construction work		——	——	——
Overhead line equipment	Lecture and practice 2 months		— —	— —	
	Construction work		——	——	——
Signalling	Lecture and practice 2 months	— —	— —		
	Construction work	——	——	——	
Communica-tions	Lecture and practice 2 months	— —	—		
	Construction work	——	——		

CHAPTER 11 INVESTMENT PLAN

CHAPTER 11 INVESTMENT PLAN

11-1 Investment

11-1-1 Premises

a. Estimation is made as of March 1985, excluding inflation factor.

b. Estimation is made for local and foreign currency portions.

c. Exchange rate is as of March 1985 (1 R_p. = 0.235 Japanese yen).

d. Passenger and freight cars are locally manufactured by knock-down system.

e. Electric locomotives are treated as imported goods, although there is a possibility of their domestic production in the future by using technology transferred from foreign countries.

f. Cement, ballast, wood, prestressed concrete poles, steel materials, and wires are locally procured.

g. Most works are conducted by local employees. Wage rate is based on PJKA materials.

Skilled worker	(electrical)	5,500 Rp./day
Skilled worker	(civil)	5,000 Rp./day
Unskilled worker	(general)	2,800 Rp./day

h. Personnel cost for expatriate engineers is estimated in the foreign currency portion.

i. Cost of imported equipment/material is based on CIF price.

j. Customs duty and excise tax on the imported equipment/material is exempted.

k. Of the construction cost of ground facilities, 5 - 10% is allowed for contingency.

11-1-2 Number of Rolling Stock

Number of electric locomotives, passenger cars, and freight cars initially required is as follows.

Electric locomotive	58
Passenger car	107
Freight car	478

The surplus diesel locomotives will be transferred to other sections.

11-1-3 Major Works Related to Ground Facilities

The major ground facilities initially required are as follows.

(1) Substation

Construction of substation	3
Construction of SP, SSP, and AT	30

(2) Overhead line equipment

Installation of feeder line	450 km
Installation of catenary line	500 km
Erection of supporting structure	8,500

(3) Track and structure

Construction of siding	13 km
Replacement of sleeper	150 places
Modification of bridge and aqueduct	12 places
Remodelling of tunnel	1 place
Addition of workshop building	1 workshop

(4) Inspection & repair equipment

Installation in depot	2 depots
Installation in workshop	1 workshop

(5) Signalling facilities

Installation of interlocking device	26 stations
Installation of automatic block system	190 km
Conversion to color light signal	16 stations
Improvement of level crossing safety equipment	54 crossings
Installation of CTC system	135 km

(6) Communication facilities

Installation of underground screened cable	580 km
Installation of automatic exchange	8 places
Addition of UHF carrier equipment	25 sets
Addition of telephone	600 sets

(7) Engineering and training

Designing

Supervision

Training

11-1-4 Initial Investment

Initial investment is shown in Table 11.1.1.

Table 11.1.1 Initial Investment

(Unit: million Rp.)

	Local	Foreign	Total
Rolling Stock	13,500	98,800	112,300
Electric Locomotive	800	76,700	77,500
Passenger Car, Freight Car	12,700	22,100	34,800
Substation	4,400	8,200	12,600
Overhead Line Equipment	10,500	10,400	20,900
Track and Structure	7,000	3,200	10,200
Inspection & Repair Equipment for EL	2,400	8,700	11,100
Power Distribution Lines	800	0	800
Signalling	3,300	10,800	14,100
Communications	1,700	5,300	7,000
Subtotal	43,600	145,400	189,000
Engineering & Training	3,100	12,000	15,100
Contingency	2,300	2,200	4,500
Total	49,000	159,600	208,600

11-2 Project Schedule

The project schedule will be prepared according to the following policy.

a. The Bekasi - Cirebon section which has heavier traffic will be electrified one year earlier than the Cikampek - Bandung section.

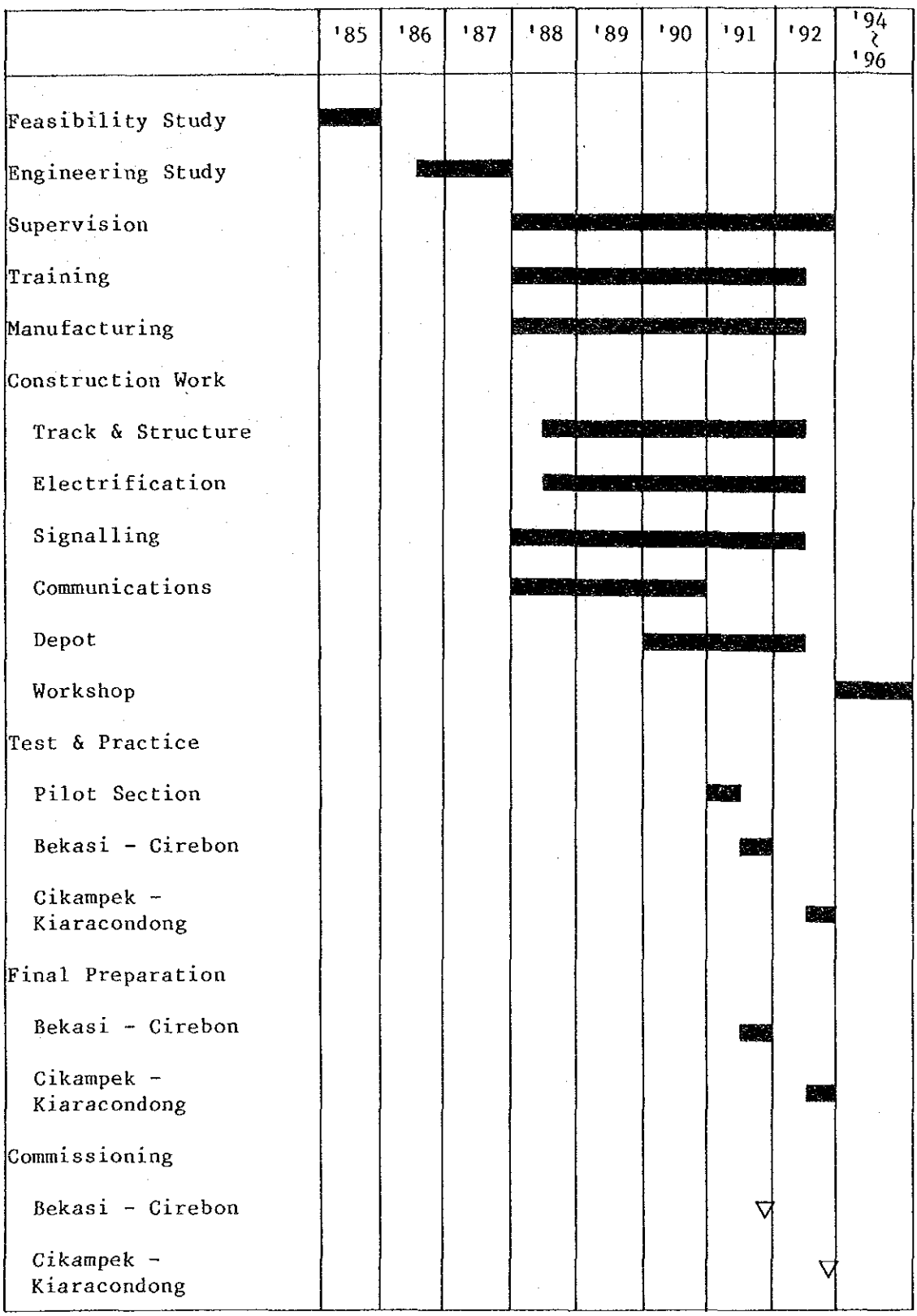
b. A part of the Cikampek - Cirebon section will be electrified in advance as a pilot section.

c. Signalling on the Bekasi - Cirebon section and communications will be improved two years earlier than electrified operation.

d. Track of the Sasaksaat Tunnel will be lowered while continuing train operation.

e. Yogyakarta workshop will be improved in 1996.

Table 11.2.1 Project Schedule



CHAPTER 12 ECONOMIC AND FINANCIAL ANALYSIS AND ENVIRONMENTAL ASSESSMENT

CHAPTER 12 ECONOMIC AND FINANCIAL ANALYSIS AND ENVIRONMENTAL ASSESSMENT

12-1 Economic Analysis

12-1-1 Objective

The objective of economic analysis is to analyze and evaluate this project from the standpoint of the national economy.

12-1-2 Method

The costs and benefits of both implementing the project ("With the Project") and not implementing the project ("Without the Project") are analyzed and compared, and the Economic Internal Rate of Return (EIRR) is then calculated as an index for evaluating the viability of the project.

The costs consist of the investment and operating costs, and the benefit consists of the time saving involved in passenger and freight transport which is assigned a monetary value.

The EIRR is the discount rate which would make the present value of the costs equal to the present value of the benefits. The EIRR is calculated as follows:

$$0 = \sum_{i-1}^{n} Ai/(1+R)^{i-1}$$

Where :

R: EIRR

n: Project life

Ai: Differences of investment and operating cost between "With the Project" and "Without the Project" plus benefit of implementing the project in each year

A sensitivity analysis is conducted for the cases in which traffic demand falls under the predicted value and/or in which the construction cost rises unexpectedly.

Besides the factors included in the EIRR analysis, a study is made of other possible effects of the implementation of the project.

(1) EIRR analysis items

	With the Project	Without the Project
Investment	Railway facilities	Railway facilities
	Rolling stock	Rolling stock
		Bus & truck
Operating cost	Railway maintenance cost	Railway maintenance cost
	Railway personnel cost	Railway personnel cost
	Railway power & fuel cost	Railway power & fuel cost
		Bus & truck maintenance cost
		Bus & truck personnel cost
		Bus & truck power & fuel cost
Benefits	Railway passenger transport time	Railway passenger transport time
	Railway freight transport time	Railway freight transport time
		Bus passenger transport time
		Truck freight transport time

(2) Other analysis items

a. Petroleum consumption saving

b. Improvement of road traffic conditions and reduction of road investment

c. Promotion of related industries

d. Technology transfer

12-1-3 Premises

(1) Analysis period

The analysis covers the 30-year period from the start of construction (1988/2017).

(2) Traffic volume and investment

The relationship between traffic volume and railway investment, the details of which are given in Chapter 4 and in Chapter 11 respectively, is stated as follows:

a. With the Project

Investment in the railway sector will provide the facilities and rolling stock required for traffic demand with the railway transportation service as it is (normal traffic volume) and the traffic diverted from bus and truck to railway as a result of the improved railway transportation service brought about by implementing this project (diverted traffic volume).

b. Without the Project

Investment in the railway sector will provide the facilities and rolling stock required for traffic demand with the railway transportation service as it is.

Investment in the road sector includes the purchase of buses and trucks to handle the road traffic that would be diverted to railway transportation in the "With the Project" case.

(3) Exchange rate

US$1.00 = Rp. 1,101

Japanese Yen 1.00 = Rp. 4.249

(As of March 1985)

(4) Price

The price subtracting tax and adding subsidies, that are regarded as transfer items from the standpoint of the national economy, from/to

the market price as of March 1985 (economic price) is used in this study. The price is fixed for the period of analysis.

(5) Reinvestment

The same amount of the initial investment of depreciable assets is reinvested in the year following the expiration of its useful life.

(6) Residual value

The unamortized portion of depreciable assets and a half of the replacement assets, as residual value, will be counted as negative investments.

(7) Inflation

Inflation is not considered in the analysis, for it is virtually impossible to forecast the inflation rate for the 30-year period.

(8) Diversion of diesel locomotives in the "With the Project" case

The residual value of the surplus diesel locomotives diverted to other sections will be counted as a negative investment at the opening year of electrification.

12-1-4 Investment

(1) Investment items

a. "With the Project" (million Rp.)

Railway	1988/1992	1993/2002	2003/2017
Rolling Stock	75,345	29,664	5,666
Substation & Overhead Line Equipment	39,662	24	12,710
Track and Structure	11,604	461	0
Inspection & Repair Equipment for EL	2,717	10,141	12,858
Signalling & Communications	26,291	6,215	14,813
Total	155,619	46,505	46,047

b. "Without the Project"

(million Rp.)

Railway	1988/1992	1993/2002	2003/2017
Rolling Stock	0	59,732	7,625
Track and Structure	248	0	0
Inspection & Repair Equipment for EL	0	0	0
Signalling & Communications	8,248	895	6,957
Subtotal	8,496	60,627	14,582

Road	1988/1992	1993/2002	2003/2017
Bus	4,018	50,098	78,595
Truck	2,423	27,155	41,653
Subtotal	6,441	77,253	120,248
Total	14,937	137,880	134,830

Data on buses and trucks are, based on information provided by the State-owned Bus Corporation (DAMRI) and other organizations, as follows.

Bus

- Capacity	55 passengers
- Average occupancy rate	70%
- Useful life	6 years
- Traveling distance	100,000 km/year
- Price (economic price)	32,250,000 Rp.
- Others	Bus for middle and long-distance service, air-conditioner not provided

Truck

- Capacity	6 tons
- Average loading rate	90%
- Useful life	7 years
- Traveling distance	60,000 km/year
- Price	16,050,000 Rp.

(2) Economic price adjustment

a. Railway

(a) Foreign currency portion

CIF price is adopted. Import sales taxes, and custom duties are not included.

(b) Local currency portion (materials & facilities)

The price obtained by subtracting the sales tax and other charges from the market price is regarded as the economic price.

An average tax rate of 24.5% for materials and facilities is used to calculate the economic price.

The tax rate prevailing before the introduction of the value added tax on April 1, 1985 is used.

(c) Local currency portion (personnel cost)

No tax adjustment is required for the personnel expenditures because the wage of the average worker (spouse and 3 children) is estimated to be below taxable income.

The allowable deductions from income tax are as follows:

Item	Deduction
Earner	960,000 (Rp./year)
Spouse	480,000 (Rp./year)
Children	480,000 (Rp./year)

b. Buses and trucks

The dealer's price, which does not include the sales tax and the registration charge, is used.

12-1-5 Operating Cost

(1) Railway

a. Maintenance cost

Maintenance cost = Depreciable assets maintenance cost + Replaceable assets maintenance cost + Replaceable assets replacement cost.

where:

Depreciable assets maintenance cost = Total investment of depreciable assets x Maintenance rate.

Replaceable assets maintenance cost = Total investment of replaceable assets x Maintenance rate.

Replaceable assets replacement cost = Total investment of replaceable assets x replacement rate.

Classification of depreciable/replaceable assets, maintenance rate, and useful life is based on the past record of JNR adjusted to PJKA's conditions (See Tabel 12.1.1).

b. Personnel cost

Personnel cost = Increase of personnel by occupation after implementation of the project x Average annual wage by occupation.

Increase of personnel by occupation after implementation of the project:

	1992	2002	2007	(person)
Driver	224	262	272	
Conductor	130	157	163	

Average monthly wage of PJKA employees by occupation

	(Rp./month)
Driver	128,744
Conductor	125,832

Table 12.1.1 Maintenance & Replacement Rate and Useful Life of Assets

		Depreciation/replacement	Useful life	Maintenance rate	Replacement rate
Track & structure	Roadbed	Depreciation	60	0.000468	-
	Road bridge, elevated bridge, railway bridge	"	50	-	-
	Tunnel (track lowering)	"	60	-	-
	Platform	"	50	0.004797	-
	Overbridge	"	50	0.005967	-
	Station	"	60	0.007839	-
	Other buildings depot	"	60	0.006669	-
	Track	Replacement	50	0.003335	0.02223
Signalling & communications	Level crossing facilities	Depreciation	20	0.034160	-
	Signalling facilities	"	20	0.024570	-
	Communications equipment	"	10	0.036504	-
	Signalling cable	Replacement	35	0.001111	0.03176
	Communications cable	"	35	0.001111	0.03176
	Track circuit	"	20	0.001945	0.05558
Power supply & electrification	Substation equipment	Depreciation	20	0.000936	-
	Overhead line equipment	Replacement	45	0.000321	0.02470
	Power distribution facilities	Depreciation	30	0.000321	-
	Transmission line	"	30	-	-
	Building (Substation)	"	60	0.006669	-
Inspection & repair of EL	Mechanical facilities	Depreciation	20	0.03510	-
	Electric facilities	"	35	0.06669	-
Rolling stock	Electric locomotive	Depreciation	30	0.011934	-
	Diesel locomotive	"	20	0.029285	-
	Passenger car	"	30	0.005944	-
	Freight car	"	30	0.017199	-

c. Fuel & power cost

(a) Electric power charge

The electric power charges required for the electric operation are calculated as follows:

- Annual electric power charge = Electric power consumption rate x Annual car-kilometer x Unit energy charge + Annual demand charge

where:

- Electric power consumption rate:
  EL (passenger) 0.76 kwh/car-km (JNR)
  EL (freight) 0.36 kwh/car-km (JNR)
- Unit energy charge:
  58.56 Rp./kwh
- Annual demand charge:
  1,182 million Rp./year

(b) Diesel fuel cost

The fuel cost required for diesel operation is calculated by the following equation:

- Annual fuel cost = Diesel oil consumption rate x Annual car-kilometer x Diesel oil unit price.

where:

- Diesel oil consumption rate:
  DL (passenger) 0.40 liters/car-km (JNR)
  DL (freight) 0.16 liters/car-km (JNR)
- Diesel oil price (economic price) = 236 Rp./liter
  cf. market price of diesel oil = 220 Rp./liter

(2) Buses and trucks

The average cost of maintenance, fuel and others per car-kilometer of buses and trucks, and the annual personnel cost per vehicle are calculated by using the past record.

Unit cost of buses and trucks (Rp.)

	Bus	Truck
Maintenance cost per km	125	41
Fuel and other cost per km	93	71
Personnel cost per year	3,434,400	1,605,000

Note: Economic Price (Rp.)

Diesel oil per liter	236 (220)
Engine oil per liter	680 (850)
Tyre	115,958 (138,375)

Figures within parentheses indicate market price.

Table 12.1.2 Operating Costs (million Rp./year)

		1992			2002			2007		
		with	without	(with-without)	with	without	(with-without)	with	without	(with-without)
Railway	Maintenance cost	2,063	311	1,753	3,330	1,948	1,382	3,523	2,116	1,407
	Personnel cost	542	0	542	642	0	642	666	0	666
	Power & fuel cost	15,837	13,757	2,080	18,227	16,062	2,165	18,823	16,647	2,176
	Total	18,442	14,068	4,374	22,199	18,010	4,189	23,012	18,763	4,249
Road	Maintenance cost	-	10,092	-10,092	-	12,243	-12,243	-	12,676	-12,676
	Personnel cost	-	5,103	-5,103	-	6,031	-6,031	-	6,215	-6,215
	Power & fuel cost	-	10,073	-10,073	-	11,969	-11,969	-	12,346	-12,346
	Total	-	25,268	-25,268	-	30,243	-30,243	-	31,237	-31,237
Total	Maintenance cost	2,063	10,403	-8,340	3,330	14,191	-10,861	3,523	14,792	-11,269
	Personnel cost	542	5,103	-4,561	642	6,031	-5,389	666	6,215	-5,549
	Power & fuel cost	15,837	23,830	-7,993	18,227	28,031	-9,804	18,823	28,993	-10,170
	Total	18,442	39,336	-20,893	22,199	48,253	-26,054	23,012	50,000	-26,988

12-1-6 Time-saving Benefit

Time-saving benefit = Passenger time-saving x Passenger time value
+ Freight time-saving x Freight time value

where:

Passenger time-saving = Saved interzonal transport time x Number of interzonal passengers

Freight time-saving = Saved interzonal transport time x Interzonal freight tonnage

Passenger time value: 156 Rp./(person.hour) (Refer to App. 12-1-1)

Freight time value: 20.78 Rp./(ton.hour) (Refer to App. 12-1-2).

Table 12.1.3 Time-saving Benefit (million Rp.)

	1992	2002	2007
Passenger time-saving benefit	4,025	4,649	4,711
Freight time-saving benefit	-488	-357	-274
Total	3,537	4,292	4,437

12-1-7 EIRR

Based on the differences of investment and operating cost between "With the Project" and "Without the Project", and the benefit of time saving, an EIRR is calculated by computer model, the result of which is included in Appendix 12-1-3.

	EIRR(%)
a. Base case	21.0
b. 20% traffic demand reduction	16.8
c. 20% cost overrun	18.4
d. 20% traffic demand reduction plus 20% cost overrun	14.5

12-1-8 Evaluation

The project has an EIRR of 21%, and therefore, the project can significantly benefit the national economy because the EIRR surpasses by far the opportunity cost of capital in Indonesia (estimated to be 15% in this study).

Furthermore, according to the results of the sensitivity analysis, the EIRR in the most pessimistic case still surpasses the opportunity cost of capital, evidencing the high degree of safety of this project.

The implementation of this project is expected to bring about the secondary effects mentioned below, and it is expected to contribute substantially to solving problems in traffic affairs.

(1) *Reduction of petroleum consumption*

Fuel cost saving is considered as an element for calculating the EIRR, but from the standpoint of diesel oil consumption, the implementation of this project saves approximately 58.3 million liters as of 1992, which is equivalent to saving approximately 462,770 bbls in terms of crude oil.

This value is the summation of diesel oil saving obtained by converting diesel traction to electric traction after the electrification and diesel oil saving of bus and truck resulting from the diverted traffic volume, while the petroleum consumption for electric power generation is not included.

	1992	2002	2007 (million liters)
Diesel oil saving	58.3	68.9	70.5

(2) Improvement of road traffic conditions and reduction of investment in roads

989 buses and 1213 trucks will be saved during the project life period because of the traffic diversion from road to railway as a

result of implementing this project. Therefore, mitigation of traffic jams can be expected on the main roads along the railway. As a consequence, there will be a reduction in both the number of accidents and the cost required to construct and repair roads to handle the increasing traffic volume.

(3) Promotion of related industries

Related local industries will be stimulated and expanded by manufacturing of materials and goods for the project. Furthermore, new industries would be created along with the new demand sectors.

(4) Technology transfer

New technologies, new equipment, and new facilities will be introduced concurrently with this project, and they will result in the technical upgrading not only of the PJKA technical staff but also of the related manufacturing and construction sectors. As a consequence, the project is expected to become a driving force for the future economic development of the nation.

12-2 Financial Analysis

12-2-1 Objective

The objective of financial analysis is to analyze and evaluate the profitability of the project and the cashflow after the opening of the electrification.

12-2-2 Method

(1) The Financial Internal Rate of Return (FIRR) is obtained by calculating the additional investment required for this project, and the additional revenue and increase/reduction of operating cost brought about by the implementation of the project.

(2) The fund raising method suitable for this project is examined from the standpoint of debt repayment capability by determining the cashflow of the project after the opening of electrification.

(3) A sensitivity analysis is conducted for the cases in which the demand forecast value falls under the predicted assumed values and/or in which the construction cost rises unexpectedly.

12-2-3 Premises

(1) Price

The prices of the materials, equipment, commodities, and manpower to be used in this project are as follows:

a. When locally procured

Market price is adopted.

b. When imported

CIF price is adopted, because commodities and equipment to be used in the PJKA business are exempted from import and sales taxes.

(2) Others

As for the analysis period, exchange rate, reinvestment, residual value, inflation and diversion of diesel locomotives after implementing the project, premises are the same as in economic analysis.

12-2-4 Investment

(million Rp.)

	1988/1992	1993/2002	2003/2017
Rolling Stock	76,600	-29,480	-1,896
Substation & Overhead Line Equipment	42,404	28	13,125
Track and Structure	12,324	522	0
Inspection & Repair Equipment for EL	2,760	10,461	13,221
Signalling & Communications	18,652	5,500	8,124
Total	152,740	-12,969	32,574

12-2-5 Operating Cost

The maintenance, personnel, and power & fuel costs are the same as in the economic analysis. The straight-line depreciation method is applied. The market price is used for the diesel oil cost.

Diesel oil (financial) price = 220 (Rp./liter)

(million Rp.)

	1992	2002	2007
Maintenance cost	1,813	1,462	1,479
Personnel cost	542	642	666
Fuel & power cost	2,379	2,532	2,559
Depreciation	2,947	5,756	3,494
Total	7,681	10,392	8,198

12-2-6 Revenue

Revenue is calculated as follows:

Revenue = Diverted passenger traffic (passenger-km) x Unit fare per passenger-km + Diverted freight traffic (ton-km) x Unit tariff per ton-km

Unit fare/tariff:

Passenger	12.0 (Rp./passenger-km)
Freight	25.2 (Rp./ton-km)

Note: PJKA statistics for Java (excluding JABOTABEK) as of 1983.

12-2-7 Fund raising Plan

Direct fund raising by PJKA itself is not required because investment by PJKA is covered by financial resources of the Government.

In this study, however, some financing plans have been included in the analysis of the financial viability of this project. The financing plans and their conditions are as follows.

(1) Financing plan

	Foreign Currency Portion	Local Currency Portion
Plan 1	Government-to-Government Borrowing	Government Budget
Plan 2	Ditto	(50%) Government Budget (50%) Domestic Rupiah Borrowing
Plan 3	Official Overseas Borrowing	Government Budget
Plan 4	Ditto	(50%) Government Budget (50%) Domestic Rupiah Borrowing

(2) Terms and conditions of each financing source

	Interest Rate (%)	Term (years)	Grace (years)	Repayment
Government Budget	-	-	-	Cash payment unnecessary
Government to Government Borrowing	3.5	30	10	Semi-annual installments
Official Overseas Borrowing	9.0	15	4	Ditto
Domestic Rupiah Borrowing	16.5	10	4	Ditto

12-2-8 Results

(1) Cashflow analysis

In the case of financing plan 1, the net income results in a profit of 21,399 million Rupiah from the first year of operation. Furthermore, a net income of 10,787 million Rupiah can be expected in the first year of operation with financing plan 4, which has the highest fund raising cost.

Funds from operation, obtained by adding depreciation to the net income, result in a cash surplus of 24,346 million Rupiah in the first year of operation with financing plan 1.

Table 12.2.1 Cashflow Summary

(million Rp.)

	1992	2002	2007
Financing plan 1			
Revenue	32,942	39,613	40,877
Operating costs	7,681	10,391	8,199
(depreciation)	(2,947)	(5,756)	(3,494)
expensed interest	3,862	4,391	3,366
net income	21,399	24,831	29,312
funds from operation	24,346	30,587	32,806
Financing plan 2			
net income	17,477	24,575	29,236
funds from operation	20,424	30,331	32,730
Financing plan 3			
net income	14,709	24,991	32,057
funds from operation	17,656	30,747	35,551
Financing plan 4			
net income	10,787	24,735	31,981
funds from operation	13,734	30,491	35,475

funds from operation: net income plus depreciation

(2) FIRR

Based on investment, operating cost and revenue stated above, a FIRR is calculated by computer model, the result of which is included in Appendix 12-2-1.

	FIRR %
a. Base case	18.5
b. 20% revenue reduction case	14.7
c. 20% cost overrun case	15.5
d. 20% revenue reduction plus 20% cost overrun case	12.1

(3) Benefit-Cost Ratio (B/C Ratio)

a. Financing plan 1	2.8
b. Financing plan 2	2.4
c. Financing plan 3	2.2
d. Financing plan 4	1.9

The discount rate: 15%

12-2-9 Evaluation

The FIRR of the base case, 18.5%, indicates that the profitability of the project is fairly high. Additionally, even in the pessimistic case of a 20% revenue reduction plus a 20% cost overrun, the project still maintains a safe margin of profitability with a FIRR of 12.1%.

From the cashflow standpoint, the project is expected to be viable under all financing schemes, and to contribute to improving the financial situation of PJKA.

12-3 Environmental Assessment

Impact of railway electrification on society and the natural environment is assessed as follows.

(1) Air Pollution

Diesel trains and automobiles generate air pollutants such as nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbon (HC), sulfur oxides (SOx) as a result of the combustion of light oil and gasoline.

The emission of these pollutants must be controlled because they are detrimental to the health of human beings.

The share of NOx, CO and HC emitted by automobiles in Japan is shown in Table 12.3.1. This data reveals how automobiles significantly contribute to air population.

The volume of air pollutants emitted by diesel trains is negligible compared with those by large number of automobiles; nevertheless, CO and unburned HC from diesel trains are disagreeable to passengers.

Electric railway causes no air pollution. Furthermore, the pollution emitted from a thermal power station is generally low, and preventive measures are relatively easy to implement.

Table 12.3.1 Pollutants in the Air Emitted from Automobiles

Pollutants	Percentage share of pollutants emitted from automobiles
NOx	39%
CO	93%
HC	57%

(2) Noise and Vibration

The noise and vibration generated by train operation grows with an increase in the speed of trains, axle load, number of trains and deterioration of track conditions.

Accordingly, both will increase to some extent as a consequence of electrification, but not significantly.

(3) Inductive interference in communication lines

As stated in section 7-4, communication lines will be immunized against inductive interference by replacing open wires with underground screened cables.

(4) Safety

As for personnel working on the track, they should be thoroughly trained on the prevention of electric shock from high-voltage electrification equipment.

Furthermore, to protect the public a campaign on the danger of high-voltage electricity should be carried out together with installation of protective fences.

(5) Others

Careful attention should be paid to noise and vibration generated by the construction works.

CHAPTER 13 CONCLUSION AND RECOMMENDATIONS

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13-1 Conclusion

Inter-zonal railway transportation demand in Java island was forecast for both "With" and "Without the Project" cases.

This demand forecast was used as the basis for a technical study to formulate the electrification plan in consideration of present conditions. The technical study concludes that the project is technically feasible at the minimum cost.

The investment plan based on the technical study was then made as the basis for the economic and financial analysis. These show that the project would greatly contribute to the economic development of Indonesia, and that it is financially viable for the Indonesian State Railways.

The implementation of the project is, therefore, highly recommended.

13-2 Recommendations

Electrification is the most effective step to modernize a railway system.

In general, electrification complemented by modernization of related signalling and communications will improve the competitiveness of railway transportation by achieving high-speed, high-hauling capacity, high-frequency and high safety, in addition to saving petroleum and maintenance cost. It is no exaggeration to say that the railway is renovated.

This study was conducted based on this basic philosophy, hoping that the Indonesian State railways will make a great leap forward with electrification.

Some recommendations are made in the following, to contribute to smooth implementation of this project and satisfactory operation thereafter.

(1) Maintenance

It is indispensable to keep the rolling stock and ground facilities in satisfactory conditions to realize safe and reliable transportation service.

For this purpose it is necessary to establish efficient and rational criteria and methods, to introduce modern maintenance system, and to level up maintenance personnel capability.

(2) Continuous training of personnel

To keep up satisfactorily maintenance and operate the electrified railway, the continuous training of related personnel at railway training center is indispensable.

(3) Establishment of new standards of rolling stock and facilities

During the engineering stage, it is necessary to establish standards of new rolling stock and facilities considering smooth and efficient construction and maintenance.

Compatibility with related facilities as well as future expansion of electrification should be taken into consideration.

(4) Track doubling of the Cikampek - Cirebon section

This single track section has the highest traffic, and further increase is forecast after the electrification project is implemented.

Therefore, double tracking of the section should be studied as *soon as possible.*

(5) Safety measures for pedestrian against high-speed train

The train speed will substantially increase by electrification. Therefore, pedestrians in the railway premises should be prohibited.