It will be necessary for the VNR to consult with the power companies on the work processes and division of work, etc. in connection with the work to construct the power supply and distribution facilities. If these consultations take too long due to the large number of prospective work sites, the progress of the actual work may be adversely affected. The urgent preparation of a work implementation plan and prior consultations with the power companies are, therefore, essential.

7.4.2 Signalling Facilities

(1) Replacement of Semaphore Signals by Colourlight Signals

There is a total of 162 passenger stations on the Hanoi - Ho Chi Minh Railway, including the end terminals. With the proposed 4 signalling stations, the number of stations on the improved line will increase to 166. At present, 23 stations have electric colourlight signals while the remaining 139 stations use semaphore signals. The display recognition distance for semaphore signals at night is less than 400m (sometimes even less than 100m) depending on the weather. Together with the development of the power supply facilities, therefore, these semaphore signals will be replaced by electric colourlight signals (multiple colourlight signals) in response to the train speed up and demand for improved train operation safety.

(2) Installation of Class 2 Relay Interlocking System

The introduction of colourlight signals will be followed by upgrading of the interlocking system to the Class 2 relay interlocking system for smooth manipulation of the electric signals and safe train operation. This interlocking system will allow signalling control by a control panel which is also equipped with the tokenless block device while the points are operated on-site.

The installation of the Class 1 electric relay interlocking system at the Hue, Dieu Tri and Song Than Stations in approximately 10 years time is planned. The installation of the Class 2 relay interlocking system can, therefore, be regarded as advance investment in preparation for the future upgrading to the Class 1 system to ensure safer train operation during the transitional period.

(3) Improvement of Signal Power Source and Anti-Power Stoppage Measures

The introduction of colourlight signals and relay interlocking system will increase the power consumption, necessitating an increased emergency power source capacity. As improvement of the distribution line will make it possible to use an alternative current for the signalling facilities, the following power source improvements will be made.

1) The existing, deteriorated power source will be replaced. One of the following will apply to those stations which currently have no power source.

2) Those stations with 5 or more tracks will receive high voltage power and an engine generator (EG) and batteries capable of supplying the necessary power for approximately 5 hours at the time of an EG failure will be provided.

3) Those stations with upto 4 signalling circuits will receive low voltage power and batteries capable of supplying the necessary power for 10 hours will be provided.

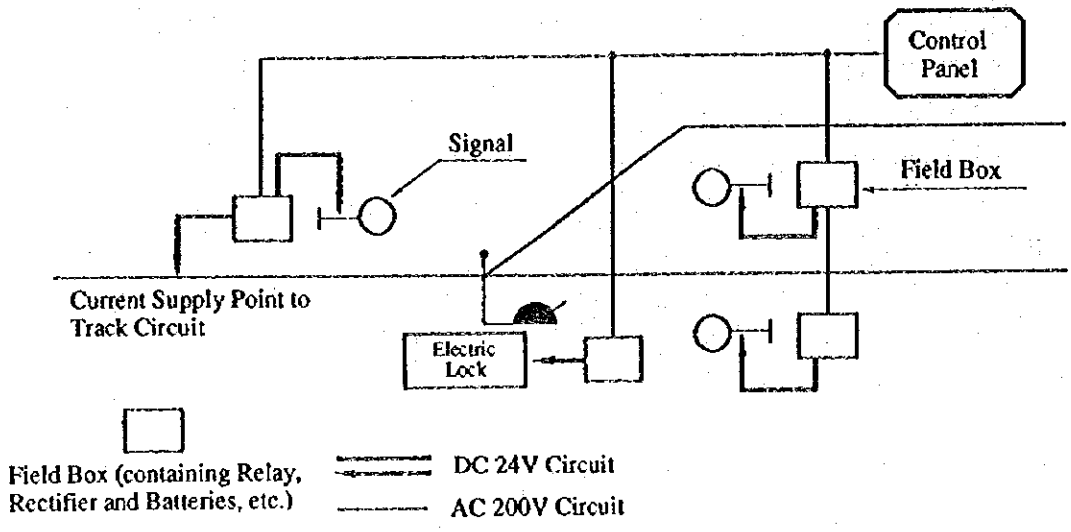

Fig. 7.4-1 Power Supply Circuit

(4) Installation of ATS Equipment

All locomotives will be equipped with an ATS equipment to safeguard train operation by preventing trains from entering or departing stations in disregard of the signal display. ATS ground elements will be placed along the track as part of the equipment. When a train ignores the stop display of a signal and passes an ATS ground element linked to the ignored signal, an audio and/or visual warning will be issued by the ATS equipment on the train. If the driver does not respond to the warning in a certain manner, the emergency brake on the train will be activated. An ATS ground element should be placed immediately below all signals. In the case of the home signal or departure signal of a through track, an additional element should be placed. The installation of the ATS equipment will be phased, commencing at priority sections. The selection of the sections to be constructed at the early stage is extremely important to minimise unnecessary confusion on the train operation prior to the complete installation of the ATS equipment along the entire route.

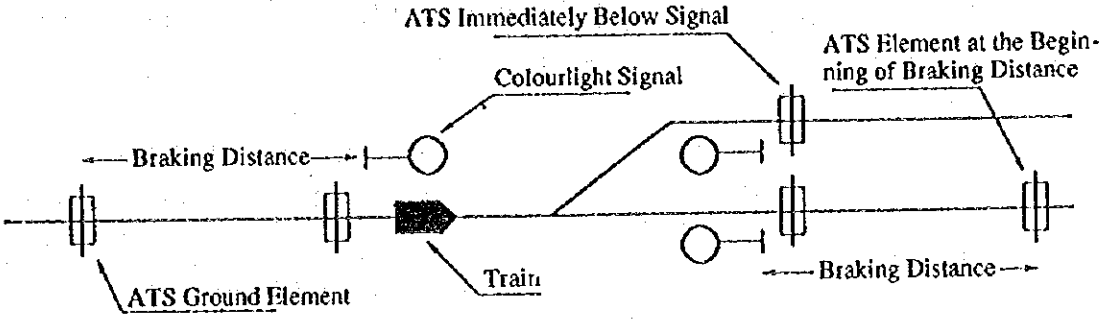

Fig. 7.4-2 ATS System

(5) Train Approach Warning System for Level Crossings

There are 200 major level crossings which require improvement. While improvement of all level crossings on the route in a short period of time is desirable, a phased improvement plan is opted for in view of the likely available investment funds for this purpose in each phase. In Phase 1, 57 manned level crossings will be improved. As these level crossings have a manual gate, an automatic train approach warning system will be installed at each level crossing to enable the accurate operation of the gate in order to minimise the adverse impacts of gate operation on road traffic. The remaining 143 level crossings are unmanned, necessitating the introduction of a warning system and an automatic gate which will cost some 50% more than the improvement cost of manned level crossings. Due to the large number of unmanned level crossings, the total investment size is quite large and this is mainly why the improvement work at unmanned level crossings will be conducted in Phase 2. The actual implementation of the improvement plan should be preceded by careful planning and collection of vital data through surveys on necessary width of level crossing and the road traffic volume at level crossings, etc.

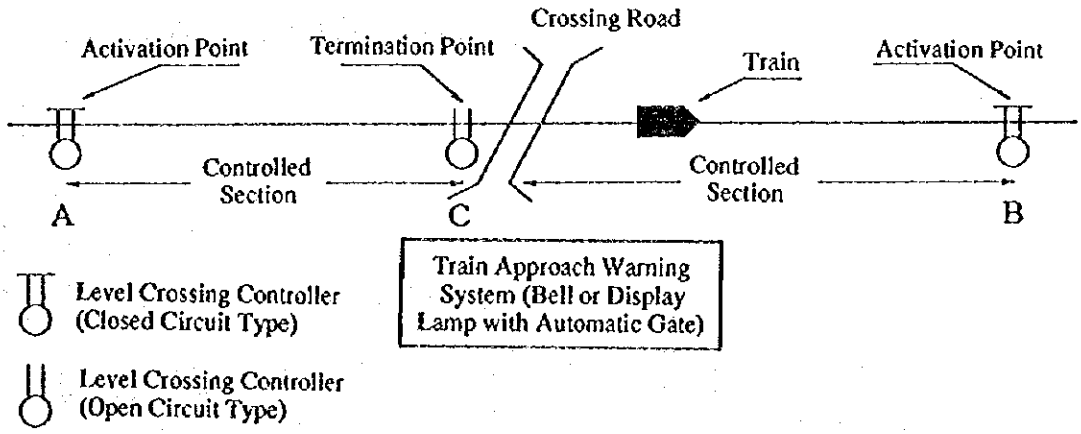

Fig. 7.4-3 Layout of Train Approach Warning System for Level Crossings

The type of automatic level crossing warning system of which the use is planned under the Optimum Alternative functions in the following manner.

When a train passes activation point A or B located several 100m from the level crossing, the warning system is activated and a command to lower the gate is issued. The gatekeeper manually lowers the gate in the case of a manual gate while the gate is lowered automatically to shut off the crossing road in the case of an automatic gate. When the front of the train passes termination point C located near the crossing road, the warning is terminated. Train location information is given by a short track circuit which is connected to points A, B and C.

(6) Introduction of Class 1 Relay Interlocking System

The Class 1 relay interlocking system will be introduced at 10 key stations, consisting of 8 stopping stations for limited express trains and 2 freight stations, i.e. Giap Bat and Song Than where the FC yard operation is rather complex. Under the Class 1 relay interlocking system, following signalling each point on the train route is switched to the signaled direction (integrated central control) and locked. Consequently, an on-site point operator is not required. In addition, efficient and safe train operation can be expected due to the much reduced risk of mistakes in point operation. The interlocking system at the Da Nang Station will have the added function of remotely controlling the Thanh Khe Signal Station.

(7) Outline of Construction Plan

As the import of the Class 1 relay interlocking system, ATS ground element and train approach warning system for level crossings, etc. has been decided, foreign engineers will be appointed for work supervision, system testing/adjustment and technical guidance. The work involving other equipment will be conducted by Vietnamese engineers. Table 7.4-1 shows the components of the construction plan and its implementation phases.

Table 7.4-1 Phased Improvement Plan for Signalling Facilities

Item	Work Involved	Phase 1 (1994–2000)	Phase 2 (2000–2005)	Phase 3 (2005–2010)
Colourlight Signals	Simultaneous introduction of Class 2 relay interlocking system	←		
Signal Power Source	Additional batteries or EGs	←		
ATS System	Placing of ATS ground elements below signals and beginning of braking distance for home and departure signals	(40% of workload)	(60% of workload)	
Train Approach Warning System for Level Crossings	Installation of activation/ termination points and automatic gate	(57 level crossings)	(143 level crossings)	
Class 1 Relay Interlocking System	Introduction of Class 1 relay interlocking system; remote control of signalling station			←
New Signalling Stations	4 sites			←

7.4.3 Communication Facilities

The National Transport Sector Review by the UNDP does not classify improvement of the communication facilities in the highest priority category and instead calls for a decision on the overall requirements in this field prior to the preparation of the relevant improvement plan.

However, the present Study has found the deterioration of the carrier system for long-distance communication to have further progressed and judges that the absence of any improvement until 2010 will result in the collapse of the dispatcher telephone system which is the minimum communication method required for the railway service.

While it could be argued that the lines owned by a communication company may be rented for long-distance communication services, the VNR has already concluded that it will be impossible to meet its requirements through consultations with such a company.

The future communication demand forecast indicates a need for increased lines by 2010 due to the following two reasons.

① Need to establish large capacity data communication lines following the introduction of computers for the MIS (Management Information System) and other systems.

② Need to establish a switchboard-operated telephone system to meet the general telephone requirements of the VNR and a similar network for facsimile transmission which is likely to become essential in the future.

Having examined the above prospects, the following improvement and consolidation of the communication facilities should be conducted.

(1) Communication Line

A new compound communication cable consisting of 8 optical conductors and 30 pairs of metal conductors will be used for the entire communication line and will be buried underground in view of efficient maintenance.

(2) Transmission Facilities

At present, the popular systems for long distance transmission are the optical cable transmission system and radio transmission system. Having compared the advantages of these 2 systems, the former is adopted for the present purposes based on the following conclusions.

- Practically the same investment cost

  Even if the radio system is opted for, communication cable must be laid along the entire track, resulting in a large construction cost. The radio system requires more relay stations than the optical system due to its shorter relay distance.

- More difficult construction work of the radio system

  Because of the characteristics of radio waves, relay stations are generally constructed on mountain tops, necessitating additional work compared to the work for the optical system, which (such as the delivery of construction materials and power supply extension, etc.) only takes place around the stations. In addition, the expected development of urban areas with multi-storey buildings in the coming years makes it difficult to determine the correct antenna height for the radio system to avoid the obstruction of radio communication.

- Easier maintenance of optical system

  The maintenance area for the optical system is virtually the same as that present area. In contrast, the radio system requires maintenance personnel to travel to the relay stations on mountain tops, demanding greater man-hours for maintenance purposes.

- Theft prevention

  The optical system is safer than the radio system as it is buried underground. The relay stations on mountain tops are vulnerable to theft with substantial damage.

The optical system will have 180 lines (2 Mbit/sec × 6) to start with but will be able to accommodate upto 480 lines (8 Mbit/sec × 4).

To compensate for increased loss due to the use of cable, metal conductors will only be used for upto 30 km. A UHF small capacity transmission unit will be installed for sections of longer than 30 km. The communication network is shown in Fig. 7.4-4.

(3) Telephone Exchange Equipment

The present manual exchange equipment with 30 or more lines (total of 14 equipment) will be automated. Because of the likely increase of users, the present capacity of all the equipment will be doubled. Moreover, a small capacity equipment (around 20 lines) will be installed in those places where the UHF transmission unit described in (2) above is installed. The exchange network will be composed as shown in Fig. 7.4-5 with re-arrangement of the dialling codes as shown in the same figure to enable nationwide direct dialling.

(4) Data Communication Facilities

A system capable of advance reservations on limited express passenger trains will be established to improve passenger services. The central unit will be located in Hanoi with terminals installed at those stations at which limited express trains stop. Stations without a terminal unit can issue tickets by communicating with the terminal installed at the Union Office via telephone.

A freight information system will be established for the modernisation of freight transportation services and efficient FC operation. The central unit will again be located in Hanoi with terminals installed at those stations with a large cargo handling volume as well as at Union Offices and Head Office controlling FC operation.

(5) Terminal Facilities

The following measures will be adopted to improve the terminal facilities.

- All telephones on all station premises will be renewed.
- A radio system will be introduced to improve the communication link between stations and those in charge of the points, bridge/tunnel watchmen and gatekeepers at level crossings.
- All stations and offices related to train operation will be provided with at least 2 telephone lines and a facsimile machine will be provided where required.
- A talk-back system to assist work-related communication will be provided at 16 major stations where shunting and other work is frequently conducted on the premises.
- A telephone terminal box will be installed at 1 km intervals along the entire route to enable communication between workers and nearby stations.

(6) Power Sources

The present power sources will be entirely renewed due to their inability to meet the increased load. In the case of AC power sources, engine generators will be provided and the power receiving facilities will be expanded. These will serve both the communication facilities and signalling facilities. The generators will be located in those places where the optical transmission system is installed but not in those places where a UHF radio unit is installed. Measures to protect the power receiving facilities from lightning will be implemented. Most of the DC circuits will use 48 V and will be provided with a rectifier and battery as a reserve a power source.

(7) Construction Plan and Investment Cost

The phased construction plan for the communication facilities is shown in Table 7.4-2. The estimated investment cost is given in Appendix 7.4-2. The following points were taken into consideration when estimating the investment cost.

- All equipment and materials will be of foreign origin except construction materials.
- The actual construction work will mainly by conducted by Viet Namese while foreign engineers will be involved in work management/supervision and the completion testing of facilities.
- Power sources and buildings common to each facility are included in the transmission facilities.

Table 7.4-2 Phased Improvement Plan

Item	Phase 1		Phase 2		Phase 3	
	1996	2000	2001	2005	2006	2010
Communication Cable						
Transmission Facilities						
Data Communication Facilities						
Telephone Exchange Equipment						
Terminal Facilities						
Educational/Training Facilities						

(8) Miscellaneous

A central control system will be introduced to monitor the operation of the various communication systems. The location of a control room at the VNR's Head Office is desirable for central operation control. However, regional control by the Union Offices is acceptable if a nationwide central control system proves difficult to establish in a relatively short period of time.

The newly introduced equipment will be installed in the present equipment rooms. If no equipment room is currently available, a new equipment room will be constructed to accommodate the equipment, including that relating to the signalling system. The new equipment rooms will be air-conditioned to ensure the stable operation and long service life of the new equipment.

A sufficient quantity of instruments and tools to maintain the new equipment will be provided at the time of introducing the new equipment. Extra equipment and tools, etc. which are mainly the same as the new equipment and tools, etc. to be provided for the VNR will be provided for the railway college for educational and training purposes.

The new telephone and data communication networks will be exclusively used by the VNR and no external links will be considered. The reasons for this are that external links would increase the investment cost and that the expected communication level does not justify such external links.

In connection with the future communication network of the VNR, it is useful to briefly discuss the future prospects of the VNR's factories which manufacture signalling and communication-related items. The prospect of the future development of these factories is rather bleak if their activities are limited to the VNR's requirements and their business perspective should be expanded to including national demands. For example, the production of road traffic signals should be considered in addition to railway signals. In the case of electric wires and cables, the mass production of general-purpose power cables and communication cables could be put on the agenda. Review of the future of these factories, including the option of importing foreign technologies in cooperation with organizations which have extensive production facilities for electrical items, appears necessary.

There is another possibility in regard to the establishment of an optimum communication system under the Optimum Alternative. The new optical communication system has so far been discussed solely in connection with the VNR. The optical fibre cables linking

Hanoi and Ho Chi Minh City can, in fact, create a communication system with tens of thousands of lines with the introduction of upgraded, large capacity transmission facilities. This prospect warrants further consideration in regard to the possibility of using the new network not only as a VNR network but also as a national communication network.

7.4.4 Maintenance System

The first consideration for the future maintenance of the VNR's new signalling and communication facilities is improvement of the efficiency. Improved maintenance efficiency should partly be achieved by separating those facilities which require preventive maintenance to prevent accidents and breakdowns from those facilities for which post-breakdown maintenance/repair is sufficient. Further improvement of the maintenance efficiency is possible if the work is supported by the compilation of relevant statistics and data and the introduction of appropriate inspection intervals determined by a scientific method using accurate statistics and data, including those on breakdowns and accidents.

The first step is, therefore, the preparation of accurate statistics and data and the establishment of the best method of preparing them. One important point is that these statistics and data should not be prepared for the sole use of the Hanoi - Ho Chi Minh Railway but for national railway services in Viet Nam. Through the adoption of a national perspective, railway maintenance throughout Viet Nam can be standardised for better efficiency.

Given the scope of the new facilities, the separate maintenance of each type of facility will be difficult following the completion of the improvement work. The new maintenance system should, therefore, consider the entire route as a single maintenance district with no regional boundaries. This will necessitate the location of a central maintenance office at the VNR's Head Office. In practical terms, the required central maintenance of the new facilities can only be conducted by the VNR's Head Office and, therefore, the VNR's Head Office must be reinforced in terms of manpower and facilities.

Under the overall control of the Head Office, the actual on-site maintenance work will be conducted by the signalling or communication depots. As there are only 4 depots at present, it may be necessary to increase the number of depots to ensure the proper management and implementation of maintenance work.

One of the most important future tasks for maintenance staff is to master the underlying technologies and maintenance skills for the new facilities. One way to do this is for maintenance staff to undergo specific training with the manufacturers. As most of the new

signalling and communication equipment to be introduced is totally new equipment for Viet Nam, it appears that the best way for Viet Namese maintenance staff to obtain the necessary knowledge and technical expertise is for them to learn from the respective manufacturers. In the case of communication facilities, it is advisable that the relevant staff be sent to the Vietnam Telecommunication Corporation for training as this Corporation already has and operates the key facilities/systems to be introduced for the Hanoi - Ho Chi Minh Railway.

Those who are suitably trained will then be responsible for the implementation of the facility construction/installation work under the supervision of engineers dispatched to Viet Nam by the manufacturers. They can further improve their technical knowledge and skills under this supervision and will transfer their knowledge and skills to other workers of the VNR with the overall result of improved technical ability throughout the VNR organization.

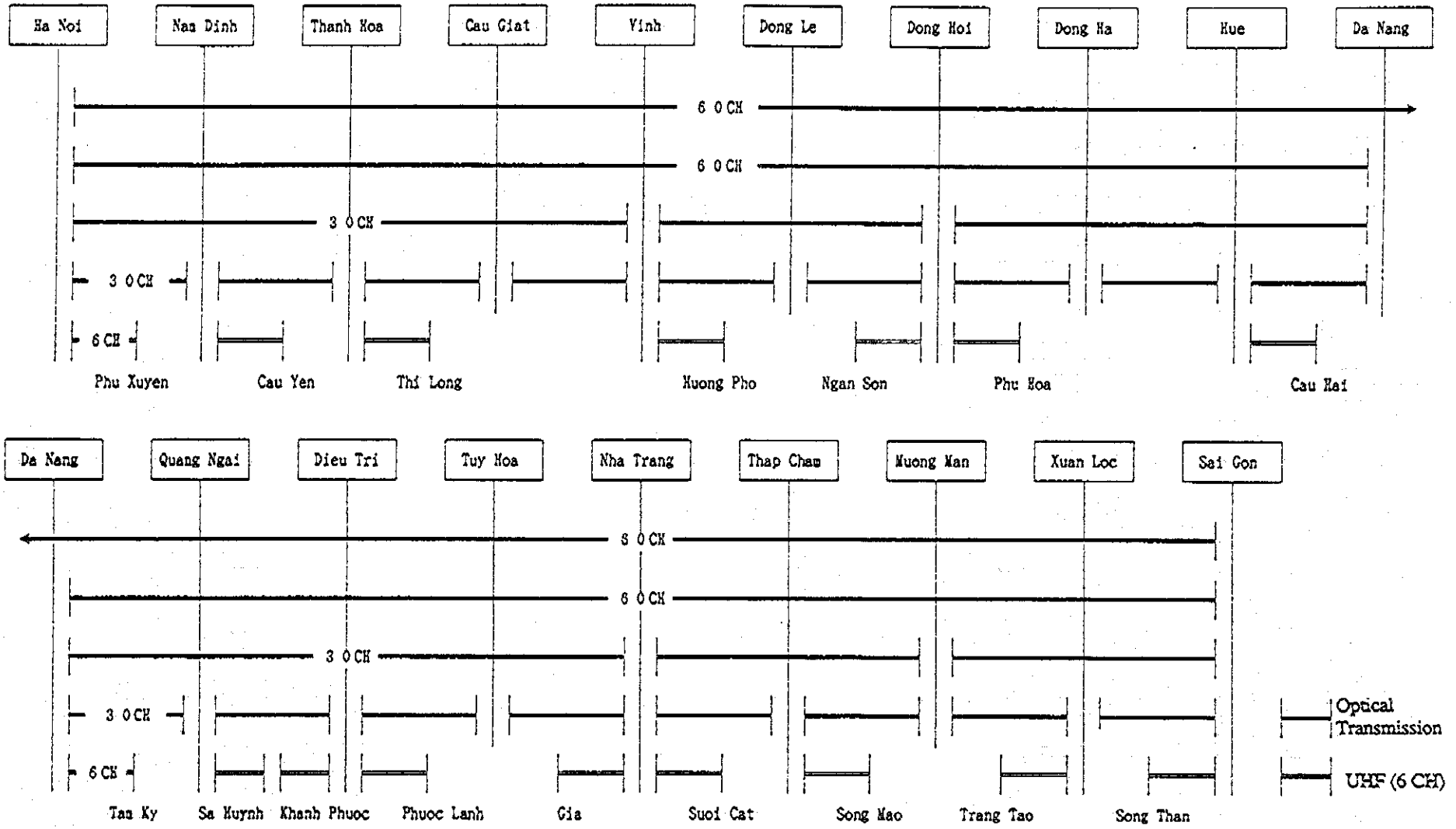

Fig. 7.4-4 Transmission Facility Network

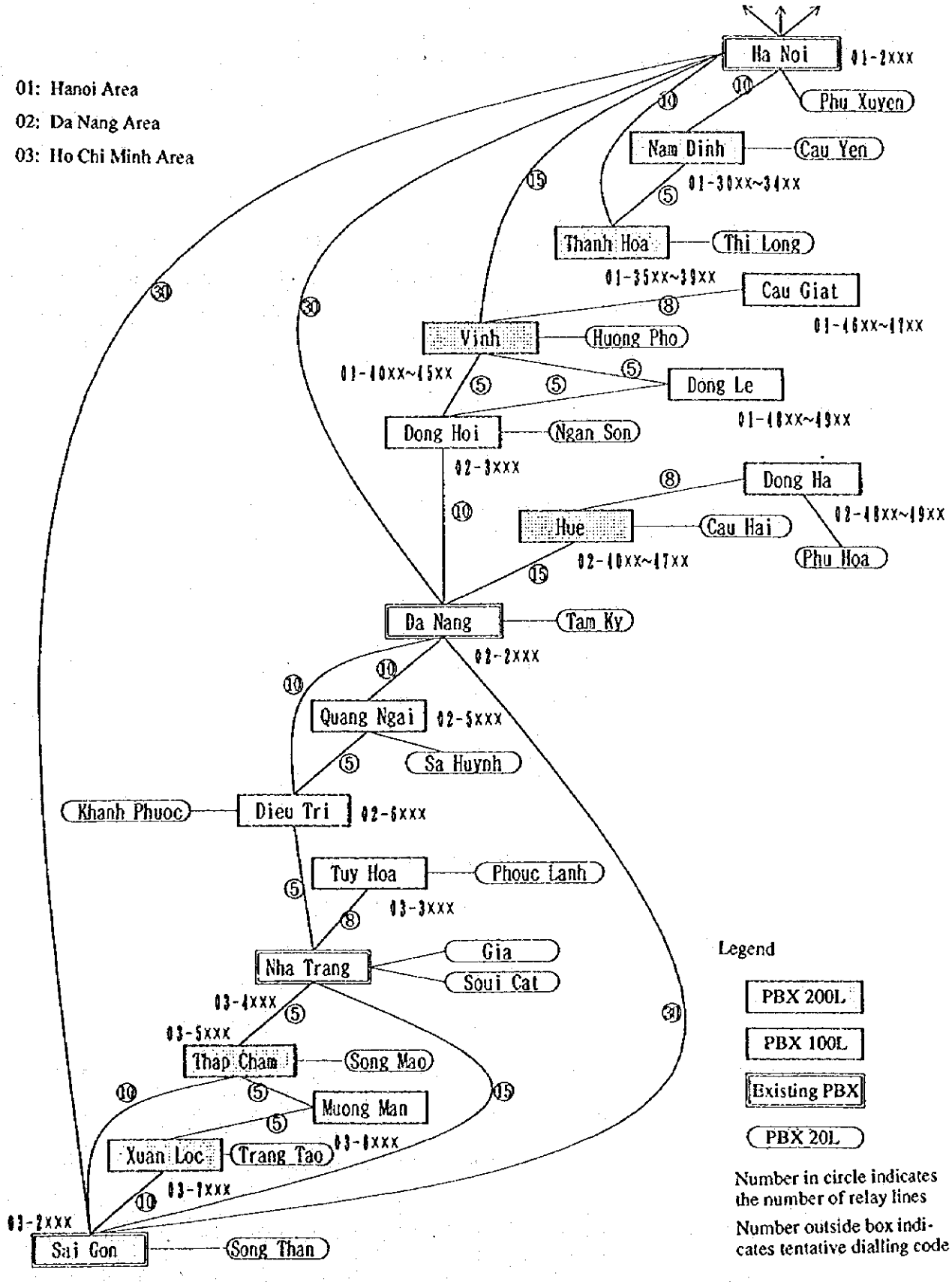

Fig. 7.4-5 Telephone Network

7.5 Rolling Stock and Its Maintenance

7.5.1 Rolling Stock

(1) New high speed train

New high speed train between Hanoi and Ho Chi Minh City is to be push-pull type train from view points of manufacturing cost, maintainability and passenger room's noise and vibration. Appendix 7.5-3 shows comparison between push-pull type train and diesel autorail train.

(2) Rolling stock plan upto 2010

1) Preconditions

(a) Existing ten D11H, forty D12E, fourteen D13E and sixteen D18E locomotives are exclusively used on Hanoi - Ho Chi Minh Railway.

(b) The new locomotives will be D12Es and D18Es in view of locomotive standardisation.

(c) The existing D11H (10 locomotives), D12E (40 locomotives), D13E (14 locomotives) and D18E (16 locomotives) will be rehabilitated after the age of rolling stock will reach 15-20 years old.

(d) D11H and D13E will be utilised as equivalent to D12E.

(e) Dining car (HC), baggage car (HL) and mail car (BV) are treated as service car (S) and one service car is connected to each train.

(f) Passenger train configuration is assumed as follows.

Limited Express (New high speed train):	$DEL + 2\times A_N + 3\times B_N + 2\times A + 2\times B + 1\times S + DEL$
Limited Express:	$DL + 1\times A_N + 3\times B_N + 2\times A + 2\times B + 1\times S$
Express (Middle distance):	$DL + 1\times A_N + 3\times B_N + 1\times A + 3\times B + 1\times S$
Express (Short distance):	$DL + 1\times A + 4\times B + 1\times S$
Local:	$DL + (2 \text{ to } 4)\times (B \text{ and/or } C) + 1\times S$

2) Summarization of existing number of rolling stock for Hanoi - Ho Chi Minh Line

Based on the received data, existing number of rolling stock calculated as of 2000 is as shown in the following Table 7.5.1-1.

Table 7.5.1-1 Existing Number of Rolling Stock as of 2000

	2000	2005	2010	Remarks
Locomotive D4H	150	120	96	*1
D9E	28	22	17	*2
D11H	10	10	10	*3
D12E	40	40	40	*3
D13E	19	19	19	*3
D18E	16	16	16	
PC	453	293	75	*4
FC	1,739	1,148	188	*4

Remarks:
*1 Available number of D4H in December, 1994, is 190. It is assumed that 20% of available D4Hs will be condemned by cannibalization for family D4Hs during successive five years. D4H is used only for local passenger train and for shunting locomotive.
*2 According to the counter part comment, 28D9Es will remain in 2000 without cannibalization and 10 to 15 D9Es are preferable to be rehabilitated. As described later, D12E class locomotives will become surplus and so it is recommendable that D9E should be kept only by cannibalization for family D9Es and be used for local passenger trains substituting for D12E class locomotives. Therefore, the existing number of D9Es is calculated in same manner as D4H.
*3 D11H, D12E and D13E are treated as D12E class locomotives. Number of D13Es in 2000 is counted as 19, because 5D13Es are planned to be procured in 1996. Therefore, total number of D12E class locomotives is 69.
*4 As for PC and FC, the calculation method for the existing number in 2000 is explained in much detail in clause 8.12.5 of Volume 2. Therefore, we do not repeat on that, here. Calculation method for the existing number in 2005 and 2010 is similar as that in 2000.

3) Required rolling stock number by improvement stage is shown in table 7.5.1-2.

4) Table 7.5.1-3 shows the detailed classification of Table 7.5.1-2 in 2000. In table 7.5.1-3, D12E means D12 class locomotive consisting of D11H, D12E and D13E.

5) Phased rolling stock plan upto 2010

According to Table 7.5.1-2, necessary number of D12Es is 70 in 2005 and 65 in 2000. In order to avoid useless investment, therefore, D4H, D9E, D12E and D18E are together examined.

(a) Table 7.5.1-4 is the explanatory table on calculation of phased new manufacturing number of D12E and D18E.

(b) Table 7.5.1-5 shows the phased rolling stock plan upto 2010 for Hanoi-Ho Chi Minh Line, together with investment cost.

Table 7.5.1-2 Required Rolling Stock Numbers by Improvement Stage

Train Type	Year	2000					2005					2010				
		New (No. of Trains)	D18E	D12E	PC	FC	New (No. of Trains)	D18E	D12E	PC	FC	New (No. of Trains)	D18E	D12E	PC	FC
P.T.	L. Exp.	5	17	75	180	–	17	–	–	–	–	18	–	–	–	–
	I. Exp.	–			204	–	10	11	26	240	–	26	–	–	–	–
	Local P.T.	–			90	–	–	–	24	130	–	–	–	37	220	–
	Total	5	17	75	474	–	27	11	50	370	–	44	–	37	220	–
F.T.	T.F.T	–	32	46	–	–	–	61	20	–	–	–	72	28	–	–
	I.F.T.	–			–	–	–			–	–	–			–	–
	Local F.T.	–			–	–	–			–	–	–			–	–
	Total	–	32	46	–	2,400	–	61	20	–	3,600	–	72	28	–	5,500
G. Total		5	49	121	474	2,400	27	72	70	370	3,600	44	72	65	220	5,500

Table 7.5.1-3 Necessary Number of Rolling Stock in 2000 for Hanoi - Ho Chi Minh Line

		No. of trains	DL					PC						FC			Remarks
			New	D18E	D12E	D9E	D4H	AN	BN	A	B	C	S	G	H	Others	
PT	New high speed train	5	10	–	–	–	–	10	15	10	10	–	5				Including one reserved train
	Limited express	20						20	60	40	40	–	20				Including 4 reserved trains
	Express (Middle distance)	8						8	24	8	24	–	8				
	Express (Short distance)	17		14	33	23	6	–	–	17	68	–	17				
	Reserved cars for Express	–		3*	6*	5*	2*	2	4	4	16	–	4				
	Local	20						–	–			70	20				• Including 4 reserved trains • Various train configurations
	Subtotal (Excluding new high speed train)		–	17	39	28	8	30	88	69	148	70	69				
FT	Coal train														65		
	Cement train			27 5*	38 8*									98			
	Others															2237	
	Subtotal			32	46									98	65	2237	
Total of DLs			10	49	85	28	8										

Remarks: PT : Passenger train
FT : Freight train
* : Reserved locomotives

Table 7.5.1-4 Explanatory Talbe on Calculation of Phased New Manufacturing Number of D12E and D18E

	D4H	D9E	D12E	D18E	Remarks
1996-200					
Necessary number			121	49	Table 7.5.1-2
Existing number	150	28	69	16	Table 7.5.1-1
Substitution to D12E	Δ 8	Δ 28	36		*1
New manufacturing			16	33	
2001-2005					
Necessary number			70	72	Table 7.5.1-2
Existing number	120	22	85 (69+16)	49 (16+33)	Table 7.5.1-1
Substitution to D12E		Δ 7	7		*2
Substitution to D18E			Δ 22	11	*3
New manufacturing			0	12	
2006-2010					
Necessary number			65	72	Table 7.5.1-2
Existing number	96	17	85 (69+16)	61 (16+33+12)	Table 7.5.1-1
Substitution to D12E		Δ 2	2		*4
Substitution to D18E			Δ 22	11	*3
New manufacturing			0	0	

Remarks:
*1 8D4Hs and 28D9Es are used for local passenger trains substituting for D12Es.
*2 7D9Es are used for local passenger trains substituting for D12Es.
*3 22D12Es are used for express passenger trains substituting for D18Es, (One D18E is replaced by two D12Es).
*4 2D9Es are used for local passenger trains substituting for D12Es.

Table 7.5.1-5 Phased Rolling Stock Plan upto 2010 for Hanoi - Ho Chi Minh Line

(Million US$)

	Unit Price		1996 - 2000				2001 - 2005				2006 - 2010				Total			
	F	D	Number	F	D	Total	Number	F	D	Total	Number	F	D	Total	Number	F	D	Total
New high speed train	3.8	1.2	5	19.0	6.0	25.0	22	83.6	26.4	110.0	17	64.6	20.4	85.0	44	167.2	52.8	220.0
D18E (New)	1.5		33	49.5		49.5	12	18.0		18.0	0			0	45	67.5		67.5
D12E (New)	0.98		16	15.7		15.7	0			0	0			0	16	15.7		15.7
PC (New)		0.11	21		2.3	2.3	56		6.2	6.2	68		7.5	7.5	145		16.0	16.0
FC (New)		0.032	661		21.2	21.2	1791		57.3	57.3	2860		91.5	91.5	5312		170.0	170.0
D11H (RHB)	0.44	0.24	10	4.4	2.4	6.8	0			0	0			0	10	4.4	2.4	6.8
D13E, D18E (RHB)	0.66	0.39	0			0	30	19.8	11.7	31.5	0			0	30	19.8	11.7	31.5
D12E (RHB)	0.44	0.246	0			0	0			0	40	17.6	9.8	27.4	40	17.6	9.8	27.4
PC (Remodelling)		0.06	20		1.2	1.2	0			0	0			0	20		1.2	1.2
Total				88.6	33.1	121.7		121.4	101.6	223.0		82.2	129.2	211.4		292.2	263.9	556.1

7.5.2 Rolling Stock Maintenance

The scope of rolling stock inspection/maintenance improvement addresses all the relevant facilities of the Hanoi - Ho Chi Minh Railway. The following reinforcement of the maintenance facilities, work method improvement and provision of spare parts for DELs will be conducted to establish a full-scale rolling stock maintenance system by 2010.

(1) Establishment of Maintenance Facilities for DELs and PCs for New High Speed Trains

As the DELs and PCs for high speed trains will be newly procured, the establishment of the relevant maintenance facilities is necessary as described below.

1) Maintenance facilities for the new DELs to be used for high speed trains will be provided at the Gia Lam Workshop.

2) Such maintenance facilities as washing and painting facilities and air-conditioning maintenance facilities for the new PCs to be used for high speed trains will also be provided at the Gia Lam Workshop. The existing facilities will be used for all other maintenance work.

3) A high speed train consisting of new DELs and PC will enter the workshop for maintenance purposes without changing its composition and will leave the workshop after completion of train set test.

4) Sewage disposal facilities to treat the sewage from the toilets of the PCs of high speed trains will be provided at the Gia Lam Workshop and at the Hanoi, Vinh, Da Nang, Nha Trang and Saigon station yards.

(2) Consolidation of DEL Maintenance Facilities

The existing DEL maintenance facilities are rather inadequate and new facilities will be provided to improve the operational reliability of DELs.

1) The Gia Lam Workshop currently has no DEL maintenance facilities. While the Workshop requires remodelling to conduct DEL maintenance, it will be able to share the new facilities described in (1) - 1) above. The required improvement work consists of the following.

- Improvement of facilities required for maintenance
- Provision of maintenance plant and machinery
- Provision of necessary instruments and tools, etc.

2) The existing DEL maintenance facilities at 4 depots (Hanoi, Vinh, Da Nang and Saigon) will be improved and the required improvement work consists of the following.

- Improvement of engine shop
- Provision of engine performance testing unit
- Provision of comprehensive engine and generator testing unit
- Provision of washing unit
- Provision of necessary instruments and tools, etc.

(3) Provision of Spare Parts for DEL Maintenance

In order to shorten the DEL maintenance process to reduce the number of DELs waiting for maintenance and to shorten the idling period of DELs with a view to improving the DEL availability, the reserved main equipment and spare parts should be stored at the Gia Lam Workshop.

- Engines and their spare parts
- Generators and their spare parts
- Traction motors and their spare parts
- Others

(4) Modernisation of PC and FC Maintenance Work

Some of the depots assigned to conduct PC and FC maintenance work do not have an EOTC and use manual jacks to lift the body and to remove the bogie. New machinery and equipment will, therefore, be provided for these depots to modernise their PC and FC maintenance work together with improvement of the work processes to achieve safer and more efficient work.

- Improvement of maintenance buildings and floors, etc. (Hanoi PC/FC and Da Nang PC/FC Depots)
- Provision of EOTC (Hanoi PC/FC and Da Nang PC/FC Depots)
- Provision of new washing, painting and other facilities (Hanoi PC/FC, Da Nang PC/FC, Vinh PC/FC and Saigon PC Depots, and Thuan Hai FC Shop)
- Provision of necessary instruments and tools, etc. (Hanoi PC/FC, Da Nang PC/FC, Vinh PC/FC and Saigon PC Depots, and Thuan Hai FC Shop)

(5) Introduction of Effluent Treatment Plant

Effluent from the maintenance depot, etc. is currently discharged with no prior treatment. As such untreated effluent may become a source of environmental pollution in the future, an effluent treatment plant will be introduced at all of the workshops and depots.

- Oil separation unit
- pH treatment unit
- Others

(6) Improvement Plan for Gia Lam Workshop

1) The following conditions must be met prior to the commencement of DEL maintenance work at the Gia Lam Workshop.

- As the maintenance staff of the Gia Lam Workshop have no experience in DEL maintenance, their urgent training is required.
- There are currently no DEL maintenance facilities at the Gia Lam Workshop, necessitating the urgent introduction of these facilities.
- All new DELs and PCs for high speed trains will be overhauled at the Gia Lam Workshop.
- The Gia Lam Workshop will also conduct the overhauling of all DLs belonging to Union 1.
- The major repair of all engines, generators, traction motors and other main equipment of the DELs owned by the VNR will be conducted at the Gia Lam Workshop.
- Washing facility, painting facility and maintenance facility for air-conditioning equipment will be provided for the Gia Lam Workshop as a part of the PC and FC maintenance facilities.

2) The following items will be examined to prepare a viable improvement plan.

- Maintenance interval: the possibility of extending the current maintenance interval will be examined.
- Standard cycle time: the possibility of the gradual shortening of standard maintenance cycle time will be examined.
- Calculation of annual maintenance volume: the feasible annual maintenance volume for rolling stock will be calculated based on the total volume of rolling stock in each year and the maintenance interval for each type of rolling stock.

- Calculation of rolling stock volume concurrently being maintained: the volume of rolling stock concurrently being maintained will be calculated based on the annual maintenance volume, standard cycle time and annual number of working days, etc.

3) Planning of Maintenance Shops

The size of each maintenance shop will be examined based on the volume of rolling stock concurrently being maintained and the shop locations will be selected taking the following into consideration.

- Flow of maintenance work
- Layout of maintenance shops
- Choice between the construction of a new shop or refurbishment of an existing shop

  Location and structure of new shop building or partitions, flooring and painting, etc. in the case of refurbishment will be examined.

4) Maintenance Shop Facilities and Equipment

Such facilities as track, pits and scaffold, etc. which are required by each shop will be examined together with essential equipment, machinery, instruments and tools, etc.

- Required facilities of each shop: location and length of track, location, size and shape of pit, location, size and shape of scaffold and other required facilities
- Required equipment and machinery of each shop: type, size, shape, quantity and location of equipment and machinery required for rolling stock maintenance work, particularly equipment and machinery required for major repairs and the completion testing of such main DEL components as engines, generators and traction motors
- Required instruments and tools, etc. of each shop: type, size, shape and quantity of instruments and tools, etc. required for rolling stock maintenance work
- Other facilities: capacity, quantity and location of electrical wiring, compressed air tubes, water supply tubes and steam tubes, etc.

7.6 Environment

7.6.1 Basic Framework for Environmental Mitigating Measures

Environmental mitigating measures consist of facilities and environmental mitigating management at construction or operation stage. Alternative I aims at the highest service level and requires the largest scale of improvement works among three alternatives. Therefore, it is required to design environmental mitigating measures to eradicate any serious depression on the surrounding environment at construction or operation stage.

7.6.2 Contents of Environmental Mitigating Measures

(1) Facilities

1) Facility concerning Public Health

In Alternative I, the evacuation tanks will be facilitated for 40 of new high-speed rolling stocks and the installation of treatment facilities are also planned at Gia Lam Workshop, Hanoi, Vinh, Danang, Nha Trang and Saigon Depot. However, 235 nos. of the existing passenger cargoes will be still used without any improvement. Therefore, the regulation not to dump any pollutants from their cargoes is required especially when the train pass through the residential areas.

In Alternative I, slope improvement facility, rockfall preventing facility, rockfall warning system and drainage facilities such as drainage improvement are planned in order to reduce these hazardous problems. The items of these facilities are shown in Table 7.6-1.

Table 7.6-1 Facilities concerning Hazard Prevention

Item	Method	Quantity (km)
Slope Improvement	Crib, stone revetment, etc.	160
Rockfall Preventing Construction	Preventing wall, rock sheds, etc.	2
Rockfall Warning System	-	20
Drainage Improvement	Drain ditch, etc.	130

3) Facility concerning Noise and Vibration Prevention

The environmental mitigating measures on noise and vibration are made by such counter-measures as weighting and lengthening of rails, installing soundproof walls. However, the adoption of soundproof walls is excluded from the counter-measures by the following reasons.

- There is no clear standards on train noise.
- There are difficulties on equipping soundproof walls due to the narrow space of railway land, structural problems and increase of construction cost.

In Alternative I, the present rails of 27 or 30 km/m are replaced with the 43 kg/m and 12 m rails. The existing decrepit sleepers made of woods or iron are replaced with concrete sleepers and its number is increased from 1,440 nos./km to 1,660 nos./km for the curved sections above 600 m. The existing wooden sleepers in the sections below 600 m are planned to be increased from 1,660 nos./km to 1,720 nos./km. The ballasts are planned to be improved from the thickness of below 20 cm to the thickness above 25 cm. The values of 4 ~ 5 dB(A) is expected as a reduced effect of noise by weighting rails. Figures in Table 7.6-2 shows a magnitude of this kind of improvement.

Table 7.6-2 Reduced Effect of Train Noise by Weighting Rails

unit: dB(A)

Items	Measured Values at 60 kg/m section (A)	Measured Values at 50 kg/m section (B)	Reduced Value (B-A)
Up side	77	82	-5
Down side	77	81	-4

Notes ; 1) : Measuring point is located as approximately 23 m from the rail center.
2) : The figures are mean values of measured trains.

Source : "Report on Railway Noise and Vibration of Conventional Railway Lines (1981)", Construction Pollution Division, Kita Ward, Tokyo Metropolitan City, Japan.

4) Facility concerning Water Pollution Prevention

Each workshop has facilities for overhauling, washing, gilding and molding of rolling stocks. Gia Lam Workshop also includes a water treatment facility.

In Alternative I, water treatment facilities such as an oil separator and a pH regulator are planned in each workshop and depot. Therefore, the pollutants such as oil, detergent, organic solvent and heavy metals are drained out after sufficient treatment.

(2) Environmental Management

1) Legislation and Environmental Impact Assessment

Environmental management of Alternative I basically conforms to "Environmental Protection Law" and "Guidelines on Environmental Impact Assessment". The following procedures are planned at the feasible study stage.

a. The development entity conduct environmental impact assessment (E.I.A.) especially on the items such as public health, waste, landscape, air pollution, water pollution, noise and vibration by conforming to "Guidelines on Environmental Impact Assessment" and take appropriate counter-measures if necessary.

b. The development entity makes reports on E.I.A. to the State.

c. The development entity should accept the States' inspection on the environmental mitigation facilities and/or management.

2) At Construction Stage

a) Waste

Construction wastes such as iron scraps, concrete, and excavation dumps will be generated in such works of rehabilitation and improvement in tracks, stations, bridges and tunnels. In Alternative I, the quantity of construction wastes will be largest among alternatives because of its project scale.

The following environmental management is planned on the treatment of construction wastes.

- To adopt recycling systems such as utilization of excavated materials for embankment as much as possible in order to reduce generated wastes.
- To select appropriate methods and disposal areas aimed at environmental mitigation when construction wastes are dumped.

b) Hazards

In Alternative I, large-scaled construction works are executed in the whole sections of the North-South Railway Line. Some disasters such as landslide, rockfalls and outbreaks of underground water are anticipated in the works of slope improvement, rockfall preventing works and tunneling.

The following environmental management is planned on the construction plan of above works.

- To make the construction plan in order to keep safe conditions for the railway passengers or the inhabitants along the railway such as installing protection fences at the dangerous areas or safety guide for their walking.

c) Air Pollution

Dump trucks or agitator trucks conveying construction materials or wastes will be used. Dusts will be generated at traveling of these vehicles.

In Alternative I, the following environmental management is planned on construction works especially at residential areas.

- To take countermeasures such as water sprinkling or sheet covering in order to prevent from generating dusts.
- To select traveling route which impacts on the surrounding environment at a minimum.

d. Noise and Vibration

In Alternative I, the following environmental management is planned.

- To adopt possible construction equipment that keep noise and vibration low. Reverse-circulation method is planned instead of percussion method in piling works.
- To reduce the continuos long-time works of generating noise or night works in order to impact on the surrounding inhabitants at minimum if possible.

e) Water Pollution

Turbid water or water with leaked oil is anticipated at concrete, grouting and boring works especially at tunneling works.

The following are planned at planning construction schedules near water sources or wells.

- To adopt the treatment process of separating SS (Suspended Solid) or oil content or the process of regulating pH values of drainage water with cement before discharge especially at water source areas, if necessary.

3) At Operation Stage

a. Public Health

The existing passenger cargoes of the North-South Railway Line are poor in its sanitary condition. The dumped pollutants without treatment aggravated public health condition, especially at residential areas. In Alternative I, the pollutant treatment facilities will be equipped to new high-speed trains at Hanoi, Vinh, Danang, Nha Trang and Saigon depots, and sanitary treatment are done there. However, the existing passenger cargoes with no evacuation tanks will be also used on the local lines.

Therefore, the following attentions are paid to sanitary management at operation of the pollutant treatment facilities.

- Periodical cleaning or medicine sprinkling of rolling stocks and stations in order to prevent from spreading infectious diseases.
- To take counter-measures of shutting evacuation tanks at resident areas so that pollutants of local passenger cargoes are not dumped into tracks.

- To carry out periodical monitoring of water quality at the surrounding water areas during treatment works. Items of pH, SS (Suspended Solid), BOD (Biochemical Oxygen Demand), DO (Dissolved Oxygen) and Coliform Bacillus are appropriate for quality analysis of drainage water after pollutant treatment.

b) Noise and Vibration

In Alternative I, the rails of the existing 27 or 30 kg/m rails will be replaced with 43 kg/m rails, and lengthened by welding the existing 12.5 m rails with long rails at the sections where long rails can be laid. Train noise and vibration is expected to be reduced by those kinds of improvement. However, the following environmental management are planned in order to reduce noise and vibration.

- To inspect, repair and maintain periodically railway facilities in order to avoid wearing of wheels and rails.

c) Water Pollution

In Alternative I, water treatment facilities such as an oil separator or a pH regulator will be installed at each workshop and depot. The following environmental management is planned in order to keep the environment of the surrounding water areas good conditions.

- To carry out periodical monitoring for quality of water and sediment during operation works such as overhauling, washing, gilding and molding of rolling stocks. The items such as Cd (Cadmium), Cyanogen, Pb, Chromium (VI), Carbon Tetrachloride and pH are examined for quality analysis of waste water and sediment.
- To discharge the drainage water from workshops and depots in order to keep the water quality below the maximum limits of drainage water established in "Provisional Environmental Criteria".
- To carry out periodical maintenance of the facilities which can fulfill the function of water treatment in workshops and depots.

d) Landscape

The attentions to keep harmony with the surrounding landscape are paid when the design of bridges or station plazas will be done.

7.7 Management

(The management problems of the VNR and the Hanoi - Ho Chi Minh Railway and their remedial measures have already been discussed in 5.3.1. The most important points directly relating to Alternative 1 (Optimum Alternative) are reviewed here for further emphasis of their importance.)

7.7.1 Management Principles

The problems relating to the management of the Hanoi - Ho Chi Minh Railway under the Optimum Alternative are exactly the same as those discussed in 5.3.1-(1). In short, the sound management of a long distance railway service requires not only shortening of the overall travelling time, an increased number of through trains and strenuous efforts to increase long distance passengers and cargo but also consolidation of local transportation services meeting the needs of local areas along the route to establish a firm base for stable income. Consequently the 3 Union Offices can play a very important role in the promotion of such local services and their basic business capability should be greatly strengthened to enable them to prepare their own marketing plans and implement them in cooperation with the VNR's Head Office and other Union Offices.

7.7.2 Organization

The organizational problems under the Optimum Alternative are basically the same as those of the VNR described in 5.3.1-(3). In order for the VNR to improve its management efficiency as well as its performance as an organization specialized in transportation, it should try to separate fringe functions and businesses as separate organizations to reduce its management burden. Even if the VNR successfully limits its business scope to transportation only, there remains a problem of achieving the right manpower balance between the central office and local offices. The safe operation of the Hanoi - Ho Chi Minh Railway must be ensured by close cooperation between the Head Office and the 3 Union Offices while meeting the user requirements. Nevertheless, the Head Office will be fully responsible for such various systems and functions as the overall control of train operation, ticket sales and the provision of freight information and also for matters relating to management policies, including the coordination of regional interests and the provision of management guidance for

the Union Offices. These tasks of the Head Office cannot be properly performed without a strong central organization.

At the same time, however, the key to the development of the railway business and increased income is the strengthening and vitalisation of the Union Offices. From an organizational point of view, the most difficult problem is to strike the correct balance of manpower allocation with a certain level of technology between the Head Office and the Union Offices as the overall manpower size is limited by the need to make a profit.

One thing appears certain. The control of the Union Offices by the Head Office should be kept to a minimum in order that the spontaneous growth of self-reliant management spirit on the part of the Union Offices is not ruined by control or intervention by the Head Office.

7.7.3 Manpower

According to an estimate based on the productivity approach, the required manpower level to efficiently operate the Hanoi - Ho Chi Minh Railway in 2010 is approximately 24,000, by which time the productivity will have increased from the present 57,400 passenger-km-ton/employee to 380,000 passenger-km-ton/employee. However, this improved figure is not necessarily high compared to other countries as shown in Table 7.7-1.

In order to further improve the efficiency by eliminating unnecessary work, the scope of various types of work should be examined in line with the rehabilitation/improvement progress of the Hanoi - Ho Chi Minh Railway. The surplus manpower generated by rationalisation of the railway management should be absorbed by those businesses which will become separate entities from the VNR and peripheral businesses should be established following the improvement and modernisation of the railway business. Needless to say, the aptitude and personal preference of each employee must be taken into consideration at the time of finding them new employment. As already discussed in 5.3.1-(4), each Union will be responsible for finding new employment for staff to be made redundant as the Head Office lacks the necessary resources and information to do so.

Table 7.7-1 Comparison of productivity in each country

Name	Year	Million person·km/year A	Million ton·km/year B	Employee C	Productivity $\frac{A+B}{C}$ (1000 person·ton·km)
Japanese National Railways	1986	198,299	20,145	223,947	975.4
Korean National Railroad	1980	21,640	10,798	40,629	798
Railways of the People's Republic of China	1987	284,000	945,600	3,247,000	379
Taiwan Railways	1987	8,446	2,399	20,551	528
State Railway of Tailand	1985	9,140	2,718	25,432	466
Indonesian State Railways	1989	10,301	2,867	23,302	565
Indian Railways	1985	226,582	196,600	1,361,256	311
Pakistan Railways	1980	16,311	7,917	130,297	186
Bolivian National Railways	1989	386	512	7,090	127
	2020	2,115	1,843	7,600	521

7.7.4 Education

There is no specific agenda relating to staff education/training under the Optimum Alternative and this should be discussed within the framework of an overall educational programme for the VNR (see 5.3.1-(5)).

7.7.5 Management Cost

As already pointed out in 5.3.1-(2) Finance, the management cost should be discussed in terms of cost categories as well as spending purposes and this applies to both the Head Office and Union Offices.

7.8 Cost Estimate

The planned investment size under the Optimum Alternative is shown in Table 7.8-1. Compared with Alternative I (Table 6.4-2), the total cost has increased by 20.5 million US$, mainly because of the review of the rolling stock plan based on revised demand forecast.

This increase, however, has no bearing on the selection of the Optimum Alternative from the 3 available alternatives and Alternative I is still considered to be the Optimum Alternative.

Table 7.8-1 Investment Size Under Optimum Alternative

Item	Optimum Alternative (million US$)
Track Stations Disaster Prevention	413.30
Bridges	427.60
Tunnels	56.30
Signalling	62.10
Communication	108.50
Rolling Stock	556.10
Workshops and Depots	65.00
Total	1688.9

7.9 Economic and Financial Evaluation

7.9.1 Economic Evaluation

This section aims at reviewing an economic evaluation of the selected alternative (Alternative I) of the Master Plan based on the modified investment schedule and the revised project cost, and also aims at finalizing the EIRR of the selected master plan alternative.

This is because an investment schedule was revised to make the plan more practical and to make it more smooth to carry out. In addition, the project cost was re-calculated based on the detailed data about age of present rolling stocks.

Methodology of the evaluation is the same as that in Section 10.1 of this report, and the same items and figures of economic benefits are adopted. Because of lack of data, (1) saving in railway accident damage and (2) saving in natural disaster relief expenditure are not incorporated in this analysis.

Table 7.9-1 summarizes the results of re-calculation. It is evident that EIRR is higher than 0.7% than that reckoned based on the preliminary project cost, showing a marginal difference. Its absolute level is almost equivalent to the opportunity cost of capital.

Table 7.9-1 EIRR of Selected Master Plan and Results of Sensitivity Analysis (based on Phased Improvement Plan)

Cost / Benefit	+20%	+10%	Normal	-10%	-20%
Selected Master Plan (Alternative I)					
-20%	na		6.1%		
-10%		6.3%	7.2%		
Normal	6.5%	7.3%	8.3%	9.3%	10.6%
+10%			9.2%		
+20%			10.1%		

And it is necessary to evaluate this figure by taking into consideration indirect effects such as income distribution effect and its significant role as a trunk line of traffic flow between two major economic cores in Vietnam as well as National Road 1. On this points, more detail explanation is shown in Section 10.1 of this report.

Sensitivity analysis proves that the EIRR is the most sensitive to the reduction of cost and the reduction of benefit. The latter will lowers the EIRR up to 6.1% if the benefit is reduced by

20%. It is judged that benefit reduction attributable to the slower economic growth will affect the viability of the project if it occurred, and the observation of economic trend is especially significant in this project.

7.9.2 Financial Evaluation

The financial evaluation of Alternative I has already been discussed in 6.4-4. In finalising Alternative I as the Optimum Alternative for the Master Plan, the total investment size was increased by approximately 58.4 million US$ to meet the specific requirements of the VNR. As a result, the financial analysis was directly affected by the increased investment of 57.55 million US$ in rolling stock (556.10 million US$ - 498.55 million US$).

The revised evaluation results, incorporating additional investment, are shown in the Revised Base Case. The FIRR for the 35 year period dropped by 1.18% compared to the original figure.

Nine different sensitivity analyses were conducted for the Revised Base Case, representing ± 10% and ±20% changes of the income and operation cost. The calculation results for these cases are given below.

In conclusion, management of the Hanoi - Ho Chi Minh Railway is fairly sensitive to financial conditions as a 3.58% increase of the total investment (11.54% increase of rolling stock investment) results in a 1.18% decrease of the FIRR. Given such sensitivity, extra management efforts will be required to achieve a higher income and lower cost than the target figures indicated by a long-term plan. To be more precise, the basic business strength of the Hanoi - Ho Chi Minh Railway should be improved to bring about a FIRR of 10% or more as in the case of Sensitivity Analyses Marked*.

Table 7.9-2 Sensitivity Analysis (FIRR for 35 Years Evaluation)

Benefit \ Cost	0	+10%	+20%	-10%	-20%
0	9.4%	8.3%	7.2%	10.5%	11.6%
-10%	6.9%	5.7%			
-20%	4.1%				
+10%	11.9%				
+20%	14.4%				

CHAPTER 8 PHASED IMPROVMENT PLAN

8.1 Introduction

As stated in 6.4.6, the JICA Study Team recommends Alternative I as the optimum Master Plan for the rehabilitation and improvement of the Hanoi - Ho Chi Minh Railway. The contents of the Phased Improvement Plan for Alternative I are described below and the following target values for each stage and phased development contents have been established through discussions with the Vietnamese side.

Despite the established contents and targets for each phase, the feasibility study for Phase 1 has examined the possible investment deferment for some of the components of Phase 1 to the Phase 2 period and for some of the components of Phase 2 to the Phase 3 period based on strict assessment of the investment necessity and likely cost of each component in each phase.

8.2 Establishment of Quantitative Targets for Each Phase

As easily understandable improvement indices for each phase, the travelling times of limited express passenger trains and direct freight trains between Hanoi and Ho Chi Minh City are set as described below. Naturally, it is necessary to take reliability and service safety into proper consideration. The target values are given for each phase for the basic items relating to safety and reliability.

The target values for each phase shown in Table 8.2-1 has been changed during the feasibility study process for Phase 1, where new idea of selecting priority sections in Hanoi - Hochi Minh Line and of placing emphasis on management improvement has been introduced in addition to improving safety and reliability and services.

8.3 Results of Demand Forecast

In this section, traffic demands of railway in 2000, 2010 are estimated, which are used to plan the detail implementation plan of the selected master plan alternative (Alternative I).

Figures in 2005 are estimated by using a simple interpolated method since the traffic demands in 1994 and 2000, and 2010 have been already projected.

Tables 8.3-1 and 8.3-2 show the passenger trips by mode, and Tables 8.3-3 and 8.3-4 show the cargo trips by mode respectively. These tables cover all the railway network and all the transport modes. Railway passengers is expected in 2000 to increase 1.4 times as much as that in 1994, and it reaches at 2.6 times in 2010. While cargo demand is expected to increase moderately up to 2000, 1.4 times as much as that of 1994, and reaches 4.3 times in 2010, showing a remarkably high growth rate.

Table 8.3-1 Passener Trips by Mode, 2000

UNIT: 000 trips/year

	Total (All mode)		Road		Railway		Aviation	
	Generated	Attracted	Generated	Attracted	Generated	Attracted	Generated	Attracted
1 Ha Giang	478.4	476.2	478.4	476.2	0.0	0.0	0.0	0.0
2 Tuyen Quang	1,143.1	1,146.5	1,143.1	1,146.5	0.0	0.0	0.0	0.0
3 Cao Bang	1,064.8	1,073.2	1,064.8	1,073.2	0.0	0.0	0.0	0.0
4 Lang Son	2,062.6	2,108.1	1,846.2	1,853.9	216.3	254.2	0.0	0.0
5 Lai Chau	899.9	875.2	891.8	868.0	0.0	0.0	8.2	7.3
6 Lao Cai	989.9	997.5	569.4	578.9	420.4	418.6	0.0	0.0
7 Yen Bai	1,347.9	1,384.8	886.1	887.1	461.8	497.7	0.0	0.0
8 Bac Thai	4,069.2	4,065.9	3,846.6	3,845.6	222.6	220.3	0.0	0.0
9 Son La	770.2	744.4	770.2	744.4	0.0	0.0	0.0	0.0
10 Hoa Binh	2,770.7	2,815.8	2,770.7	2,815.8	0.0	0.0	0.0	0.0
11 Vinh Phu	5,703.5	5,700.9	4,646.1	4,601.4	1,057.4	1,099.5	0.0	0.0
12 Ha Bac	9,591.9	9,706.1	9,247.0	9,362.9	344.8	343.2	0.0	0.0
13 Quang Ninh	6,167.8	6,176.7	5,796.9	5,808.7	370.9	368.0	0.0	0.0
14 Hanoi Capital	45,038.3	44,856.0	42,245.3	42,218.4	2,361.5	2,202.8	431.6	434.9
15 Hai Phong	13,152.3	13,237.9	12,555.4	12,683.9	545.2	505.6	51.8	48.4
16 Hai Hung	12,291.8	12,281.8	11,787.2	11,713.7	504.6	568.2	0.0	0.0
17 Ha Tay	8,742.7	8,683.3	8,714.4	8,630.7	28.3	52.7	0.0	0.0
18 Thai Binh	5,537.4	5,608.9	5,537.4	5,608.9	0.0	0.0	0.0	0.0
19 Nam Ha	10,900.4	10,595.9	10,521.3	10,239.0	379.1	356.8	0.0	0.0
20 Ninh Binh	2,706.2	2,693.7	2,636.9	2,630.1	69.3	63.6	0.0	0.0
21 Thanh Hoa	4,624.7	4,554.2	4,142.0	4,066.6	482.7	487.5	0.0	0.0
22 Nghe An	3,779.5	3,757.3	3,195.0	3,192.2	555.5	532.0	29.0	33.1
23 Ha Tinh	2,847.1	2,857.4	2,688.9	2,693.4	158.2	158.0	0.0	0.0
24 Quang Binh	2,580.1	2,575.9	1,936.1	1,935.2	643.9	640.7	0.0	0.0
25 Quang Tri	1,176.9	1,194.0	1,074.6	1,084.3	102.3	109.7	0.0	0.0
26 Thua Thien - Hue	3,930.9	3,932.3	3,266.4	3,278.5	595.5	616.5	68.9	37.3
27 Quang Nam - Da Nai	7,868.2	7,867.9	6,739.2	6,733.0	834.0	812.0	294.9	322.8
28 Quang Ngai	3,734.7	3,742.7	3,629.3	3,627.8	105.5	114.9	0.0	0.0
29 Binh Dinh	4,574.1	4,586.1	4,343.5	4,357.1	200.5	192.2	30.1	36.8
30 Phu Yen	2,371.5	2,370.9	2,333.3	2,339.5	38.2	31.5	0.0	0.0
31 Khanh Hoa	4,367.1	4,413.8	4,055.1	4,098.9	268.9	274.6	43.1	40.3
32 Ninh Thuan	2,424.2	2,448.3	2,333.7	2,355.7	90.6	92.6	0.0	0.0
33 Binh Thuan	2,024.7	2,025.1	1,910.9	1,913.8	113.7	111.3	0.0	0.0
34 Gia Lai	1,301.0	1,292.8	1,267.1	1,258.6	0.0	0.0	33.9	34.2
35 Kon Tum	549.1	552.1	549.1	552.1	0.0	0.0	0.0	0.0
36 Dac Lac	2,104.8	2,089.3	2,047.0	2,032.6	0.0	0.0	57.8	56.7
37 Lam Dong	2,093.3	2,096.7	1,900.1	1,901.3	176.8	175.2	16.4	20.2
38 Ho Chi Minh City	85,776.9	85,786.6	83,952.7	83,921.3	1,064.5	1,115.1	759.7	750.3
39 Song Be	4,977.3	4,977.4	4,977.3	4,977.4	0.0	0.0	0.0	0.0
40 Tay Ninh	3,464.4	3,468.3	3,464.4	3,468.3	0.0	0.0	0.0	0.0
41 Dong Nai	13,289.4	13,403.0	13,285.7	13,401.1	3.7	1.9	0.0	0.0
42 Ba Ria - Vung Tau	30,914.2	30,994.5	30,914.2	30,994.5	0.0	0.0	0.0	0.0
43 Long An	5,065.7	5,067.2	5,065.7	5,067.2	0.0	0.0	0.0	0.0
44 Dong Thap	4,967.1	4,967.3	4,967.1	4,967.3	0.0	0.0	0.0	0.0
45 An Giang	7,819.4	7,805.8	7,819.4	7,805.8	0.0	0.0	0.0	0.0
46 Tien Giang	7,949.1	7,937.0	7,949.1	7,937.0	0.0	0.0	0.0	0.0
47 Ben Tre	4,484.3	4,477.4	4,484.3	4,477.4	0.0	0.0	0.0	0.0
48 Vinh Long	4,425.8	4,430.2	4,425.8	4,430.2	0.0	0.0	0.0	0.0
49 Tra Vinh	3,146.5	3,153.0	3,146.5	3,153.0	0.0	0.0	0.0	0.0
50 Can Tho	6,449.9	6,443.9	6,449.9	6,443.9	0.0	0.0	0.0	0.0
51 Soc Trang	3,729.0	3,728.7	3,729.0	3,728.7	0.0	0.0	0.0	0.0
52 Kien Giang	4,738.7	4,741.3	4,727.7	4,727.5	0.0	0.0	11.0	13.8
53 Minh Hai	5,655.8	5,667.2	5,655.8	5,667.2	0.0	0.0	0.0	0.0
Total	384,634.4	384,634.4	370,381.4	370,381.4	12,416.8	12,416.8	1,836.1	1,836.1

Table 8.3-2 Passener Trips by Mode, 2010

UNIT: 000 trips/year

	Total (All mode)		Road		Railway		Aviation	
	Generated	Attracted	Generated	Attracted	Generated	Attracted	Generated	Attracted
1 Ha Giang	1,812.9	1,828.1	1,812.9	1,828.1	0.0	0.0	0.0	0.0
2 Tuyen Quang	3,232.2	3,252.1	3,232.2	3,252.1	0.0	0.0	0.0	0.0
3 Cao Bang	2,534.5	2,547.2	2,534.5	2,547.2	0.0	0.0	0.0	0.0
4 Lang Son	3,099.2	3,117.1	2,849.1	2,847.4	250.1	269.8	0.0	0.0
5 Lai Chau	3,938.0	3,912.5	3,790.9	3,776.7	0.0	0.0	147.1	135.9
6 Lao Cai	2,051.4	2,066.7	1,598.5	1,617.5	452.9	449.2	0.0	0.0
7 Yen Bai	3,289.9	3,307.7	2,684.7	2,683.2	605.2	624.5	0.0	0.0
8 Bac Thai	10,808.9	10,814.2	10,436.8	10,446.9	372.1	367.3	0.0	0.0
9 Son La	3,138.9	3,121.3	3,138.9	3,121.3	0.0	0.0	0.0	0.0
10 Hoa Binh	8,002.7	8,023.4	8,002.7	8,023.4	0.0	0.0	0.0	0.0
11 Vinh Phu	15,328.2	15,296.5	12,868.1	12,834.9	2,460.1	2,461.6	0.0	0.0
12 Ha Bac	18,865.3	18,818.0	17,923.0	17,876.9	942.3	941.1	0.0	0.0
13 Quang Ninh	21,587.8	21,617.4	20,821.4	20,849.8	766.4	767.6	0.0	0.0
14 Hanoi Capital	103,120.2	102,880.1	97,366.8	97,254.6	4,535.2	4,380.4	1,218.2	1,245.1
15 Hai Phong	39,410.1	39,427.1	38,425.0	38,508.1	801.3	744.7	183.9	174.3
16 Hai Hung	37,685.4	37,659.8	36,841.3	36,724.8	844.1	935.0	0.0	0.0
17 Ha Tay	17,733.9	17,648.7	17,673.3	17,536.0	60.6	112.7	0.0	0.0
18 Thai Binh	14,900.8	14,898.4	14,900.8	14,898.4	0.0	0.0	0.0	0.0
19 Nam Ha	21,541.4	21,454.9	20,793.0	20,745.5	748.5	709.5	0.0	0.0
20 Ninh Binh	6,512.2	6,493.5	6,365.8	6,353.9	146.4	139.6	0.0	0.0
21 Thanh Hoa	19,415.5	19,379.4	18,196.5	18,118.3	1,219.0	1,261.1	0.0	0.0
22 Nghe An	14,163.6	14,120.3	12,843.2	12,814.3	1,049.2	1,032.8	271.1	273.3
23 Ha Tinh	7,009.0	7,014.9	6,700.2	6,699.6	308.9	315.3	0.0	0.0
24 Quang Binh	4,864.9	4,878.7	4,107.1	4,122.2	757.7	756.5	0.0	0.0
25 Quang Tri	3,021.2	3,047.7	2,857.9	2,867.7	163.2	180.0	0.0	0.0
26 Thua Thien - Hue	11,405.5	11,425.4	10,296.0	10,368.5	922.3	945.4	187.2	111.5
27 Quang Nam - Da Nai	26,260.2	26,253.0	23,420.1	23,423.8	1,723.5	1,696.7	1,116.6	1,132.6
28 Quang Ngai	11,597.6	11,612.1	11,244.4	11,230.9	353.3	381.2	0.0	0.0
29 Binh Dinh	11,817.5	11,821.2	11,192.7	11,193.6	504.8	504.2	120.0	123.4
30 Phu Yen	5,789.0	5,809.3	5,671.6	5,709.1	117.5	100.2	0.0	0.0
31 Khanh Hoa	11,084.7	11,103.1	10,443.1	10,463.3	500.8	510.4	140.8	129.3
32 Ninh Thuan	5,636.8	5,666.1	5,452.7	5,481.3	184.1	184.7	0.0	0.0
33 Binh Thuan	5,749.9	5,755.8	5,563.2	5,573.1	186.8	182.7	0.0	0.0
34 Gia Lai	4,129.7	4,108.2	3,813.0	3,800.4	0.0	0.0	316.7	307.8
35 Kon Tum	2,163.2	2,175.0	2,163.2	2,175.0	0.0	0.0	0.0	0.0
36 Dac Lac	10,807.6	10,758.3	9,904.2	9,883.5	0.0	0.0	903.4	874.8
37 Lam Dong	7,145.4	7,139.4	6,747.3	6,742.3	274.5	274.3	123.6	122.8
38 Ho Chi Minh City	242,282.3	242,717.2	237,848.9	238,162.7	1,855.9	1,884.8	2,577.6	2,669.7
39 Song Be	18,873.8	18,881.1	18,873.8	18,881.1	0.0	0.0	0.0	0.0
40 Tay Ninh	8,233.0	8,247.1	8,233.0	8,247.1	0.0	0.0	0.0	0.0
41 Dong Nai	50,617.5	50,646.9	50,604.2	50,639.9	13.3	6.9	0.0	0.0
42 Ba Ria - Vung Tau	98,202.6	98,290.1	98,202.6	98,290.1	0.0	0.0	0.0	0.0
43 Long An	12,153.4	12,154.0	12,153.4	12,154.0	0.0	0.0	0.0	0.0
44 Dong Thap	15,979.7	15,965.5	15,979.7	15,965.5	0.0	0.0	0.0	0.0
45 An Giang	20,983.8	20,950.8	20,983.8	20,950.8	0.0	0.0	0.0	0.0
46 Tien Giang	18,833.0	18,781.2	18,833.0	18,781.2	0.0	0.0	0.0	0.0
47 Ben Tre	12,204.4	12,174.5	12,204.4	12,174.5	0.0	0.0	0.0	0.0
48 Vinh Long	13,676.1	13,644.7	13,676.1	13,644.7	0.0	0.0	0.0	0.0
49 Tra Vinh	9,601.1	9,595.1	9,601.1	9,595.1	0.0	0.0	0.0	0.0
50 Can Tho	19,419.6	19,388.0	19,419.6	19,388.0	0.0	0.0	0.0	0.0
51 Soc Trang	11,059.8	11,052.5	11,059.8	11,052.5	0.0	0.0	0.0	0.0
52 Kien Giang	14,290.2	14,300.9	14,152.5	14,157.7	0.0	0.0	137.7	143.2
53 Minh Hai	27,071.2	27,094.7	27,071.2	27,094.7	0.0	0.0	0.0	0.0
Total	##########	##########	##########	##########	23,119.9	23,119.9	7,443.7	7,443.7

Table 8.3-3 Cargo Trips by Mode, 2000

UNIT: 000 tons/year

	Total (All mode)		Road		Railway		Inland waterway	
	Generated	Attracted	Generated	Attracted	Generated	Attracted	Generated	Attracted
1 Ha Giang	110.9	110.9	110.9	110.9	0.0	0.0	0.0	0.0
2 Tuyen Quang	138.1	229.3	138.1	91.4	0.0	0.0	0.0	137.9
3 Cao Bang	145.9	144.4	145.9	144.4	0.0	0.0	0.0	0.0
4 Lang Son	696.1	621.4	474.6	469.5	221.5	151.9	0.0	0.0
5 Lai Chau	468.9	470.5	468.9	470.5	0.0	0.0	0.0	0.0
6 Lao Cai	957.3	559.3	534.4	480.5	423.0	78.8	0.0	0.0
7 Yen Bai	501.1	549.8	478.9	481.8	22.2	53.6	0.0	14.5
8 Bac Thai	1,966.7	1,917.4	1,868.7	1,821.0	98.1	96.4	0.0	0.0
9 Son La	259.3	260.1	259.3	260.1	0.0	0.0	0.0	0.0
10 Hoa Binh	898.2	890.6	898.2	890.6	0.0	0.0	0.0	0.0
11 Vinh Phu	3,962.4	3,557.0	2,053.4	2,349.8	216.4	479.0	1,692.7	728.2
12 Ha Bac	1,848.9	2,412.2	1,756.4	1,643.6	50.1	357.7	42.3	410.9
13 Quang Ninh	11,917.2	6,323.0	5,075.6	5,376.6	495.0	10.9	6,346.7	935.6
14 Hanoi Capital	4,650.8	7,851.4	4,438.2	4,629.7	212.6	1,199.4	0.0	2,022.3
15 Hai Phong	4,591.1	5,547.9	3,010.7	3,196.5	265.4	399.3	1,318.0	1,952.0
16 Hai Hung	2,280.6	4,036.9	1,874.2	1,783.2	11.7	13.6	394.7	2,240.0
17 Ha Tay	1,443.3	1,812.7	1,443.3	1,641.4	0.0	19.2	0.0	152.1
18 Thai Binh	1,104.5	1,158.4	951.1	975.3	0.0	0.0	153.5	183.1
19 Nam Ha	2,155.6	3,322.7	2,129.6	2,214.8	11.1	58.3	14.9	1,049.6
20 Ninh Binh	870.4	970.0	595.3	621.3	272.6	51.4	2.4	297.3
21 Thanh Hoa	3,561.8	2,975.2	2,272.2	2,481.6	1,035.4	402.4	254.3	91.2
22 Nghe An	1,468.7	1,322.4	1,319.7	1,192.8	142.3	119.5	6.7	10.0
23 Ha Tinh	646.7	585.3	621.7	541.1	22.7	40.3	2.3	3.9
24 Quang Binh	872.3	880.7	813.6	777.2	58.7	103.5	0.0	0.0
25 Quang Tri	471.7	409.3	292.6	313.8	179.1	95.5	0.0	0.0
26 Thua Thien - Hue	797.1	810.9	763.3	675.7	33.8	135.1	0.0	0.0
27 Quang Nam - Da Nan	1,595.4	1,656.2	1,523.8	1,317.0	71.6	339.2	0.0	0.0
28 Quang Ngai	602.0	574.1	566.7	515.1	35.3	59.2	0.0	0.0
29 Binh Dinh	1,610.2	1,588.2	1,603.5	1,492.5	6.7	95.7	0.0	0.0
30 Phu Yen	354.1	337.1	333.5	303.4	20.7	33.7	0.0	0.0
31 Khanh Hoa	1,926.2	1,880.9	1,881.4	1,832.1	44.8	48.8	0.0	0.0
32 Ninh Thuan	800.1	747.0	750.9	740.0	49.2	7.0	0.0	0.0
33 Binh Thuan	548.4	530.1	528.5	512.8	19.8	17.3	0.0	0.0
34 Gia Lai	276.8	274.6	276.8	274.6	0.0	0.0	0.0	0.0
35 Kon Tum	127.5	126.9	127.5	126.9	0.0	0.0	0.0	0.0
36 Dac Lac	667.7	665.4	667.7	665.4	0.0	0.0	0.0	0.0
37 Lam Dong	468.7	468.0	468.7	468.0	0.0	0.0	0.0	0.0
38 Ho Chi Minh City	11,949.0	14,206.4	8,234.1	8,027.2	634.2	159.4	3,080.7	6,019.7
39 Song Be	1,836.6	1,850.0	1,706.2	1,800.3	0.0	0.0	130.4	49.7
40 Tay Ninh	648.2	636.3	559.2	353.5	0.0	0.0	88.9	282.8
41 Dong Nai	3,614.6	2,576.3	2,017.4	2,406.4	1.1	28.8	1,596.2	141.1
42 Ba Ria - Vung Tau	2,784.5	1,725.5	2,551.9	1,640.0	0.0	0.0	232.7	85.4
43 Long An	1,614.7	1,539.9	1,337.5	1,264.7	0.0	0.0	277.2	275.1
44 Dong Thap	1,761.7	1,432.1	964.7	1,073.5	0.0	0.0	797.1	358.6
45 An Giang	3,372.5	2,593.8	1,113.3	1,272.0	0.0	0.0	2,259.2	1,321.8
46 Tien Giang	1,200.7	1,664.1	1,012.9	957.1	0.0	0.0	187.9	707.0
47 Ben Tre	698.6	729.0	447.1	443.5	0.0	0.0	251.5	285.5
48 Vinh Long	909.0	1,011.5	569.5	547.1	0.0	0.0	339.6	464.4
49 Tra Vinh	654.4	638.9	306.1	252.5	0.0	0.0	348.3	386.3
50 Can Tho	2,248.1	2,374.7	1,315.2	1,351.2	0.0	0.0	932.9	1,023.5
51 Soc Trang	1,042.4	1,065.1	507.8	503.9	0.0	0.0	534.6	561.2
52 Kien Giang	3,254.7	2,865.2	1,888.4	2,145.5	0.0	0.0	1,366.3	719.6
53 Minh Hai	1,487.5	1,356.2	723.5	850.8	0.0	0.0	764.0	505.4
Total	96,843.1	96,843.1	68,772.6	68,772.6	4,654.9	4,654.9	23,415.6	23,415.6

Table 8.3-4 Cargo Trips by Mode, 2010

UNIT: 000 tons/year

	Total (All mode)		Road		Railway		Inland waterway	
	Generated	Attracted	Generated	Attracted	Generated	Attracted	Generated	Attracted
1 Ha Giang	382.3	375.0	382.3	375.0	0.0	0.0	0.0	0.0
2 Tuyen Quang	507.8	662.8	507.8	432.9	0.0	0.0	0.0	229.9
3 Cao Bang	386.5	377.9	386.5	377.9	0.0	0.0	0.0	0.0
4 Lang Son	914.3	743.3	670.7	574.8	243.6	168.5	0.0	0.0
5 Lai Chau	675.4	675.2	675.4	675.2	0.0	0.0	0.0	0.0
6 Lao Cai	1,375.2	786.0	980.0	713.7	395.2	72.3	0.0	0.0
7 Yen Bai	837.1	909.2	791.1	821.5	45.9	75.1	0.0	12.6
8 Bac Thai	3,403.8	3,178.7	2,903.2	2,648.5	500.6	530.2	0.0	0.0
9 Son La	687.4	667.3	687.4	667.3	0.0	0.0	0.0	0.0
10 Hoa Binh	1,409.6	1,366.7	1,409.6	1,366.7	0.0	0.0	0.0	0.0
11 Vinh Phu	6,827.9	6,866.5	4,591.8	5,278.2	398.9	685.4	1,837.2	902.9
12 Ha Bac	4,197.4	5,097.7	3,569.6	3,401.8	538.8	623.3	89.1	1,072.6
13 Quang Ninh	21,071.5	13,636.5	12,432.1	11,695.5	589.0	465.2	8,050.4	1,475.8
14 Hanoi Capital	8,274.3	14,654.2	7,103.8	9,820.5	1,170.5	2,619.4	0.0	2,214.2
15 Hai Phong	9,629.8	10,891.8	7,541.7	8,125.0	307.0	596.8	1,778.1	2,170.0
16 Hai Hung	5,692.9	8,891.5	4,638.0	5,382.5	231.6	191.4	823.3	3,317.6
17 Ha Tay	2,465.2	3,624.7	2,465.2	3,232.0	0.0	202.9	0.0	189.8
18 Thai Binh	2,558.4	2,633.0	2,249.8	2,325.9	0.0	0.0	308.7	307.1
19 Nam Ha	4,100.7	5,331.6	3,779.0	3,782.6	290.8	604.8	31.0	944.1
20 Ninh Binh	1,882.4	1,646.0	1,412.6	1,101.7	464.9	264.9	4.9	279.3
21 Thanh Hoa	6,892.5	6,107.7	4,402.1	4,881.7	2,193.6	1,130.3	296.9	95.8
22 Nghe An	3,897.5	3,370.2	2,908.6	2,584.4	977.5	768.8	11.4	17.0
23 Ha Tinh	1,751.5	1,439.6	1,427.4	1,171.0	323.0	262.4	4.1	6.3
24 Quang Binh	1,548.6	1,465.4	1,065.2	979.9	483.3	485.5	0.0	0.0
25 Quang Tri	932.9	780.8	510.5	457.9	422.4	322.9	0.0	0.0
26 Thua Thien - Hue	1,586.4	1,418.6	1,311.9	1,036.5	274.5	382.1	0.0	0.0
27 Quang Nam - Da Nai	3,334.1	3,069.4	2,698.3	2,411.0	635.8	658.4	0.0	0.0
28 Quang Ngai	1,449.0	1,270.3	1,206.9	869.1	242.1	401.2	0.0	0.0
29 Binh Dinh	3,069.2	2,813.7	2,762.8	2,376.1	306.5	437.6	0.0	0.0
30 Phu Yen	989.1	882.1	732.9	751.6	256.2	130.5	0.0	0.0
31 Khanh Hoa	3,249.6	2,976.1	2,893.1	2,677.8	356.4	298.3	0.0	0.0
32 Ninh Thuan	1,401.2	1,229.9	1,170.0	1,115.6	231.2	114.2	0.0	0.0
33 Binh Thuan	1,227.8	1,130.5	978.5	942.3	249.3	188.2	0.0	0.0
34 Gia Lai	659.5	639.1	659.5	639.1	0.0	0.0	0.0	0.0
35 Kon Tum	349.8	341.5	349.8	341.5	0.0	0.0	0.0	0.0
36 Dac Lac	1,597.9	1,554.2	1,597.9	1,554.2	0.0	0.0	0.0	0.0
37 Lam Dong	1,118.8	1,093.4	1,118.8	1,093.4	0.0	0.0	0.0	0.0
38 Ho Chi Minh City	31,025.3	35,470.5	23,273.6	24,782.1	2,215.4	1,265.7	5,536.4	9,422.6
39 Song Be	4,361.2	4,539.5	4,189.8	4,476.8	0.0	0.0	174.4	62.7
40 Tay Ninh	1,855.6	1,355.8	1,708.4	918.5	0.0	0.0	147.2	437.2
41 Dong Nai	9,062.2	7,818.2	6,150.1	6,628.7	488.1	885.3	2,424.0	304.1
42 Ba Ria - Vung Tau	10,790.4	6,442.5	10,018.4	6,096.2	0.0	0.0	772.0	346.4
43 Long An	3,176.9	2,679.3	2,602.0	2,214.8	0.0	0.0	575.0	464.5
44 Dong Thap	3,125.8	2,992.5	2,152.8	2,454.1	0.0	0.0	973.0	538.4
45 An Giang	7,208.1	6,376.0	4,127.8	4,191.7	0.0	0.0	3,080.3	2,184.3
46 Tien Giang	2,932.8	3,375.2	2,502.5	2,320.0	0.0	0.0	430.2	1,055.2
47 Ben Tre	2,219.2	2,079.9	1,618.8	1,521.1	0.0	0.0	600.4	558.8
48 Vinh Long	2,216.1	2,280.9	1,611.7	1,513.4	0.0	0.0	604.3	767.5
49 Tra Vinh	1,910.5	1,600.9	1,223.5	940.8	0.0	0.0	687.0	660.1
50 Can Tho	4,132.3	4,543.2	2,896.4	3,153.7	0.0	0.0	1,235.9	1,389.6
51 Soc Trang	2,278.0	2,261.6	1,495.9	1,475.5	0.0	0.0	782.1	786.1
52 Kien Giang	6,682.7	6,658.0	4,882.6	5,515.0	0.0	0.0	1,800.1	1,143.0
53 Minh Hai	4,051.8	4,297.9	2,702.3	3,247.0	0.0	0.0	1,349.4	1,050.9
Total	209,369.9	209,369.9	160,131.6	160,131.6	14,831.8	14,831.8	34,406.6	34,406.6

8.4 Preparation of Phased Improvement Plan

The Phased Improvement Plan shown in Table 8-4-1 has been prepared based on the following principle. Investment in Phase 1 will be concentrated on those items with high priority in terms of both safety and reliability improvement while investment in items of lesser priority will be conducted in Phase 2 or Phase 3. A more detailed explanation of Table 8-4-1 is given below.

(1) Commercial Prospect, Transportation and Management

The subject investment items in Phase 1 will be accident analysis, staff training and train operation control by the Head Office as these items will have the most direct and positive effect on the safety and reliability of train operation.

(2) Track and Stations

In regard to track, the dangerous 27 kg/m and 30 kg/m rails due to deterioration will be replaced in Phase 1 and the track in other sections will be gradually improved in Phase 2 and Phase 3. The improvement of level crossings in Phase 1 will also give priority to those involving either of the above rail types. Similarly, the roadbed improvement in Phase 1 will be conducted in sections using either 27 kg/m or 30 kg/m rails in addition to highly hazardous other sections. A track inspection car will be procured in Phase 2 while 2 MTTs will be procured for Union 3 (27 kg/m or 30 kg/m rail sections) in Phase 1 with additional MTTs being procured in the succeeding phases for Union 1 and Union 2. Ballast production facilities will be procured in Phase 1 for Union 3.

(3) Bridges

In the case of relatively long bridges of 20 m or more, those with a current speed limit of less than 30 km/hr due to high risk will be improved in Phase 1 and the remainder ($V \geq$ 30 km/hr) will be improved in Phase 2 and Phase 3.

In the case of shorter bridges of less than 20 m in length, those with a current speed limit of less than 50 km/hr will be improved in Phase 1 and the remainder ($V \geq 50$ km/hr) will be improved in Phase 2 and Phase 3.

For other bridges, improvement will be conducted in Phase 1 if those bridges are included in the sections of track which will be improved in the said phase due to the use of 27 kg/m or 30 kg/m rails.

(4) Tunnels

Those tunnels with a current speed limit of less than 30 km/hr due to high risk will be improved in Phase 1 and the remainder will be improved in Phase 2 and Phase 3.

(5) Signals

Colour-light signals and the Class 2 relay interlocking system, both of which have important bearing on the safety and reliability of train operation, will be introduced in Phase 1. And ATS will be installed in Phase 1 in those sections where the train frequency is high and the train speed is fast. Other sections will be equipped with ATS in the later phases. The introduction of the Class 1 relay interlocking system at major stations will take place in Phase 3.

An approaching train warning system will be installed in Phase 1 at those level crossings with heavy road traffic in urban areas and at the remaining major level crossings in the later phases.

(6) Communication Facilities

The laying of cable, which together with transmission facilities is the basis of the communication system, will be conducted in Phase 1 and Phase 2. The improvement of switchboards and the telephone system on station premises will be conducted in Phase 3.

(7) Rolling Stock

New high speed rolling stock will be gradually procured right from the Phase 1 period. The number of rolling stock will be gradually increased taking the transportation demand level and the rolling stock life expectancy into consideration.

(8) Workshops and Depots

The Gia Lam Workshop will be improved in Phase 1 to establish a reliable DEL overhaul system and will be followed by improvement of the Dian Workshop in Phase 2. The improvement of the DEL, PC and FC depots will be conducted in Phase 2 and Phase 3.

(9) Disaster Prevention Facilities

The construction of slope improvement works, falling rock prevention/protection facilities and drainage facilities, etc. will start in Phase 1, commencing with high risk sites.

(10) Sites Vulnerable to Flooding

Sites vulnerable to flooding will be improved in Phase 2 and Phase 3.

Table 8-2-1 Targets of Each Phase

	Type of Service	Phase 1 - 2000	Phase 2 - 2005	Phase 3 - 2010	Remarks
Safety and Reliability (key items only)	Reduction of slow speed sections at bridges and tunnels	23%	40%	37%	
	Introduction of colour-light signals	all stations			
	Introduction of relay interlocking together with power supply	2nd class relay interlocking for all stations, excluding stations where 1st class relay interlocking is introduced		1st class relay interlocking 10 stations	
	Introduction of ATS	38%	62%		
Travelling Time	Limited Express Passenger Trains (Hanoi - Ho Chi Minh City)	32.5 hours	28.0 hours	24.0 hours	Inclusive of some 70 minutes for stoppages (7 stations) and spare time
	Direct Freight Trains (Giap B. - Ho Chi Minh City)	46.0 hours	43.0 hours	40.0 hours	Inclusive of some 13 hours for stoppages (14 stations) and spare time

Notes
1. The line conditions for each phase are given by the phased improvement plan for track, etc.
2. The maximum train speeds are 110 km/hr for limited express passenger trains and 80 km/hr for through freight trains.

Table 8.4-1 Outline of Phased Improvement Plan

	First Phase					Second Phase					Third Phase				
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Commercial, Transportation, Management															
Establishment of advance ticket booking and sales system															
Establishment of cargo information system															
Transportation management, analysis of train accidents, guidance and training															
Strengthening of central management functions in relation to above issues															
Track and Stations															
Track Reinforcement	Track reinforcement extension 530 km					Track reinforcement extension 580 km					Track reinforcement extension 666 km				
Rails 43 kg/m rails															
25 m, long rails															
Turnouts															
Sleepers															
Track bed															
Level Crossing Improvement	205 places					322 places					334 places				
Roadbed Improvement															
Cant and Transition curve Improvement															
Curvature Improvement															
Maintenance Facilities															
Track inspection car						○ 1									
MTT					○	2		○	2					○	2
Ballast equipment	○	U-3				○	U-2				○	U-1			
Other tools and equipment															
Training Facilities															
New Signal Stations	3 stations					4 stations					3 stations				
Increase of Storage siding															
Station square improvement								2 stations			4 stations				
Investment Sub-Total	129.1					93.4					86.8				
Bridges															
Bridge rebuilding in sections of Stage I track reinforcement (excluding the following)															
Rebuilding of all L ≥ 20 m, V < 30 km/h bridges	56 places, 2.2 km														
Rebuilding of L ≥ 20 m, V ≥ 30 km/h bridges (in the same sections and stages as track reinforcement)	26 places, 3.5 km														
Rebuilding of all L < 20 m, V < 50 km/h bridges						84 places, 4.9 km					122 places, 6.6 km				
Rebuilding of L < 20 m, V ≥ 50 km/h bridges (in the same sections and stages as track reinforcement)	68 places, 0.6 km														
Training Facilities and Measuring Instruments						162 places, 1.0 km					108 places, 0.9 km				
Investment Sub-Total	142.5					142.5					142.5				
Tunnels															
Rebuilding of all V < 30 km/h tunnels															
Rebuilding of V ≥ 30 km/h tunnels (in the same sections and stages as track reinforcement)	10 places, 2.8 km														
Training Facilities and Measuring Instruments						10 places, 3.7 km					7 places, 1.3 km				
Investment Sub-Total	22.5					24.9					8.0				

	First Phase					Second Phase					Third Phase				
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Signals															
Colourlight signals		139 stations													
Improvement or introduction of Class 2 relay interlocking devices and power units and signal stations		162 stations + 3						4					3		
ATS system installation			62 stations					100 stations							
Introduction of level crossing approach warning system			57 places					143 places					10 stations		
Introduction of class 1 relay interlocking devices															
Training Facilities															
Investment Sub-Total	28.2					21.7					12.2				
Communications															
Laying of communication cable		792 km						934 km							
Installation of transmission devices				10 places					8 places						
Installation of data transmission facilities									2 sets						
Renewal of switchboards													14 places		
Renewal of terminal facilities (including new signal stations)													172 stations		
Training Facilities															
Investment Sub-Total	40.4					56.9					11.2				
Rolling Stock															
New high speed trains			5 trains					22 trains					17 trains		
New D18Es			33 cars					12 cars							
New D12Es			16 cars												
New passenger car			21					56					68 cars		
New freight cars			661 cars PC 20 cars					1791 cars					2860 cars		
Rehabilitation			D11H 10 cars					D13E, D18E 30 cars					D12E 40 cars		
Investment Sub-Total	121.7					223.0					211.4				
Workshops and Depots															
Improvement of Workshop															
Gia Lam Workshop	Building, facilities, machinery, equipment and tools, sewage disposal facility etc.										Effluent treatment plant				
						More circulatory spare parts for DEL maintenance									
Dian Workshop						Machinery, equipment, tools etc.					Effluent treatment plant				
Improvement of Depot															
Hanoi, Vinh, Da Nang, Nha Trang, Saigon Depot	Sewage disposal facility														
DL Depot								Machinery, equipment, tools etc.							
PC FC Depot											Building, machinery, equipment, tools etc.				
DL PC FC Depot													Effluent treatment plant		
Investment Sub-Total	36.0					11.7					17.3				
Disaster Prevention Measures															
Slope improvements															
Protection from falling rocks															
Drainage facilities															
Investment Sub-Total	10.0					23.0					12.0				
Banking to prevent flood															
Investment Sub-Total						17.0					42.0				
Investment Total (million US$)	530.4					614.1					544.4				

CHAPTER 9 SELECTION OF FEASIBILITY STUDY PROJECTS

9.1 Selection of Feasibility Study Projects based on Hanoi – Ho Chi Minh Railway Master Plan

The subject of the F/S is in principle the Phase I of the Phased Improvement plan of Master Plan with a target year of 2000.

Feasibility study has been carried out with due consideration not only on safe and reliable train operation but also on management analysis and improvement, and marketing. Further three priority sections were selected in the line where investment and services were intensified with a view to present a demonstration effect.

In addition, the investment necessity for improvement items in Phase I has been further examined as part of the relevant F/S to strictly determine the required investment amount, transferring some improvement items from Phase I to Phase II, or from Phase II to Phase III.

9.2 Selection of Lao Cai – Cai Lan Line as Feasibility Study Projects

9.2.1 Examination of Feasibility Study Project Selection Process

The Study Team was required to select an urgent project for a feasibility study through consultations with the Ministry of Transport and Communications of Vietnam based on the Master Plan Study on Transport Development in the Northern Part of Vietnam (JICA) (hereinafter referred to as the Northern Transport M/P) within the given Scope of Work.

Nine railway projects, ranging from the RW1 (Hanoi - Haiphong Line Passenger Transport Improvement) to the RW9, are selected as short-term projects in the Northern Transport M/P which suggests the possible inclusion of the RW10 (Cai Lan Port Cargo Transport by Rail and Ha Noi Land Port Construction) in the list of short-term projects depending on the official development policy for Port Cai Lan.

The Government of Vietnam made it clear that it did not wish the Study Team to include the RW1 (Hanoi - Haiphong Line Passenger Transport Improvement), which is the highest priority project under the Northern Transport M/P, in the list of feasibility study candidates, as it had already been decided that a British consultant would conduct the said feasibility study. After examining other short-term projects identified by the Northern Transport M/P,

the Study Team suggested the Hanoi - Lao Cai Line as the subject line for a feasibility study to the Government of Vietnam.

In response to this suggestion, the Government of Vietnam made a request for a feasibility study for the railway line stretching from Lao Cai to Cai Lan, which will consolidate the East-West axis in the North, as it believes the development of Port Cai Lan to be both important and urgently necessary. The Ministry of Transport and Communications of Vietnam subsequently made a formal request for a feasibility study on the Lao Cai - Cai Lan Line via the Embassy of Japan.

9.2.2 Roles and Importance of Lao Cai - Cai Lan Line

(1) Development of Areas Along Its Route

Some 6 million people live in areas along the Lao Cai - Cai Lan Line and industrial zones are found in Hanoi, Viet Tri, Phu Duc and Cao Nho etc. A new industrial park is planned in Yen Vien. As these areas are said to be endowed with rich mineral resources, such as phosphate rock, copper and iron ore, there appears to be a good prospect for mining as well as industrial development.

(2) Importance of Port Cai Lan

The Northern Transport M/P calls for restraint in regard to the development of Port Cai Lan to protect tourism resources in Ha Long Bay and designates Port Haiphong as the key port in the North with Port Cai Lan playing a supplementary role. The development of Port Cai Lan is proposed to handle the surplus cargo of Port Haiphong as the demand for maritime cargo transportation in the North exceeds the handling capacity of Port Haiphong. The Northern Transport M/P does not envisage industrial development in the hinterland of Port Cai Lan and assumes that all landed cargo will be forwarded to Hanoi and its surrounding areas. The railway line development priority is decided by the railway improvement plan of the Northern Transport M/P, using improved port access as an important factor, and gives the Hanoi - Haiphong Line the highest improvement priority.

At the time of the submission of the Draft Final Report of the Northern Transport M/P with emphasis on Haiphong Port development to the Government of Vietnam, however, the new development policy of developing Port Cai Lan as the largest port in the North together with industrial development in its hinterland was announced by the Government of Vietnam.

Taking this new government policy into consideration, the Draft Final Report of the JICA's Feasibility Study on Cai Lan Port Construction Project (hereinafter referred to as the JICA Port Cai Lan F/S) Team came up with different cargo handling figures in the year 2010 for Port Cai Lan and Port Haiphong from those of the Northern Transport M/P as shown below.

	JICA Port Cai Lan F/S	Northern Transport M/P
Port Cai Lan	14.3 million tons	6.3 million tons
Port Haiphong	8.4 million tons	8.2 million tons

(3) International Transport Connection with China

The Lao Cai - Haiphong Line was originally constructed in 1906 as the Yunnan Railway linking Kunming in China's Yunnan Province to Port Haiphong and has meter gauge throughout its route. China is now constructing a domestic railway line running eastwards from Kunming to a domestic port. Though the Kunming - Cai Lan/Haiphong Line has about the same length as the domestic route, China may use the Lao Cai - Cai Lan/Haiphong Line to ship some of its international cargo, however, there is no reliable forecast of how much cargo China may send along this route.

(4) Through Cargo Flow Between Lao Cai and Cai Lan

Given the potential for mining resources development and industrial development along the Lao Cai - Cai Lan Line, the plan to make Port Cai Lan the largest port in northern Vietnam, the industrial development plan for the hinterland of Port Cai Lan and the possible influx of international cargo from China, the volume of through cargo between Lao Cai and Cai Lan via Hanoi in the future may become substantial with the progress of these development plans.

(5) Support Line for Daily Life

The Hanoi - Lao Cai Line is essential for the daily lives of people living in areas along its route as no parallel road network exists.

(6) Tourism

Port Ha Long has the potential to become one of the world's leading tourist sites and the number of tourists is forecast to increase from the present 840,000 a year to some 2 million a year in 2010, implying a substantial tourist demand for the Hanoi - Cai Lan Line.

9.2.3 Suitability of Lao Cai – Cai Lan Line as Subject Project of Feasibility Study

(1) Consolidation of East-West Axis

The Study Team believes that the railway network improvement priority in Vietnam should be given to (a) the East-West corridor in the North (Lao Cai - Hanoi - Cai Lan or Haiphong) and (b) the North-South railway line (Hanoi - Ho Chi Minh Railway). The Northern Transport M/P identifies the RW1 (Hanoi - Haiphong) and RW5 (Haiphong - Lao Cai) as short-term improvement projects to strengthen the East-West axis in the North and leaves room for the inclusion of the RW10 (Cai Lan Port Cargo Transport by Rail and Hanoi Land Port Construction) on the list of short-term projects depending on the outcome of the Port Cai Lan development policy. The identification by Northern Transport M/P was based on the then forecast role and cargo handling volume of Port Cai Lan and Port Haiphong. However, development priority should be given to the Lao Cai - Cai Lan Line rather than to the Lao Cai - Haiphong line because of the reasons given in 2-(2) above.

(2) Suitability as Subject of Feasibility Study

As the Lao Cai - Cai Lan Line is expected to play an important role in consolidating the East-West axis in northern Vietnam, its selection as the subject project of the feasibility study to facilitate the formulation of an improvement plan is deemed highly appropriate. This line, in fact, urgently requires improvement efforts to solve the following important issues it faces today, underlining its high feasibility study priority.

1) The line runs through areas where no other mode of transport, such as roads, exists. The improved reliability of the sole means of transport in these areas is important from the viewpoint of rectifying the regional economic gap which is one of Vietnam's national targets. Moreover, the line is used for international cargo transport from Kunming in China and maintenance of its service level is essential. While the necessity to repair and improve the line has been advocated for some time, a detailed study is required to determine the timing, scope and economy of improvement work.

2) The Government of Vietnam has announced its policy of withdrawing the standard gauge and unifying all gauges to the meter gauge. When this policy should be enforced for this line has become an important issue.

3) No clear demand forecast has been made for the line. The planned development of mineral resources along the route, with the transportation service provided by the line constituting a lifeline for such development, is mentioned in government circles in Vietnam. Modification of the cargo transportation demand forecast to and from Port Cai Lan under the Northern Transport M/P is required to reflect changes of the development prospect of Port Cai Lan based on JICA Port Cai Lan F/S. Under these circumstances, it is necessary to clearly establish the likely future transportation demand for the line in order to provide a guideline for the planning of the line's improvement by the Government of Vietnam.

4) The change of the development policy for Port Cai Lan has necessitated major reconsideration of how to transport cargo handled by the port and how to develop port-related facilities (including the ICD).

5) Estimation of the investment cost of Hanoi - Ho Chi Minh Railway (North-South axis) and Lao Cai - Cai Lan Line (East-West axis), both of which are designated highest priority railway lines for improvement by the Government of Vietnam, is necessary to estimate the likely total investment cost for the railway sector as a whole.

9.2.4 Points to Note in Implementing Feasibility Study

As described earlier, the Lao Cai - Cai Lan Line may well play a variety of roles, including cargo transportation necessitated by the development of Port Cai Lan and its surrounding areas, the transportation of mineral resources, such as phosphate rock produced along the route, the role of a lifeline for people living in areas between Hanoi and Lao Cai, the transportation of tourists to Ha Long Bay and international cargo transportation to and from China. When considered in terms of a short timespan of, say, the year 2000, however, the development of Port Cai Lan and its surrounding areas will not have been completely conducted and the railway is expected to transport as little as some 31,000 tons/year of Port Cai Lan's annual cargo handling volume of 2.67 million tons. In addition, the need for railway transportation of minerals at that time will not be very high even if mining development does take place. Taking all these probabilities into consideration, together with the fact that the section between Kep and Cai Lan is relatively new, the improvement targets for the Lao Cai - Cai Lan Line for the target year of 2000 will be the rehabilitation of aged/deteriorated railway facilities between Hanoi and Lao Cai, improvement of the disaster prevention system and possible increase of the tourist transportation capacity to Ha Long, etc. In short, the emphasis will be on the improved safety and reliability of railway transportation

services with a minimum level of investment. When the focus is placed on a long timespan upto the year 2010, the development of Port Cai Lan and its surrounding areas will have progressed to Port Cai Lan having an annual cargo handling volume of 14.3 million tons, of which 1.4 million tons are estimated to be dealt with by the railway. An additional railway transportation capacity may well be required depending on the state of progress of mining development along the route. The transportation demand will be further boosted by an increase of tourists to Ha Long of 250% from the present level. Consequently, the issues to be addressed by a long-term improvement plan upto the year 2010 for the Lao Cai - Cai Lan Line will significantly differ from those to be addressed by a short-term improvement plan upto the year 2000.

A short-term improvement plan is liable to make serious mistakes if it does not take various requirements into consideration from the viewpoint of long-term improvement. It is desirable to firstly formulate a conceptual improvement plan with the long timespan of upto 2010, followed by a phased improvement plan to materialise this conceptual plan. A feasibility study for a short-term improvement plan for the Lao Cai - Cai Lan Line upto the year 2000 should be conducted based on this phased improvement plan. In formulating the long-term conceptual improvement plan, the possibility of introducing a short cut route will be examined together with examination of the preferable timing to change the standard gauge on the Hanoi - Cai Lan section to the meter gauge in accordance with the government policy. The necessary measures for management improvement (such as manpower reduction, marketing of passenger and freight services and an improved service level) should be carefully examined together with those for the improved operational safety and reliability of the Lao Cai - Cai Lan Line.

CHAPTER 10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions and Recommendations

As mentioned in 6.4.6, the most standard methods of quantitative evaluation are to use the national economy viewpoint indices of EIRR, CBR and NPV etc. to evaluate the Master Plan, and to use corporate financial viewpoint indices such as the FIRR etc. to evaluate the financial standing of the VNR which is the subject of the Master Plan.

EIRR and FIRR of the Master Plan are provided in 7.9. The Project aims to draw up a Master Plan for the rehabilitation and improvement of a north-south railway between Hanoi and Ho Chi Minh by the target date of 2010. As was described in 5.2.1, this will be a main railway line which acts as the backbone of Vietnam in supporting the nation's social and economic development. It is felt that evaluation of Master Plan should be conducted from the national economic viewpoints. Moreover, it should be mentioned that the financial analysis assumes that the government will provide all of the VNR infrastructure investment, and thus financial evaluation does not take the state investment into consideration.

The EIRR value for the Master Plan provided in 7.9.1 is almost equivalent to capital opportunity cost of Viet Nam. Normally, the feasibility of projects in terms of national economy is evaluated with the EIRR and judgment of economic feasibility is made depending on whether or not the EIRR value is greater than the country's capital opportunity cost (Capital opportunity cost varies depending on the economic conditions of a country).

Only quantitative benefits such as time and transportation cost benefits are considered in EIRR calculations (there is a possibility that the EIRR value would increase if other quantitative benefits such accident benefits (the benefits obtained from reduced accidents), which were not included in these calculations due to no data being available, were included). However, many indirect and unquantifiable benefits are not taken into consideration in calculating EIRR. In this regard, the Master Plan Project should not be evaluated by EIRR alone.

The Project is a national project designed to achieve the restoration and modernization of the Hanoi-Ho Chi Minh Railway. By fully developing the functions of the said railway, the Project achieves (1) stimulate socio-economic development along the line, (2) induce beneficial effects for related industries, (3) expand employment through investment, (4) form an efficient and integrated transport system in Vietnam together with improvements in road,

air, sea and other transport system, and (5) promote north-south integration in Vietnam which had previously been politically, socially and economically divided.

Considering these and other indirect benefits of the Project which cannot be measured in quantitative terms, it is recommended that the Project Master Plan should be implemented immediately as a significant transport infrastructure that will support economic development of Vietnam.

In realizing the Master Plan of Hanoi-Ho Chi Minh Railway, improvement should be made step by step. In this regard, JICA Study Team has drawn up the phased improvement plan under close cooperation of the Counterpart. The First phase of the phased improvement plan will be taken up as the Project for feasibility Study. Feasibility Study of Lao Cai-Cai Lan Railway will be also carried out. The results of these feasibility studies will be presented in the Final Report.

10.2 Recommendations for Improvement After 2010

The JICA Study Team has now proposed the Hanoi - Ho Chi Minh Railway Rehabilitation and Improvement Master Plan with a target year of 2010. In preparing this Master Plan, strict emphasis was placed on a realistic investment size. As a result, the Master Plan does not necessarily include the world's latest railway technologies relating to meter gauge. Here, a further improvement plan for the VNR beyond 2010 is recommended, taking the world's latest railway technologies into consideration. However, when the long term Master Plan will be reviewed after 5-10 years, these recommendation suggested to be introduced after 2010, may be reviewed for introduction depending on the economic situation of Viet Nam.

10.2.1 Management and Operation

At present, Viet Nam's railway network does not fully realise its potential because of damage to its physical facilities caused by war and the lack of investment. Consequently, the Master Plan stresses improvement of the infrastructure and rolling stock, etc. to enable the full functioning of railway services. The healthy operation of railway services, however, requires efficient management and high productivity in addition to sound facilities. Efforts to improve the management efficiency as well as productivity should, therefore, be continuously made both before and after 2010 together with consolidation of the railway facilities at a desirable level. Concrete measures to achieve continual improvement of the management efficiency and productivity include the establishment of a management information system (MIS), adoption of management policies delegating more management responsibility to the Unions

with a close understanding of specific local requirements, improvement of railway services in line with development along the route and promotion of related business activities.

The VNR will be continuously required to maintain its commitment to studying developments of railway management in industrialised foreign countries and to positively adopting a rational management style. In regard to the need to secure capable staff, new measures should be introduced to increase wages to a level which is comparable with the real standard of living to keep useful manpower within the VNR. Finally, efforts should be made to improve or develop indigenous technologies to maximise the local production/manufacture of equipment and facilities.

10.2.2 Transportation Plan

Railway services after 2010 will need to provide more improved reliability and travelling comfort in response to the growing competition from other modes of transportation under a market economy and an increased national income level. The following points should be discussed well in advance in preparation for the further improvement of railway services.

1) In order to further improve the transportation reliability, the introduction of the Class 1 relay interlocking system should be promoted, commencing at those stations near large cities. Follwing the upgrading of the signalling system to an automatic (special automatic) signalling system, the CTC system should be introduced to modernise transportation control.

2) In order to improve passenger services, the number of trains in areas near large cities should be increased to cope with the increase of traffic demand. It will be necessary to construct a second track and/or to electrify the route in addition to elevate the railway track in view of the safe and efficient operation of an increased number of trains.

3) In view of the likely increase of the cargo transportation demand, the introduction of container train yards and other new facilities should be considered to facilitate container transportation and multi-mode transportation (combined railway and road transportation services in particular).

10.2.3 Various Railway Facilities

(1) Civil Engineering Structures and Track, etc.

1) Bridges and Tunnels

An increased transportation demand will necessitate electrification of the route, in turn requiring the rebuilding of bridges and tunnels in response to the enlarged construction gauge to accommodate electrified trains. It is, therefore, important that the new bridges and tunnels to be constructed in the future have an appropriate cross-section for electrified trains. Moreover, the need to improve steep slope sections and sharply curved sections will necessitate a longer tunnel length. These new requirements should be taken into consideration in any future railway improvement plan together with the provision for possible double tracking.

2) Other Civil Engineering Structures

Those sections vulnerable to flooding, except those earmarked for new high banking with new track to be completed by 2010 shown in Table 3-6-1-1, should be raised. From the viewpoint of efficient maintenance, the present roadbed width of 4.4m should be widened to 5m or more. A disaster prevention system should be firmly established to allow preventive maintenance rather than all available manpower being used for pressing rehabilitation or temporary repair work as in the present case.

3) Track and Level Crossings

Alteration of the route at sharply curved sections and steep slope sections and other fundamental improvements will be necessary to permit increased train services, less maintenance work and higher speed services. Other measures include the introduction of heavier rails (50 km/m, etc.) and monoblock PC sleepers and adoption of maintenance-free track inside tunnels. A grade separation should be considered at those level crossings with particularly heavy road traffic.

4) Stations

The present height of the platforms should be reviewed at busy stations for better passenger access and to shorten the stoppage time. The progress of urban development and an increased number of passengers will necessitate the construction of station squares. The provision of safety siding will be required for added safety at stations.

5) Maintenance System

The introduction of such large machinery as ballast cleaners and the construction of maintenance bases will be required to improve the efficiency of maintenance work.

(2) Electrical Facilities

1) Signals

The introduction of the relay interlocking system and colourlights for the entire route will allow higher train speeds and an increased transportation volume for some time to come. Nevertheless, the need for increased flexibility of the train operation diagramme to allow additional trains to efficiently respond to complex transportation demands requires facilities allowing the successive following trains and also trains running in opposite directions to pass each other, not just at stations but also between stations. To be more precise, the construction of double track at certain sections and the introduction of the single track automatic block system will be necessary. Moreover, the increased speed of limited express trains and inter-regional express trains and others will make traffic accidents at level crossings far more serious than those involving slower speeds. Therefore, in addition to grade separation of heavy traffic level crossing, it is necessary to consider the installation of an automatic warning system and obstacle detection system at unmanned level crossings which are also used by vehicles.

2) Communication

The introduction of most of the basic communication facilities will have been completed by 2010. Thereafter, improvement efforts are expected to focus on individual equipment or systems of which the introduction will further contribute to the improved safety of train operation, improved services and improved management efficiency, etc. as described below.

a) Improved safety of train operation

① Train radios

- New facilities to enable direct communication between the train crew and operation control office or station
- Disaster prevention radio system to transmit an emergency train stop signal from the train or designated locations of a danger to train operation

② Disaster prevention information control system

- Central control of disaster information (numerical data and still images, etc.) affecting train operation
- Central gathering of information on wind velocity, rainfall, water level and rock fall, etc. to decide necessary instructions for train safety operation (slowing down of travelling speed and temporary stoppage of trains, etc.)
- Fixed point monitoring: visual monitoring of dangerous sites using still images

b) New services: new information services at stations using train information boards and video display, etc.

- Information board: literal information service regarding train status and other topics
- Video display: tourism promotion films and news, etc.

c) Strengthening of data communication system

- Introduction of budget control, accounting and asset control systems and sharing of terminals
- Introduction of electronic mail system

(3) Rolling Stock Workshops

1) Rolling Stock

a) The following measures should be considered based on the assumption that the maintenance system for diesel cars (DC) has been fully established.

- Introduction of pendulum DCs for daytime inter-regional express trains (without sleepers) for further speeding up
- Introduction of commuter DCs in large cities (ECs for electrified sections)

b) Introduction of container trains

2) Rolling Stock Workshops

a) The introduction of a computer system to control the following work for appropriate and speedy maintenance should be considered.

① Car history control

② Inventory control for rolling stock maintenance parts and materials.

③ Personnel control at each workshop and depot, etc.

b) The automation of maintenance work to speed up operation and to reduce manpower (towards unmanned maintenance) should be considered.

① Washing and cleaning work

② Body polishing and painting

③ Machining

④ Inspection and testing

c) The establishment of an electric car maintenance system (modernisation of rolling stock maintenance) should be considered in case electrification is to be introduced.

① Training of electric car maintenance staff

② Introduction of electric car maintenance facilities

10.2.4 Environmental Conservation

The recommendations after 2010 concerning environment are summarized in Table 10.2-1 corresponding to the remaining problems in Master Plan.

Table 10.2-1 Summary of Recommendations

Remaining Environmental Problem	Recommendations
Congestion of road traffic at level crossings, particularly in urban areas, due to increased train services	Introduction of railway viaducts or flyover roads
Absence of sewage tanks for existing PCs	Installation of sewage tanks for as many PCs as possible
Noise, vibration and risk of accidents due to speeding up and increased train services	Further improvement of the track (long rails and heavy rails), thorough maintenance and erection of safety fencing (guard-rails), etc.
Extreme proximity of houses to railway track	• Preparation of a long-term land use plan to guide railway development planning • Introduction of laws regarding the relocation of houses and preparation of an appropriate housing relocation programme

10.2.5 Speeding Up

Under the Master Plan for 2010, a maximum train speed of 110 km/hr has been proposed to ensure a realistic investment size and economical maintenance. After 2010, however, the target maximum speed should be increased to 120 - 130 km/hr which is the top level speed for meter gauge throughout the world. This speeding up must be preceded by track reinforcement (with the use of heavy rails, long rails, monoblock PC sleepers and double elastic fasteners, etc.) For the speeding up of not only the maximum speed but also the schedule speed, integrated improvement measures must be adopted, ranging from improvement of the alignment, curve (curvature, cant and transitional curve) and rolling stock to the introduction of an automatic signalling system.

10.2.6 Electrification

Compared to diesel locomotives, electric locomotives have such advantages as a lower maintenance cost (lower fuel and manpower costs), increased traction power due to a larger engine output, higher speed and energy source flexibility (the power can be generated by water, coal, gas or oil or can be nuclear power), etc. At the same time, huge investment is required to construct the power generation and transmission facilities, substations and overhead trolley, etc. Consequently, electrification cannot be justified from the economic viewpoint unless the number of trains operating each day is sufficiently large. The electrification of the Hanoi - Ho Chi Minh Railway should be discussed in the future when the number of trains operating each day increases to a certain level to respond to the increased transportation demand. As the yardstick to justify electrification varies from country to country and also from line to line depending on the characteristics of the railway line in question, a feasibility study must be conducted to confirm the economic feasibility of electrification of a given line.

A quantitative survey on urban transport was not conducted under the present study. Should the Hanoi - Ho Chi Minh Railway serve urban transport in Hanoi and Ho Chi Minh City, the necessity to electrify both urban and suburban sections of the route could arise well before the need for the electrification of intercity services between Hanoi and Ho Chi Minh City (see Appendix 10.2-1).

10.2.7 Upgrading to Double Track

There is no urgent need to upgrade the Hanoi - Ho Chi Minh Railway to a double track route before 2010. With the introduction of 4 new signalling stations, the track capacity will be sufficient to handle the transportation demand upto 2010. However, it will be necessary to

introduce measures to gradually increase the track capacity after 2010 in response to the likely continuation of the transportation demand increase.

The track capacity can be increased by the introduction of double track, speeding up and/or an automatic signalling system and the introduction of double track is the most effective of these options. Upgrading of the entire route to double track should be conducted in stages with the construction of additional signalling stations, stations and section-by-section upgrading to double track (see Appendix10.2-2).

APPENDIX

Appendix 1.1-1

MINUTES OF MEETING

ON REPORT

ON

"SELECTION OF OPTIMUM ALTERNATIVES OF MASTER PLAN AT 2010 FOR REHABILITATION AND IMPROVEMENT OF HANOI - HOCHIMINH RAILWAY"

(Hereinafter referred to as the Report)

1. JICA Study team presented appropriate number of copies of the Report to the Ministry of Transport (MOT) of the Vietnamese Government and to the Counterpart. The Study Team explained the Report to and discussed with the Counterpart on October 4th and 5th 1994, and MOT and the related Agencies on Oct. 6th, 1994.

2. There were presented various useful comments on the Report from the Vietnamese Side. Vietnamese Side agreed that Alternative I be selected as the Optimum Alternative for the Master Plan. Many useful comments presented by the Vietnamese Side would be suitably reflected in finalizing the Master Plan to be included in the Interim Report I.

3. Vietnamese Side has also agreed in principle with the basic contents of the Phased Improvement Plan proposed by JICA Study Team. However, JICA Study Team will duly take into consideration the various useful comments presented by Vietnamese side in finalizing the Phased Improvement Plan to be included in the Interim Report I.

At Hanoi *Oct. 7, 1994*

PHAM VAN DANH
General Director
International Relation Department
MINISTRY OF TRANSPORT

SADAAKI KURODA
Leader
JICA Study Team

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ON MASTER PLAN FOR HANOI - HCM RAILWAY

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APPENDIX CHAPTER 2.1

Appendix Table 2.1-1 Freeboards of Railway Bridges and Recommended Priority of Improvement

Hanoi - Da Nang		Location	Length (m)	Elevation			Freeboard (m)	Recommended priority of improvement		
No.	Name of bridges			Bottom level of the beam	Highest river water Level	Year		Emergency Fb<0m	Long term 0<=Fb<0.8m	Review of freeboard
1	Do Xa	28 km+ 922	19.30	4.580	-		-			*
2	Caw Gie	38 km+ 265	49.90	5.480 @	3.200		2.280			
3	Phu Ly	55 km+ 000	62.25	-	-		-			*
4	Yen Do	70 km+ 459	38.15	3.340	-		-			*
5	Phu Oc	84 km+ 197	33.24	2.470 @	-		-			*
6	Cau Danh	92 km+ 079	34.51	1.915	-		-			*
7	Cau Chuoi	95 km+ 499	31.30	2.183	-		-			*
8	Cau Tao	103 km+ 523	37.30	2.880 @	-		-			*
9	Ninh Binh	113 km+ 359	222.12	4.240 @	4.290		-0.050	*		
10	Cau Yen	119 km+ 515	51.90	3.690	-		-			*
11	Cau Ghenh	123 km+ 637	32.65	3.964 @	-		-			*
12	Can Do	125 km+ 500	29.93	3.730 @	-		-			*
13	Tong Giang	144 km+ 248	45.50	4.090	-		-			*
14	Cau Cu	145 km+ 481	43.63	4.070	-		-			*
15	Do Len	153 km+ 244	170.88	6.250	-		-			*
16	Tao Xuyen	168 km+ 448	82.96	5.959	-		-			*
17	Ham Rong	170 km+ 478	180.74	8.750	-		-			*
18	Chui Ham Rong	171 km+ 144	27.44	10.083	-		-			*
19	Tho Hac	172 km+ 570	312.25	-	-		-			*
20	Can Vuong	185 km+ 989	57.39	-	4.800		-			*
21	Can Lac	192 km+ 801	56.50	-	4.600		-			*
22	Cau Cun	197 km+ 958	71.98	4.080	-		-			*
23	Thi Long	208 km+ 284	48.51	4.883	-		-			*
24	Cau Dong	211 km+ 456	43.40	8.120	-		-			*
25	Cau Cu	221 km+ 136	37.14	4.240 @	4.300	1980	-0.060	*		
26	Luong Muc	230 km+ 668	46.03	4.890 @	5.280	1970	-0.390	*		
27	Hoang Mai	246 km+ 648	109.18	6.510	-		-			*
28	Cau Trich	249 km+ 115	45.65	5.440	-		-			*

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Appendix Table 2.1-1 (continued)

Hanoi - Da Nang		Location	Length (m)	Elevation			Freeboard (m)	Recommended priority of improvement		
No.	Name of bridges			Bottom level of the beam	Highest river water Level	Year		Emergency Fb<0m	Long term 0<=Fb<0.8m	Review of freeboard
29	Giap Duc	261 km+ 634	36.10	4.250	-		-			*
30	Yen Chu	263 km+ 505	46.33	4.030	-		-			*
31	Cam Bao	269 km+ 205	47.57	3.645	-		-			*
32	Cau Loi	273 km+ 511	87.10	-	-		-			*
33	Dien Hoa	279 km+ 835	33.30	-	-		-			*
34	Do Dao	282 km+ 725	113.27	4.610	-		-			*
35	Phu Dien	284 km+ 665	42.10	3.310 @	-		-			*
36	Do Cam	300 km+ 161	126.50	4.530	2.640		1.890			
37	Cua Tien	321 km+ 661	39.82	3.330	2.800		0.530		*	
38	Do Yen -1	324 km+ 707	40.76	3.318	3.270	1950	0.048		*	
39	Do Yen -2	324 km+ 839	27.40	3.750	2.800		0.950			
40	Yen Xuan	331 km+ 008	436.76	6.500	7.490		-0.990	*		
41	Cau Han	334 km+ 100	38.92	4.312	4.930		-0.618	*		
42	Lo Vang	336 km+ 382	25.24	-	6.572	1954	-			*
43	Cho Thuong	338 km+ 125	259.04	6.900 @	7.560	1978	-0.660	*		
44	Hoi Co	348 km+ 419	34.35	8.410	8.990		-0.580	*		
45	Cau 18	358 km+ 700	35.83	12.900	10.250		2.650			
46	Cua Rao	360 km+ 530	170.90	15.330	12.900		2.430			
47	Thanh Luyen	370 km+ 311	59.37	15.470	15.910		-0.440	*		
48	Huong Tan	375 km+ 827	46.40	14.560	-		-			*
49	Loc Yen	388 km+ 092	88.62	17.210	17.160		0.050		*	
50	Khe Ac	391 km+ 110	27.24	17.440 @	18.500		-1.060	*		
51	Cau 393	394 km+ 680	27.92	-	19.880	1944	-			*
52	La Khe	403 km+ 376	248.50	28.700	27.600		1.100			
53	Tan Doc	405 km+ 150	66.08	30.230	30.930		-0.700	*		
54	Cau 413	414 km+ 203	33.28	48.446	44.700		3.746			
55	Khe Net	421 km+ 210	98.92	33.360	32.700		0.660		*	
56	Kim Lu -1	425 km+ 411	31.02	24.424	-		-			*
57	Kim Lu -2	425 km+ 628	57.28	24.605	29.150	1944	-4.545	*		
58	Khe Be	429 km+ 570	37.80	22.765	25.400	1944	-2.635	*		

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Appendix Table 2.1-1 (continued)

Hanoi - Da Nang		Location	Length (m)	Elevation			Freeboard (m)	Recommended priority of improvement		
No.	Name of bridges			Bottom level of the beam	Highest river water Level	Year		Emergency Fb<0m	Long term 0<=Fb<0.8m	Review of freeboard
59	Do Vang	432 km+ 425	176.87	20.880 @	23.800		-2.920	*		
60	Dong Le	435 km+ 048	49.29	17.216	19.100	1934	-1.884	*		
61	Khe Chua	441 km+ 955	35.44	28.296	24.410		3.886			
62	Da Bo	443 661	27.41	31.040	28.500	1970	2.540			
63	Mong	445 km+ 337	27.26	37.970 @	35.910		2.060			
64	Met	446 km+ 549	33.52	29.241	28.38	1944	0.861			
65	Ngoc Ram	451 km+ 015	37.38	9.780	12.200		-2.420	*		
66	Dap Lang	453 km+ 834	32.00	10.400	11.100		-0.700	*		
67	Minh Le	482 km+ 604	153.12	6.080	5.020		1.060			
68	Ngan Son	487 km+ 822	188.86	7.400	5.910		1.490			
69	Vac Da	499 km+ 901	51.20	5.690	4.720	1934	0.970			
70	Mu Ba	505 km+ 111	51.46	5.700	-		-			*
71	Rong Truoc	505 km+ 847	83.40	5.380	-		-			*
72	Cao 510	510 km+ 024	25.90	5.310 @	6.250	1934	-0.940	*		
73	Chanh Hoa	511 298	109.14	9.040	7.150		1.890			
74	Cau Giao	512 km+ 282	33.68	7.436 @	-		-			*
75	Cau 514	514 km+ 419	29.82	-	-		-			*
76	Duc Pho	524 km+ 507	36.29	5.246	3.130	1950	2.116			
77	Le Ky	526 km+ 719	66.68	4.930 @	4.350		0.580		*	
78	Vinh Tuy -1	531 km+ 043	59.92	6.833 @	4.020	1950	2.813			
79	Vinh Tuy -2	531 km+ 678	25.78	3.100 @	3.040		0.060		*	
80	Hau Phan	534 km+ 484	31.02	5.390	4.690	1950	0.700		*	
81	Long Dai	538 km+ 401	175.57	6.930	4.720		2.210			
82	My Duc	551 km+ 687	60.83	4.520	5.000		-0.480	*		
83	Phu Ky	554 km+ 719	44.03	5.676	5.350		0.326		*	
84	Phu Hoa	557 km+ 526	69.26	4.110	5.500		-1.390	*		
85	Trach Ban	560 km+ 179	55.42	5.806	4.850		0.956			
86	My Trach	564 km+ 100	179.31	6.290	5.510		0.780		*	
87	Hai Nham	573 km+ 793	37.32	7.976	-		-			*
88	Cau 583	583 km+ 732	33.74	11.540	-		-			*

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Appendix Table 2.1-1 (continued)

Hanoi - Da Nang		Location	Length (m)	Elevation			Freeboard (m)	Recommended priority of improvement		
No.	Name of bridges			Bottom level of the beam	Highest river water Level	Year		Emergency Fb<0m	Long term 0<=Fb<0.8m	Review of freeboard
89	Sa Lung	588 km+ 223	73.74	5.430	4.920		0.510		*	
90	Ben Tranh	589 km+ 223	42.77	5.136	2.553	1975	2.583			
91	Tien An	599 km+ 613	132.58	5.314	5.460	1983	-0.146	*		
92	Le Mon	603 km+ 203	27.12	8.086 @	-		-			*
93	Tiuc Khe	613 km+ 713	46.82	5.090 @	3.627		1.463			
94	Dong Ha	618 km+ 632	172.72	4.372	4.450	1950	-0.078	*		
95	Lai Phuoc	624 km+ 995	90.77	3.918	6.418	1983	-2.500	*		
96	Ai Tu	627 km+ 449	38.82	4.280	4.732	1971	-0.452	*		
97	Ngnyit Bieu	631 km+ 676	33.43	7.960	6.100	1960	1.860			
98	Nham Bieu	632 km+ 786	90.30	8.286 @	8.900		-0.614	*		
99	Thach Han	633 km+ 218	258.06	8.540	7.050	1971	1.490			
100	Rong	641 km+ 500	69.44	8.385	-		-			*
101	Ben Da	646 km+ 930	48.92	5.460	5.145	1975	0.315		*	
102	My Chanh	651 km+ 084	149.88	6.420	-		-			*
103	Cau Nhi	653 km+ 785	54.93	7.290	6.100		1.190			
104	Pho Trach	659 km+ 203	94.14	8.970	8.180		0.790		*	
105	Dong Lam	663 km+ 850	53.00	6.440	5.970		0.470		*	
106	Hien Sy	670 km+ 951	32.49	-	8.200		-			*
107	Song Bo	671 km+ 400	148.10	8.920	8.200		-			*
108	An Hoa	684 km+ 691	68.42	3.980	3.730	1975	0.250		*	
109	Buoc Mang	686 km+ 810	29.04	2.800	-		-			*
110	Bach Ho	687 km+ 364	309.32	4.460	-		-			*
111	Gia Vien	687 km+ 687	107.71	-	6.460		-			*
112	Huong Thuy	697 km+ 320	50.05	-	6.420		-			*
113	Phu Bai	706 km+ 752	58.77	7.520	7.000		0.520		*	
114	Noong	708 km+ 743	106.19	7.440	6.170		1.270			
115	La Son	710 km+ 729	31.08	6.726	5.560		1.166			
116	Chi Hoa	713 km+ 164	49.34	7.140	5.740	1975	1.400			
117	Truoi	715 km+ 064	125.17	7.452	5.120		2.332			
118	Su Lo	716 km+ 677	28.20	4.026	3.160		0.866			

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Appendix Table 2.1-1 (continued)

Hanoi - Da Nang		Location	Length (m)	Elevation			Freeboard (m)	Recommended priority of improvement		
No.	Name of bridges			Bottom level of the beam	Highest river water Level	Year		Emergency Fb<0m	Long term 0<=Fb<0.8m	Review of freeboard
119	Luong Dien	717 km+ 366	29.16	4.026	3.160		0.866			
120	Ong Loai	719 km+ 832	32.36	-	-		-			*
121	Cau Hai	728 km+ 934	30.00	-	4.050		-			*
122	Hoi Rui	730 km+ 362	59.92	-	7.000		-			*
123	Thach Ban	733 km+ 917	25.90	-	6.040		-			*
124	Nuot Ngot	736 km+ 452	45.90	-	8.500		-			*
125	Thua Lun	740 km+ 969	87.88	-	8.660		-			*
126	Hoi Mit	750 km+ 357	57.82	-	4.220		-			*
127	Hoi Can	751 km+ 769	47.00	-	3.810		-			*
128	Hoi Dua	753 km+ 164	55.38	-	-		-			*
129	Cau Vom	757 km+ 950	65.90	-	-		-			*
130	Ong An	758 km+ 955	81.60	-	-		-			*
131	Vom	759 km+ 055	50.10	-	-		-			*
132	Vom	759 km+ 156	40.00	-	-		-			*
133	Vom	759 km+ 800	41.60	-	-		-			*
134	Boc Long	760 km+ 009	27.32	-	-		-			*
135	Boi Tong	761 km+ 542	63.70	-	-		-			*
136	Boi Tong	762 km+ 703	48.75	-	-		-			*
137	Vom	763 km+ 236	58.65	-	-		-			*
138	Vom	764 km+ 881	27.10	-	-		-			*
139	Vom	767 km+ 544	51.73	-	-		-			*
140	Vom	771 km+ 234	53.25	-	-		-			*
141	Lien Chien	776 km+ 041	45.07	-	5.560		-			*
142	Nam O	778 km+ 150	290.48	-	-		-			*
143	Hoa My	786 km+ 284	25.76	-	-		-			*

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Appendix Table 2.1-1 (continued)

Da Nang - Ho Chi Minh		Location	Length (m)	Elevation			Freeboard (m)	Recommended priority of improvement		
				Bottom level	Highest river water			Emergency	Long term	Review of
No.	Name of bridges			of the beam	Level	Year		Fb<0m	0<=Fb<0.8m	freeboard
1	Phong Le	800 km+ 639	213.45	-	5.910		-			*
2	Bau Sau	807 km+ 530	116.81	8.670	7.610		1.060			
3	Chau Lau	812 km+ 400	122.80	8.660	8.100		0.560		*	
4	Ky Lan	817 km+ 037	520.58	10.350	9.940		0.410		*	
5	Chiem Son	819 km+ 802	417.84	10.270	9.940	1952	0.330		*	
6	Ru Ri	838 km+ 191	108.68	16.260	16.950		-0.690	*		
7	Tam Ky	866 km+ 948	161.44	7.250	6.250		1.000			
8	Ba Bau	872 km+ 943	114.76	3.140 @	2.550		0.590		*	
9	Ben Van	889 km+ 577	119.70	4.102	1.530		2.572			
10	Tra Bong	907 km+ 756	267.40	7.800 @	6.750		1.050			
11	Truong Xuan	926 km+ 643	575.56	12.250	-		-			*
12	Song Ve	941 km+ 273	209.58	10.290	9.400		0.890			
13	Tra Cau Lon	936 km+ 650	128.95	9.730	-		-			*
14	Bong Son	1,017 km+ 953	416.00	12.140	10.280		1.860			
15	Phu Ly	1,059 km+ 669	119.80	-	-		-			*
16	Nha Dai	1,073 km+ 350	142.99	12.900	12.200	1968	0.700		*	
17	Ben Go	1,077 km+ 804	141.25	14.060	12.330		1.730			
18	Tam Bich	1,081 km+ 815	120.03	13.800	-		-			*
19	Tan An	1,086 km+ 671	140.78	11.380	-		-			*
20	Ganh	1,088 km+ 540	114.07	11.200 @	-		-			*
21	La Hai	1,155 km+ 776	323.21	16.350	14.430		1.920			
22	Song Chua	1,198 km+ 709	179.33	7.340	-		-			*
23	Da Rang	1,199 km+ 907	1,100.00	-	-		-			*
24	Thach Tuan	1,212 km+ 227	267.70	6.530	5.900		0.630		*	
25	Song Dinh	1,279 km+ 717	124.45	8.386	7.370		1.016			
26	Song Cai	1,311 km+ 661	213.50	4.450	5.250		-0.800	*		
27	Thap Cham	1,408 km+ 554	169.15	10.451	10.040		0.411		*	
28	Song Long Song	1,464 km+ 797	1,670.42	28.030	28.900		-0.870	*		
29	Dang Nai Nho	1,699 km+ 245	128.75	5.550	4.400		1.150			
30	Dong Nai Lon	1,699 km+ 861	237.69	8.250	5.670		2.580			
31	Binh Loi	1,719 km+ 091	280.40	4.170	2.690		1.480			

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Appendix Table 2.1-2 Records of Inundation between Hanoi and Ho Chi Minh

Stations		Submerged track sections				Covered track spots with water			Collapsed track embankment spots	
	Location		Location (km)		length					
Name	(km)	No.	from	to	(m)	Nos.	Locations		Nos.	Locations
Hanoi	0.0									
Giap Bat	5.1									
Van Dien	8.9									
Thuong Tin	17.5									
Cho Tia	25.5									
Do Xa	29.3									
Phu Xuyen	33.5									
Dong Van	44.6									
Phu Ly	55.7									
Binh Luc	66.5									
Cau Ho	72.9									
Dang Xa	81.0									
Nam Dinh	86.7									
Trih Xuyen	93.3									
Nui Goi	100.8									
Cat Dang	107.7									
Ninh Binh	114.6									
Cau Yen	120.3									
Ghenh	125.1									
		1	130.0	131.0	1,000					
		2	133.0	134.0	1,000					
Dong Giao	133.7									
		3	141.0	141.5	500	2	140.5	140.9		
Bim Son	141.5									
		3	141.5	152.3	10,800					
Do Len	152.3									
		3	152.3	156.0	3,700					
Nghin Treng	161.2									
		4	183.5	184.2	700				1	163.0
Yen Thai	187.4									
		5	190.0	192.5	2,500				1	193.2
		6	195.5	196.5	1,000					
Mihn Khoi	196.9									
		7	198.2	201.5	3,300					
		8	202.1	204.1	2,000					
Thi Long	207.0									
		9	208.7	210.5	1,800	1	218.0			
VanTrai	218.9									
		10	225.0	229.0	5,000	1	219.0			
Khoa Truong	229.0									
		10	229.0	230.0	16,000	1	229.3			

Appendix Table 2.1-2 (continued)

Stations		Submerged track sections				Covered track spots with water						Collapsed track embankment spots			
			Location (km)		length										
Name	Location (km)	No.	from	to	(m)	Nos.	Locations					Nos.	Locations		
Truong Lam	237.8														
		11	244.0	245.0	1,000										
Hoang Mai	245.5														
		12	248.5	249.1	600										
Cau Giat	260.9														
Yen Ly	271.5														
		13	278.0	283.0	5,000										
Cho Sy	279.0														
My Ly	291.0														
Quan Hanh	308.2														
Vinh	319.0														
Yen Xuan	329.9														
		14	332.0	337.5	5,500	5	331.0	332.6	333.2	333.5	333.7				
						3	333.9	334.8	336.5						
Cho Thuong	337.5														
		14	337.5	339.0	1,500	2	337.7	337.9							
Duc Luc	344.7														
		15	346.3	350.0	3,700	1	348.4								
Yen Due	351.4														
		16	354.0	357.0	3,000							1	351.6		
Hoa Duyet	357.0														
		16	357.0	369.6	12,600	5	359.4	360.5	361.7	363.0	364.9	2	358.2	358.8	
Thauh Lu Yen	369.6														
		16	369.6	371.0	1,400										
		17	376.0	380.6	4,600										
Chu Le	380.6														
		17	380.6	386.0	5,400										
Huong Pho	386.7														
		18	387.0	388.8	1,800										
Phuc Trach	396.1														
		19	404.2	404.4	200							1	403.0		
La Khe	404.4														
		19	404.4	407.4	3,000										
Tan Ap	408.6														
(Khe Net pass)															
Khe Net	414.9														
(Khe Net pass)															
		20	417.0	419.0	2,000										
		21	421.7	425.9	4,200										
		21	425.9	427.8	1,900										
Kim Lu	425.9														
		22	430.7	436.3	5,600							3	427.3	433.9	435.6
Dong Le	436.3														
		22	436.3	439.5	3,200	1	449.0								
Ngoc Lam	449.5														
		23	450.0	458.5	8,500	3	454.0	454.5	455.4			1	457.8		

Appendix Table 2.1-2 (continued)

Stations		Submerged track sections				Covered track spots with water			Collapsed track embankment spots					
	Location		Location (km)		length									
Name	(km)	No.	from	to	(m)	Nos.	Locations		Nos.	Locations				
Lac Son	458.5													
		23	458.5	467.1	8,600				2	460.8	462.8			
									1	537.9				
Le Son	467.1													
		23	467.1	472.0	4,900	2	474.0	475.6	1	468.3				
Minh Le	481.7													
		24	487.0	488.5	1,500									
Ngan Son	488.5													
		24	488.5	489.0	500									
Tho Loc	498.7													
		25	505.1	505.9	800				3	505.2	505.7	506.6		
		26	509.0	509.3	300									
Phuc Tu	510.6													
Dong Hoi	521.8													
									1	528.2				
Le Ky	529.0													
Long Dai	539.1													
		27	542.5	546.3	3,800				3	542.3	542.5	544.2		
		28	549.0	550.9	1,900				4	549.3	549.5	550.1	550.6	
My Duc	550.9													
		28	550.9	551.7	800									
		29	554.0	558.4	4,400				3	554.3	555.6	557.5		
Phu Hoa	558.4													
		29	558.4	561.0	2,600				2	559.2	560.2			
My Trach	565.0													
Thuong Lam	572.1													
		30	587.0	587.5	500	2	582.5	587.2						
Sa Lung	587.5													
		30	587.5	588.0	500	1	587.6		1	598.8				
Tien An	598.9													
		31	606.0	606.5	500	2	599.1	601.1	1	600.1				
Ha Thanh	609.4													
		32	612.0	622.1	10,100				5	614.0	614.3	615.0	615.8	616.0
									3	616.9	617.6	621.0		
Dong Ha	622.1													
		32	622.1	633.8	11,700				5	622.6	623.5	625.0	625.3	627.0
						2	630.6	632.2	4	627.2	627.8	628.4	628.6	
Quang Tri	633.8													
		32	633.8	634.7	900									
		33	638.0	638.7	700									
Dien Sanh	642.7													
		34	647.0	648.0	1,000									
		35	651.0	651.6	600									
My Trach	651.6													
		35	651.6	659.2	7,600	1	656.4		4	655.0	655.6	656.7	657.8	

Appendix Table 2.1-2 (continued)

Stations		Submerged track sections				Covered track spots with water				Collapsed track embankment spots					
	Location		Location (km)		length										
Name	(km)	No.	from	to	(m)	Nos.	Locations			Nos.	Locations				
Pho Trach	659.6														
		36	663.3	664.1	800					3	663.5	663.7	664.0		
Hoin Sy	669.8														
										1	672.3				
Van Xa	678.2														
		37	680.2	683.3	3,100	1	681.5			5	678.5	680.2	681.1	682.2	683.3
										1	684.4				
Hue	688.3														
Huong Thuy	697.6														
Cau Truoi	715.3														
Cau Hai	729.4														
Thua Luu	741.6														
						3	736.0	751.0	751.5						
Lang Co	755.4														
(Hai Van pass)															
Hai Van Bac	760.6														
(Hai Van pass)															
T. Dinh Deo	765.6														
(Hai Van pass)															
(Hai Van pass)															
Hai Van Nam	771.5														
Kim Lien	776.6														
Thanh Khe	788.3														
Da Nang	791.4														
Thanh Khe	788.3														
		38	800.0	804.1	4,100	1	793.6			2	801.2	803.0			
Le Trach	804.1														
		38	804.1	813.6	9,500					4	807.3	811.7	812.2	813.4	
Nong Son	813.6														
		38	813.6	824.0	10,400					5	814.5	815.9	816.9	817.8	819.6
Tra Kieu	824.7														
		39	834.1	834.4	300										
		40	835.0	835.2	200										
		41	837.8	838.0	200										
Phu Cang	841.7														
		42	855.5	856.0	500										
An My	857.1														
						1	862.1			2	858.9	860.9			
Tam Ky	864.7														
										2	865.5	869.3			
Diem Pho	879.4														
						1	881.3			1	881.9				
Nui Thanh	890.4														
Tri Binh	901.0														
Binh Son	909.0														

Appendix Table 2.1-2 (continued)

Stations		Submerged track sections				Covered track spots with water				Collapsed track embankment spots			
			Location (km)		length								
Name	Location (km)	No.	from	to	(m)	Nos.	Locations			Nos.	Locations		
Dai Loc	919.5												
						1	926.6			3	921.0	923.5	924.2
Quang Ngai	927.9												
						1	934.4			2	934.1	937.3	
Hoa Vinh Tay	940.4												
						2	941.2	945.5					
Van P. Tay	948.9												
Mo Duc	958.7												
Duo Pho	967.7												
						1	971.5						
Thuy Trach	977.1												
		43	985.3	985.5	200								
		44	990.5	990.7	200								
Sa Huynh	990.8												
Tam Quan	1,001.4												
Bong Son	1,017.0												
		45	1,022.0	1,027.0	5,000	1	1,030.6						
Van Phu	1,032.7												
		46	1,041.5	1,041.8	300	2	1,044.5	1,045.3					
Phu My	1,049.4												
		47	1,054.9	1,055.4	500	1	1,049.8						
Khanh Phuoc	1,060.3												
						3	1,061.7	1,064.5	1,070.6				
Phu Cat	1,070.8												
						2	1,077.8	1,082.3					
Binh Dinh	1,084.7												
						1	1,086.6						
Dieu Tri	1,095.5												
Tan Vinh	1,110.0												
Van Canh	1,123.4												
						1	1,126.3						
Phuoc Lanh	1,139.4												
La Hai	1,154.4												
		48	1,165.0	1,168.0	3,000								
		49	1,170.0	1,170.4	400								
Chi Thanh	1,170.4												
		49	1,170.4	1,175.0	4,600	1	1,171.3			1	1,178.6		
		50	1,179.0	1,181.8	2,800								
Hoa Da	1,183.9												
Tuy Hoa	1,197.4												
Dong Tac	1,202.3												
		51	1,203.0	1,206.0	3,000					1	1,206.0		
Phu Hiep	1,210.6												
		52	1,213.0	1,217.0	4,000					3	1,212.7	1,215.8	1,216.3

Appendix Table 2.1-2 (continued)

Stations		Submerged track sections				Covered track spots with water		Collapsed track embankment spots					
			Location (km)		length								
Name	Location (km)	No.	from	to	(m)	Nos.	Locations	Nos.	Locations				
Hao Son	1.220.2							1	1.222.6				
Dai Lanh	1.232.2							2	1.232.7	1.239.7			
Tu Bong	1.243.0	53	1.252.5	1.253.9	1.400			1	1.252.5				
Gia	1.254.1												
Hoa Huynh	1.269.5												
Ninh Hoa	1.280.5							1	1.283.8				
Phong Thanh	1.287.2												
Luong Son	1.302.9	54	1.307.4	1.307.6	200								
Nha Trang	1.314.7	55	1.325.0	1.327.0	2,000								
Cay Cay	1.329.1												
Suoi Dau	1.332.8												
Hoa Tan	1.340.5												
		56	1.341.5	1.342.0	500			1	1.349.7				
		57	1.349.7	1.351.3	1.600	1	1.350.3	1	1.351.0				
Suoi Cat	1.351.3							5	1.351.7	1.353.0	1.353.6	1.353.9	1.354.2
		57	1.351.3	1.363.0	11.700			5	1.354.7	1.354.9	1.356.3	1.357.3	1.360.5
						1	1.359.7	5	1.361.2	1.361.6	1.361.8	1.362.1	1.362.7
								1	1.363.0				
Nga Ba	1.363.8												
		58	1.368.0	1.372.0	4.000			1	1.369.3				
Ka Rom	1.381.9												
		59	1.391.7	1.393.0	1.300	1	1.389.9	2	1.396.4	1.399.8			
Thap Cham	1.407.6												
						1	1.408.5						
Ca Na	1.436.3												
Vinh Hao	1.454.9												
		60	1464.7	1.465.3	600								
Song L. Song	1.465.5												
Song Mao	1.484.3												
Chau Hanh	1.493.7												
		61	1.506.0	1.506.1	100								
Song Luy	1.506.1												
		61	1.506.1	1.507.0	900								
		62	1.508.2	1.508.5	300								
Long Thanh	1.522.5												
		63	1.526.0	1.528.0	2.000								
Ma Lam	1.532.8												

Appendix Table 2.1-2 (continued)

Stations		Submerged track sections				Covered track spots with water		Collapsed track embankment spots	
			Location (km)		length				
Name	Location (km)	No.	from	to	(m)	Nos.	Locations	Nos.	Locations
Muong Man	1,550.8								
Suoi Van	1,567.7								
Song Than	1,582.9								
Song Dinh	1,595.7								
Suoi Kiet	1,602.2								
Gia Huynh	1,613.5								
Trang Tao	1,619.9								
		64	1,628.0	1,629.0	1,000				
Gia Ray	1,630.9								
Bao Chanh	1,639.7								
		65	1,649.0	1,649.4	400				
Xuan Loc	1,649.4								
		65	1,649.4	1,649.6	200				
Dau Day	1,661.3								
Trang Bom	1,677.5								
Ho Nai	1,688.0								
		66	1,696.4	1,697.3	900				
Bien Trieu	1,697.5								
Di An	1,706.7								
Song Than	1,710.6								
		67	1,711.5	1,712.2	700				
		68	1,713.2	1,713.5	300				
Thu Duc	1,713.5								
		68	1,713.5	1,714.0	500				
Binh Trieu	1,718.3								
		69	1,720.8	1,722.0	1,200				
Go Vap	1,722.1								
Sai Gon	1,726.2								
	Total	69			273,100	63		115	

APPENDIX CHAPTER 2.2

2.2 Outline of Field Investigation

(1) General

Field investigation was made by the JICA Study Team in order to survey the current environmental conditions of noise, vibration and water quality due to the existing railway facilities. The contents of field investigation are shown as follows.

- Measurement of railway noise and vibration
- Measurement of water quality in Gia Lam Workshop
- Survey of distribution of public facilities such as hospitals and schools along the railway in Hanoi

(2) Measuring Condition

1) Measurement of Noise and Vibration

The level of train noise and vibration, and the train speeds at its passing was measured. The railway noise and vibration were measured at 12.5m, 25m and 100m from the nearest rail center. Measurement of railway noise and vibration were made in the places of Hanoi, Phu Ly, Ninh Binh, Thuongtin from 12th to 16th of April in 1994.

These places were selected in order to grasp relation between noise level and train speed.

These places are as follows.

Hanoi	: This place means large city and is located about 1 km from Hanoi Station.
Hhu Ly	: This place means small town and is located about 60 km from Hanoi City.
Ninh Binh	: This place means middle-sized town between Hanoi and Phuly and is located about 90 km from Hanoi City.
Thuongtin	: This place means a rural area and is located about 20 km from Hanoi City.

2) Water Quality in Gia Lam Workshop

Inspecting drainage course and sampling water were made Gia Lam Workshop, and analyzing water quality was also made in site and laboratory for pH, turbidity, DO (dissolved oxygen), oil content, temperature and electrical conductivity. Inspecting drainage course and water sampling were made from 12th to 13th of April in 1994.

3) Distribution of Hospitals and Schools along the Railway

These matters were surveyed by the field reconnaissance and maps in order to grasp the distribution of the areas subject to affected by train noise.

(3) Results of Measurement

1) Noise and Vibration

The results of noise and vibrations are shown in Appendix Table 2.2-1.

Appendix Table 2.2-1 Measurement Results of Noise and Vibration

No.	Place	Time	Train Type *1	Train Speed	Sound Level (dB(A))			Vibration Level (mm/s)		
				(km/h)	12.5m	25m	100m	12.5m	25m	100m
1	Hanoi	9:00~11:00	P	29.5	81	71	55	6.1	3.4	1.2
		21:00~23:00	P	32.1	85	81	51	2.7	1.3	0.6
2	Phu Ly	9:00~11:00	P	52.2	82	78	70	4.3	2.7	0.9
		21:00~23:00	P	31.2	78	76	51	3.4	1.6	0.6
3	Ninh-binh	9:00~11:00	P	33.2	85	84	61	6.1	3.0	1.2
		21:00~23:00	C	20.1	79	84	59	5.4	2.1	0.6
4	Thuongtin	9:00~11:00	P	36.3	94	92	55	5.4	2.3	0.6
		21:00~23:00	P	48.6	93	85	61	4.3	2.7	0.9

Notes: *1: P and F means passenger coach and cargo coach respectively.

2) Water Quality

a) Drainage Course

The main functions of Gia Lam Workshop are to repair and maintain rolling stocks. The drainage course is shown in Figure 2.2-1. The drainage water and rain water in the workshop are jointly collected into the same drainage system. Drainage water from Gia Lam Workshop is directly

joined into same drainage system and discharged into the pond through three outlets without treatment. Figure 2.2-1 shows five sampling points, which are the outlet directly after drainage from the workshop ß(No. 1), three outlets entering into nearby ponds through sewerage pipes from the workshop (No. 2, No. 3 and No. 4) and the point on the drainage canal from the pond (No. 5).

b) Results of Water Quality

The results of measured water quality at each measuring point are shown in Appendix Table 2.2-2.

Appendix Table 2.2-2 Results of Measured Water Quality

Place	Sam-pling	Sampling Date	Measurement Items					
			pH	DO	Oil Content	Tur-bidity	Elect-rical Conduc-tivity	Tempe-rature
	No.			(mg/l)	(mg/l)	(mg/l)	(ms/cm)	(degree)
No.1	1	13,Apr.(am)	6.7	1.0	0.335	201	0.7	24.7
No.2	2	12,Apr.(pm)	7.5	5.8	0.195	178	0.2	25.4
	3	13,Apr.(pm)	7.5	4.9	0.31	163	0.3	23.9
No.3	4	12,Apr.(pm)	7.1	4.4	0.14	175	0.3	24.9
No.4	5	12,Apr.(pm)	6.8	1.2	0.14	172	0.3	25
	6	13,Apr.(pm)	6.9	1.0	0.075	164	0.4	23.4
No.5	7	12,Apr.(am)	7.2	2.2	0.175	219	0.5	25
	8	13,Apr.(pm)	7.4	4.4	0.03	207	0.5	24.7

c) Survey of Public Facilities

There were three schools (Thanglong School, Polytechnic Institute and Hanoi University of Civil Engineering) and two hospitals (International Hospital and Bac Mai Hospital) along the railway line. The distribution of these facilities is shown in Figure 2.2-2. The present small frequency of trains does not bring serious impacts on these public facilities.

(4) Consideration of Results of Field Investigation

The values of train noise were obtained as 71~92dB(A) from the nearest rail. These values were a little higher than the current noise levels of Japanese

electric trains. The small frequency of train does not bring serious problems. According to "Provisional Environmental Criteria", some standards for water quality are established as maximum limit of waste water from factories.

The measured values of oil content were to 0.030~0.335 mg/l. These values were measured at non-operation time of major works at Gia Lam Workshop. However, these values were lower than 10mg/l of the maximum discharge limit, which was the limit values of class II in "Provisional Environmental Criteria". The reduction of oil content from 0.335 at No. 1 to 0.030 mg/l at No. 5 means its dilution on the way of drainage course. These results does not bring serious problems on water quality at the non-operation work at Gia Lam Workshop.

However, continuos observation should be encouraged especially at operation time of water consuming works in workshops.

Appendix 5.3.1-1

BALANCE SHEET OF V.N.R. (List of Properties) 1993

ASSETS	Amount Thou. Dong
(A) Fixed Assets, Basic Construction & Investment	1,906,384,619.
1. Fixed Assets	3,188,372,506
- Fixed Assets for business production	3,046,004,607
- " for benefit	53,457,806
- " in wait of settlement	88,910,091
2. Accumulated depreciation	△ 1,284,499,872
3. Investment under construction	2,511,985
(B) Current Assets	82,047,412
I. Inventories	65,886,079
1. Materials, raw materials	40,052,920
(of which, fuels)	(3,079,162)
2. Minor working tools	2,183,208
3. Goods in stock	273,311
4. Finished goods in stock	547,536
5. Purchased goods en route	
6. Services waiting for settlement	
7. Existing value during transport	846
8. Value of final manufacutured products	19,691,213
9. Estimated expense	3,137,045
(of which, amounts paid in advance)	(2,801,163)
II. Subsidy sourced expenses	232,366
III. Monetary assets	15,928,968
1. Cash on hand	1,414,927
a. Vietnamese currency	584,640
b. Gold, silver, prec. stones & marketable securities	799,610
c. Foreign currency	30,677
2. Cash in bank	14,121,458
a. Vietnamese currency	12,158,956
b. Foreign currency	1,962,501
c. Cash in bank for basic construction investment	
3. Transferring cash	392,583
(c) Assets for settlement	115,183,986
I. Assets in joint venture	409,175
(of which, contribution to J.V.)	(409,175)
II. Items to be collected	114,770,347
1. Payment advanced to suppliers	15,766,010
2. Account receivable from customers	12,246,271
3. Suspense payments	6,479,149
4. Inter-departmental credit balance	34,429,157
5. Commitment from state budget	53,914
6. Miscellaneous accounts receivable	45,707,064
7. Difference of foreign exchange and price index.	88,782
III. Shortage/surplus of property to be settled	4,464
TOTAL ASSETS	2,103,616,018

CAPITAL & LIABILITIES	Amount Thou. Dong
(A) Capital	1,848,351,304
1. Fixed capital	1,902,489,900
a. Legal capital	1,896,004,508
b. Self-improved capital	6,485,393
c. Joint venture capital	
2. Current capital	17,476,238
a. Legal capital	16,752,446
b. Self-improved capital	723,792
c. Joint venture equity	
3. Basic construction Capital	4,415,562
(of which, self-improved capital)	(114,368)
4. Retain earnings(enterprise's funds)	8,217,492
a. Fund for business production	3,160,185
b. Reserved fund	
c. Bonus fund	3,764,530
d. Benefit fund	1,097,673
e. Fund for scientific & technical research	195,104
g. Fund for management study	
5. Subsidy sources of expenses	455,241
(of which, state budget)	(44,968)
6. Income not yet distributed	△ 84,703,130
- Previous year	△ 24,013,241
- This year	△ 60,689,889
(B) Loan (liabilities)	40,732,461
1. Bank loan payable(short term debt)	40,128,461
(of which, foreign currency)	
2. Long term debt of banks	
(of which, foreign currency)	
3. Other loans payable	604,000
(of which, foreign currency)	
(C) Other Capital Accounts	214,532,253
I. Items to be paid	211,852,323
1. Payment to suppliers	27,005,105
2. Deposit received from customers	10,382,461
3. Inter-departmental liabilities	26,054,325
4. Payment to state budget	52,859,070
5. Payment to social insurance	10,703,451
6. Payment to state employees	39,747,646
(of which, wages)	(28,136,548)
7. Other payments	45,100,266
8. Difference of foreign exchange & price index	
(of which, diff. of price index)	
II. Surplus of property in wait of settlement	2,679,929
TOTAL CAPITAL & LIABILITIES	2,103,616,018

BALANCE SHEET OF V.N.R. (List of Properties)

Million Dong

ASSETS	1990	1991	1992	1993
(A) Fixed Assets, Basic Construction & Investment	1,267,759	1,312,045	1,871,756	1,906,385
I. Fixed Assets	2,079,503	2,158,183	3,145,707	3,188,373
- Fixed Assets for business production	2,016,537	2,093,853	2,633,251	3,046,065
- " for benefit	31,126	16,823	? 34,810	53,458
- " in wait of settlement	31,840	47,507	97,338	88,910
2. Accumulated depreciation	△ 813,489	△ 847,822	△1,277,841	△1,284,500
3. Investment under construction	1,745	1,684	3,890	2,512
(B) Current Assets	25,847	47,882	63,296	82,047
I. Inventories	18,521	36,924	49,014	65,886
1. Materials, raw materials	11,434	20,744	27,941	40,053
(of which, fuels)		(5,177)	(2,980)	(3,079)
2. Minor working tools	728	1,148	1,546	2,183
3. Goods in stock				273
4. Finished goods in stock	156	345	317	548
5. Purchased goods en route		689		
6. Services waiting for settlement	8			
7. Existing value during transport	44	71	1	1
8. Value of final manufacturered products	5,301	12,125	16,744	19,691
9. Estimated expense	850	1,803	2,465	3,137
(of which, amounts paid in advance)		(457)	(2,298)	(2,801)
II. Subsidy sourced expenses	1,683	194	232	222
III. Monetary assets	6,643	10,764	14,049	15,929
1. Cash on hand	193	449	651	1,415
a. Vietnamese currency	176	239	230	585
b. Gold, silver, prec. stones & marketable securities	16	16	353	800
c. Foreign currency		194	69	31
2. Cash in bank	5,307	9,233	12,455	14,121
a. Vietnamese currency	4,697	7,540	0,880	2,159
b. Foreign currency	610	1,693	1,575	1,963
c. Cash in bank for basic construction investment				
3. Transferring cash	1,144	1,081	944	393
(C) Assets for settlement	80,172	91,894	87,326	115,184
I. Assets in joint venture	117	198	486	409
(of which, contribution to J.V.)		(198)	(486)	(409)
II. Items to be collected	80,026	91,674	86,745	114,770
1. Payment advanced to suppliers	16,226	14,515	22,865	15,766
2. Account receivable from customers	9,843	7,800	12,266	12,246
3. Suspense payments	1,652	2,433	4,708	6,479
4. Inter-departmental credit balance	33,045	30,449	23,179	34,429
5. Commitment from state budget	6,522	22,228	10,442	54
6. Miscellaneous accounts receivable	12,728	14,251	13,180	45,707
7. Difference of foreign exchange and price index			105	89
III. Shortage/surplus of property to be settled	29	22	94	4
TOTAL ASSETS	1,374,778	1,451,821	2,022,377	2,103,616

CAPITAL & LIABILITIES	1990	1991	1992	1993
(A) Capital	1,271,752	1,318,756	1,839,205	1,848,351
1. Fixed capital	1,265,963	1,310,186	1,867,477	1,902,490
a. Legal capital	1,265,157	1,308,585	1,864,673	1,896,005
b. Self-improved capital	806	1,601	2,804	6,485
c. Joint venture capital				
2. Current capital	8,026	10,968	14,762	17,476
a. Legal capital	7,808	10,693	4,269	6,752
b. Self-improved capital	219	275	493	724
c. Joint venture equity				
3. Basic construction Capital	5,103	10,076	2,257	4,416
(of which, self-improved capital)		(817)		(114)
4. Retain earnings(enterprise's funds)	6,704	8,480	7,541	8,217
a. Fund for business production	4,053	3,561	4,262	3,160
b. Reserved fund				
c. Bonus fund	1,825	3,241	2,527	3,765
d. Benefit fund	686	1,125	770	1,098
e. Fund for scientific & technical research	86	80	31	195
g. Fund for management study	54	472	△ 48	
5. Subsidy sources of expenses	868	365	316	455
(of which, state budget)				(45)
6. Income not yet distributed	△ 14,912	△ 21,320	△ 53,149	△ 84,703
- Previous year		△ 95	△ 9,361	△ 24,013
- This year	△ 14,912	△ 21,225	△ 43,788	△ 60,690
(B) Loan (liabilities)	8,472	12,392	19,886	40,732
1. Bank loan payable(short term debt)	7,782	12,198	19,626	40,128
(of which, foreign currency)				
2. Long term debt of banks				
(of which, foreign currency)				
3. Other loans payable	690	194	260	604
(of which, foreign currency)				
(C) Other Capital Accounts	94,554	120,674	163,286	214,532
I. Items to be paid	94,544	120,655	163,225	211,852
1. Payment to suppliers	16,145	21,767	29,417	27,005
2. Deposit received from customers	4,618	4,568	8,016	10,382
3. Inter-departmental liabilities	34,097	33,503	22,849	26,054
4. Payment to state budget	11,272	25,383	39,209	52,859
5. Payment to social insurance	2,389	4,428	9,047	10,703
6. Payment to state employees	10,641	13,714	27,377	39,748
(of which, wages)			(16,027)	(28,137)
7. Other payments	14,305	16,568	27,310	45,100
8. Difference of foreign exchange & price index	1,078	717		
(of which, diff. of price index)				
II. Surplus of property in wait of settlement	9	19	61	2,680
TOTAL CAPITAL & LIABILITIES	1,374,778	1,451,821	2,022,377	2,103,616

Appendix 5.3.1-2

Result of Business. the whole year 1993
Part 1: Revenue. Expenditure & Distribution of Profit

Thou. Dong

Expenditures	Figures implemented
I Expenditures allocated for main business activities	530.934.040
1. For transportation. loading & unloading	171.236.226
2. For management activities	345.748.950
3. Tax to be collected	13.948.864
II. Expenditures for subsidiary business activities	62.041.577
1. Cost of products. labors & distribution	53.961.316
2. Cost of circulation	6.752.628
3. Tax to be collected	1.327.634
III. Expenditure for J.V. operations	
1. Cost of fund raising	
2. Loss due to reassessement of capital assets	
IV. Expenditure for financial operations	323.238
1. Loss of exchange rates	4.749
2. Loss due to selling exchange cards	
3. Loss of Price reduced	
4.	318.488
V. Other expeditures	417.802
1. Cost for renting fixed assets	
2. Cost for repairing & maintenance	25.633
3. Cost for disposing old fixed assets	392.168
VI. Special Expenditures	
1. Penalty on economic contracts	
2. Overterm & debts	
3. Loss of commodities	
4. Overlimit of damaged products	
5. Loss due to suspending production	
(Total expenditure)	(593.716.657)
VII. Results gained (LOSS)	59.389.216
1. Main business activities	△ 61.098.892
2. Subsidiary business activities	1.927.727
3. Joint Venture operatios	
4. Financial operations	△ 323.238
5. Results of other activities	105.186
6. Results of special activities	

Thou. Dong

Income	Figures implemented
I Income from main business activities	469.835.148
1. From Transportation. loading and unloading	469.835.148
II. Income from subsidiary business activities	63.969.305
1. Income from production. labor --	57.735.285
2.	6.234.020
III. Income from J.V. operations	
1. Income. JV operations	
2. Income due to reassessment of capital assets.	
IV. Income from financial operations	
1. Interest on money rent	
2. Gains from selling exchange cards	
3. Gains from goods' price increasing	
V. Other income	522.987
1. Receipt of compensation money	
2. Miscellaneous minor items	23.753
3. Surplus of property	
4. Fixed assets' rental recreived	
5. Gains from disposing old fixed assets.	60.500
6.	438.734
(Total income)	(534.327.440)
VI. Distribution of results	1.300.673
1. To the state budget. upper offices	528.053
2. To the fund for setting up enterprises.	768.423
3. Allocation to J.V.	
4. Allocation to wage fund	
5. Other items of distribution	4.197
VII. Income before distribution (LOSS + VI)	△ 60.689.889

Part 2 Contribution to the State Budget

Thou. Dong

Items to be contributed to the State Budget	Amount to be contributed	Amount contributed
I. Taxation & gained benefit	38.955.797	25.410.374
1. Tax on main business turnover	18.272.420	14.760.817
2. Tax on subsidiary business	893.435	652.397
3. Tax on capital Interest	18.445.118	9.035.146
4. Tax on registration	3.690	3.090
5. Tax on land use	373.478	357.849
6.	551.305	184.724
7.	416.352	416.352
II. Gained Benefit (of which. previous year)		
III. Amortizement (of which. previous year)	29.548.845 (1.779.496)	12.919.953 (1.753.576)
IV. Other items	4.342.786	4.334.500
1.	4.292.480	4.286.515
2.	50.306	47.984
Total	72.847.428	42.664.827

RESULT OF BUSINESS

Million Dong

	1990	1991	1992	1993
[REVENUE]				
From Main Business Activities (Transport, Loading & Unloading etc.)	143.148	277.284	400.129	469.835
From Subsidiary Business	7.530	17.955	29.860	63.969
Financial Gainings	106	100	2.344	
Miscellaneous Income	232	1.478	1.020	523
Total	151.016	296.817	433.354	534.327
[EXPENDITURE]				
For Main Business Activities	158.573	299.350	435.529	530.934
1. Transport. Loading & Unloading etc.	152.321	281.841	355.521	171.236
2. Management Activities	6.252	9.515	68.579	345.749
3. Tax to be collected		7.994	11.429	13.949
For Subsidiary Business	7.229	16.651	28.140	62.042
1. Cost of Products, labor & Distribution	7.058	16.415	27.183	53.961
2. Cost of Circulation. etc.	36		253	6.753
3. Tax to be collected	135	236	705	1.328
Financial Cost	120	445	443	323
Miscellaneous Expenses	6	1.148	12.616	418
Total	165.928	317.594	476.728	593.717
Profit or Loss (a)	△ 14.912	△ 20.776	△ 43.375	△ 59.339
Resulted by :				
Main business	△ 15.425	△ 22.066	△ 35.400	△ 61.099
Subsidiary business	301	1.304	1.720	1.928
Financial operations	△ 14	△ 345	1.901	△ 323
Other factors	226	330	△ 11.596	105
Distribution or contribution (b)	74	544	412	1.301
To the State Budget & upper offices	36	207	180	528
To the fund for setting up enterprises	38	337	237	768
Other items			5	4
Actual position (a) + (b)	△ 14.986	△ 21.320	△ 43.787	△ 60.690

Appendix 5.3.1-3

RAILWAY TRANSPORT SECTOR

THE OUTPUT, REVENUE, EXPENSE & PROFIT/ LOSS

Mil: T/km • Dong

	1990	1991	1992	1993 (P)	1993 (F)	93.9 Rev. Plan
1. Ton/km equivalent	2,797 (100)	2,915 (100)	2,883 (100)	2,877 (100)	———	2,950
a. Goods Mil.T/km	847 (30.28)	1,103 (37.86)	1,077 (37.35)	975 (33.89)		1,050
b. Passenger "	1,913 (68.39)	1,767 (60.63)	1,752 (60.76)	1,855 (64.48)		1,855
c. Luggage "	37 (1.33)	44 (1.51)	54 (1.89)	47 (1.63)		45
2. Revenue Mil.Dong	143,148 (100)	277,284 (100)	400,129 (100)	475,945 (100)	469,835	496,159
a. Goods	74,055 (51.73)	148,752 (53.65)	217,698 (54.40)	223,687 (47.00)		249,722
b. Passenger	59,114 (41.29)	110,557 (39.87)	160,091 (40.00)	225,898 (47.46)		221,432
c. Luggage	6,121 (4.28)	11,870 (4.28)	18,781 (4.69)	20,776 (4.37)		20,045
d. Others	3,858 (2.70)	6,106 (2.20)	3,960 (0.91)	5,584 (1.17)		4,960
3. Expense Mil.Dong	158,573 (100)	299,350 (100)	435,529 (100)	518,295 (100)	530,934	541,035
a. Wages	33,740 (21.28)	70,471 (23.54)	121,214 (27.83)	145,639 (28.10)		151,645
b. Social Insurance	5,061 (3.19)	11,980 (4.00)	18,489 (4.24)	21,846 (4.21)		22,747
c. Materials	26,352 (16.62)	54,805 (18.30)	76,316 (17.52)	95,660 (18.46)		97,974
d. Fuel	23,267 (14.67)	54,949 (18.35)	65,021 (14.93)	65,153 (12.57)		71,047
e. Electricity	1,198 (0.76)	2,491 (0.85)	4,320 (1.01)	5,130 (1.00)		5,049
g. Capt. Depreciation	11,995 (7.56)	15,000 (5.01)	20,000 (4.59)	22,000 (4.24)		22,000
h. Depr. of Big Repair	26,269 (16.57)	37,000 (12.36)	57,287 (13.15)	75,000 (14.47)		75,000
i. Other Expense	24,440 (15.41)	35,146 (11.74)	44,344 (10.18)	55,368 (10.68)		58,620
k. Revenue Tax	6,252 (3.94)	7,994 (2.67)	11,429 (2.62)	14,499 (2.80)		14,753
l. Capital Tax	0	9,515 (3.18)	17,108 (3.93)	18,000 (3.47)		22,200
4. Profit / Loss	△15,424	△22,066	△35,399	△ 42,350	△ 61,099	△ 44,876
5. Average Revenue/T.km	51.18	95.14	138.79	165.43	———	168.19
a. Goods	87.43	134.82	202.16	229.42		237.83
b. Passenger	30.90	62.57	91.39	121.78		119.37
c. Luggage	165.36	249.00	346.78	442.04		445.44
6. Average Expense/T.km	56.69	102.71	151.06	180.15	———	183.40
7. Expense − Income	△ 5.51	△ 7.57	△ 12.27	△ 14.72		△ 15.21
8. Average Schedule						
a. Goods Transport	361.8 km	429.8 km	388.3 km			
b. Passenger Trpt.	183.1 km	183.6 km	201.5 km			

Appendix 5.3.1-4

RAILWAY TRANSPORT SECTOR
FINANCIAL INDICATORS, 1990 ~1993

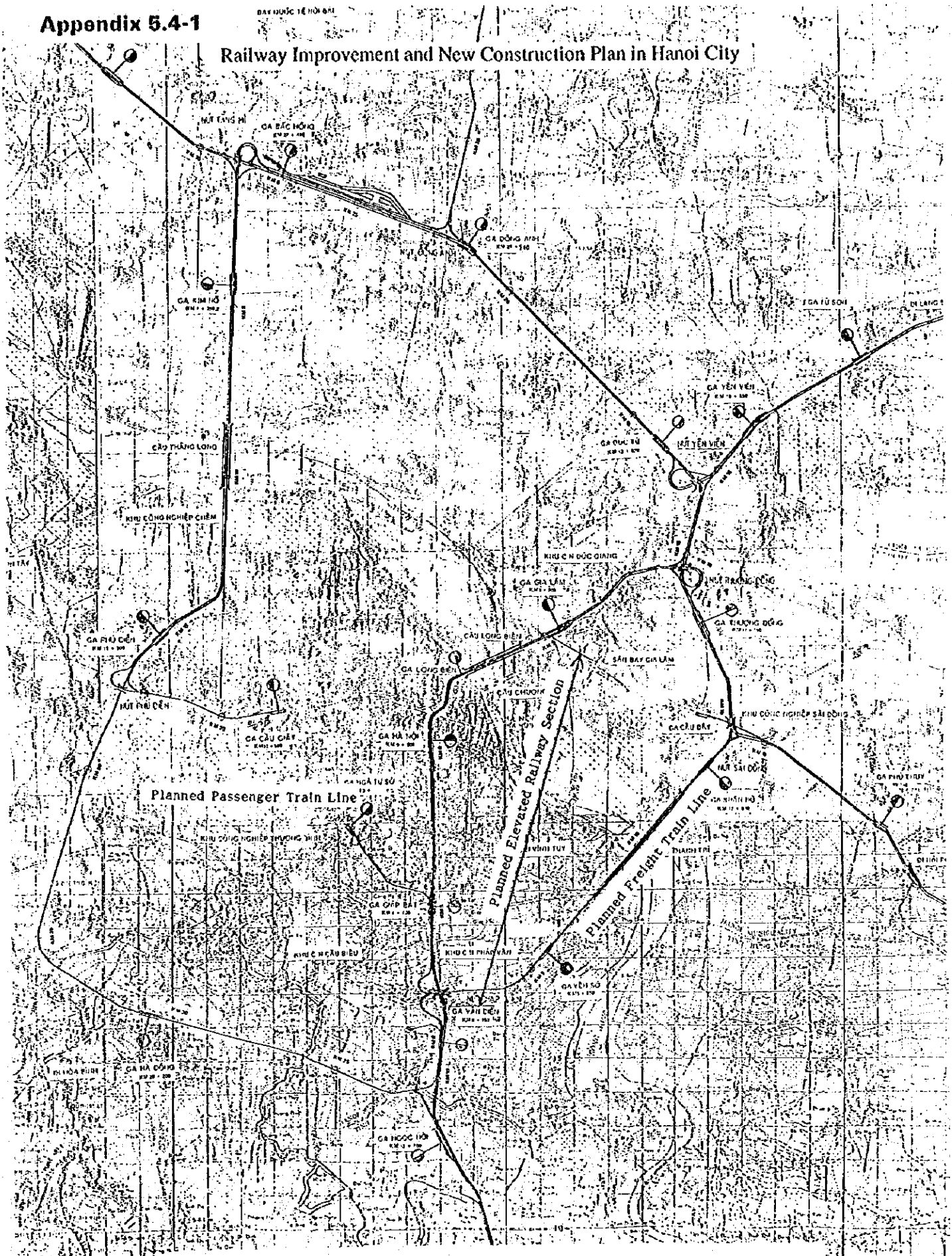
Million Dong

	1990	1991	1992	1993
A (Revenue & Expense)				
1 Revenue	143,148	277,284	400,129	469,835
2 Revenue Tax	6,252	7,994	11,429	13,949
3 Revenue after Tax	136,897	269,290	388,700	455.886
4 Expense	158,573	299,350	435,529	530,934
5 Profit or Loss (4 - 1)	△ 15,424	△ 22,066	△ 35,399	△ 61,099
6 Profit to Revenue Ratio	△(10.77%)	△ (7.95%)	△ (8.84%)	△ (13.0%)
B (Fixed Assets/ F.Capital)				
a Total Fixed Assets	2,079,503	2,158,183	3,145,707	3,188,373
b (of which, Operational)	2,016,537	2,093,853	2,663,251	3,046,005
c Total Fixed Capital	1,265,963	1,310,186	1,867,447	1,902,490
d F.Capital/ F.Assets c/a	(60.9%)	(60.7%)	(59.4%)	(59.7%)
e Revenue/ F.Assets 1/b	0.07	0.13	0.15	0.15
f Revenue/ F.Capital 1/c	0.11	0.21	0.21	0.25
C (Current Assets/C.Capital)				
g Average Fig.of C.Assets	14,521	27.722	42,969	
h Rev.aft.Tax/Average C.Asst	9.4	9.7	9.0	
i C.Capital,end of the Year	8,026	10,968	14.762	17,476
j Bal.of Debt Loan	8,472	12,198	19.626	40,128
k Debt Loan/ C.Capital	(105.6%)	(111.2%)	(132.9%)	(229.6%)
l Total C.Capital i + j	16,498	33,166	34,388	57.604
m Total C.Assets(ex.Subsidy)	18,521	36,924	49,014	65,886
n Surplus or Deficit l - m	△ 2,022	△ 3,757	14,626	△ 8,282

D (Unsettled Account)				
1 Accounts Payable end.bal	76,853	91,689	120,313	144,809
a Trade Account	6,226	14,515	22,865	15,766
b Deposit Received	4,618	4,568	8,016	10,382
c Internal Debt	34,047	33,503	22,849	26,054
d Taxes in Arrears	11,272	25,389	39,209	52,859
e Wage Fund	10,641	13,714	27,374	39,748
2 A/C. Receivable end.bal	65,566	82,242	75,304	73,754
f Deposit Receivable	16,145	21,767	29,417	27,005
g Trade Account	9,843	7,800	12,266	12,266
k Internal Debt	33,045	30,449	23,179	34,429
h Subsidy Receivable	6,532	22,226	10,442	54
3 Bal.of Unsettled A/C 1-2	11,288	9,447	45,010	71,055
E (Average Dpreciation Rate)	1.93 %	2.48 %	2.85 %	
1 Basic Depreciation Rate	0.59 %	0.71 %	0.75 %	
2 Depreciation R. on Repair	1.34 %	1.77 %	2.10 %	

Appendix 5.4-1

Railway Improvement and New Construction Plan in Hanoi City



Appendix 5.4-2

Railway Improvement and New Construction Plan in Ho chi Minh City