Estimated Transport Volume on the Lao Cai Line

Passenger transport (unit: thousands)

Year	National		Hanoi - Lao Cai			
	Ps/year (A)	Ps-km/year (B)	Ps/year (C)	Index (C/A)	Ps-km/year (D)	Index (D/B)
1989	11,768	2,109,341	2,583	21.0	225,953	10.7
1990	10,443	1,912,957	2,397	23.0	195,018	10.2
1991	9,158	1,767,060	2,352	25.7	190,566	10.8
1992	8,719	1,751,660	2,021	23.2	160,814	9.7
1993	7,793	1,720,084	1,925	24.7	180,030	10.5

Freight transport (unit: thousands)

Year	National		Hanoi - Lao Cai			
	Tons/year (A)	Ton-km/year (B)	Tons/year (C)	Index (C/A)	Ton-km/year (D)	Index (D/B)
1989	2,432	743,320	453	18.6	175,582	23.6
1990	2,341	847,023	404	17.3	210,812	24.9
1991	2,567	1,103,309	511	19.9	249,438	22.6
1992	2,774	1,076,879	497	17.9	213,223	19.8
1993	3,187	978,132	608	19.1	191,769	19.6

N.B. Based on documents provided by VNR and VRDI.

9.3 Transportation Plan

9.3.1 Current Conditions of Train Operating, etc.

(1) Train operating conditions

The Hanoi - Lao Cai Line (293.6 km) is an international line linking the capital Hanoi to Lao Cai on the border with China in the north-west, however, direct train services on the line are currently suspended.

Passenger transportation on the line amounts to 2,000,000 passengers per year, which represents 25% of the total passenger transportation volume of VNR of approximately 8,000,000. The passenger kilometers on the line amount to 180,000,000 passenger-km, which accounts for 10% of the total passenger kilometers on all VNR. The average trip distance is roughly 80 km to 90 km, which is short compared to the national average of 220 km, and the line can be said to be characterized as a daily lifestyle line for the residents living along it.

The Hanoi - Lao Cai Line is relatively flat, however, from Vu En (118 km), the line follows alongside a river and has a continuous curve radius of R = 150 m. Maximum operating speeds on the line currently range from 30 km/h to 60 km/h, and express trains (LC1/2 etc. 2 return) run the line in around 10 hours at a slow commercial speed of approximately 30 km/h. Moreover, the LC3-V2 express train runs directly from Vinh to Lao Cai via Hanoi on this line.

Freight transportation on the line amounts to 500,000 tons per year, accounting for approximately 20% of the total freight transportation of VNR, and this freight load is only second to that on the North-south Line. Transportation ton kilometers amount to 200,000,000 ton kilometers, which is again 20% of the national total.

The average freight transportation distance ranges from 300 km to 400 km, which is longer than the national average of 300 km, and it can thus be said that relatively long-distance transportation takes place on the line.

Freight transportation is carried out by temporary freight trains making one or two return trips per day, and as these trains are traction pulled by small D4H locomotives, it is estimated that the commercial speed is 15-20 km/h. The main freight transportation is carried out by apatite exclusive freight trains making around three return trips per day between Pho Lu and Tien Kien in the north.

In all, when the temporary service freight trains are included, between 10 and 20 upward and downward trains operate on the line daily. As is the case on the other lines, the line consists of single track meter gauge, and part of the line consists of three track mix gauge.

As can be gathered from Fig. 9.3.1 (Railway Routes and Commercial Distances), apatite is carried by exclusive freight train from Pom Han to Tien Kien via Pho Lu in the north, and is eventually transported to the fertilizer factory in Lam Thao.

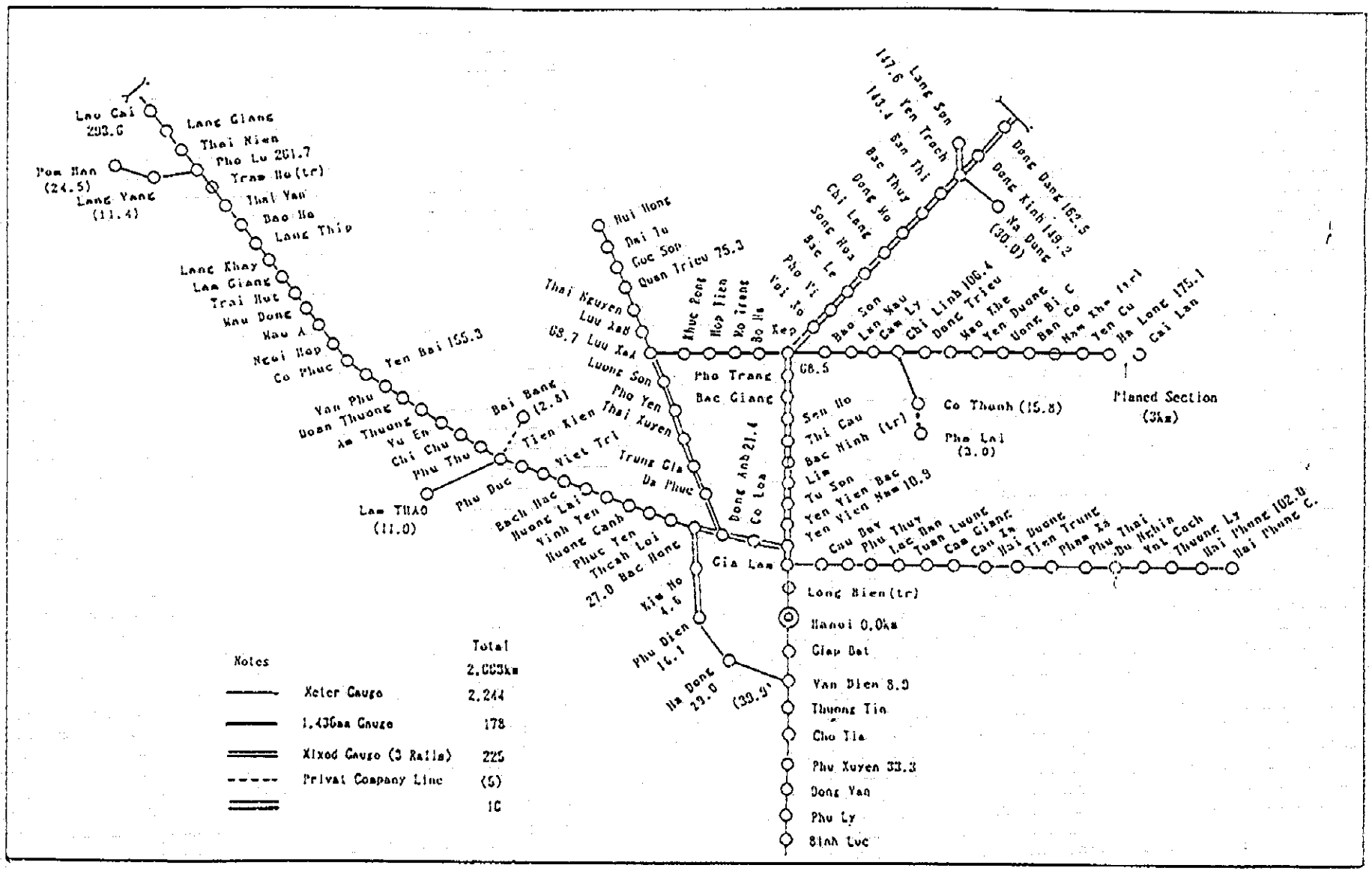


Fig. 9.3.1 Railway Route and Commercial Distance (VNR)

The line becomes standard mixed gauge from Bach Hong to Gia Lam in the south, and is then meter gauge as far as Hanoi. For part of the loop line which branches off at Bach Hong, standard track is also laid. On this section, local trains from Yen Bai operate via Van Dien.

Table 9.3.1 shows the operating conditions of trains on these line sections.

The average distance between stations is approximately 8.4 km, and the small number of operating trains means that all of the track capacity is yet to be fully exploited.

Appendix 9.3.1 gives an outline of the Lao Cai Line by showing rough drawing of track layout and track capacity, and so on.

Table 9.3.1 Train Operating Conditions (1995)
(Lao Cai Line: 293.6 km)

Passenger Trains

Train Type	Hanoi 0km		Yen Bai 155.3 km		Lao Cai 293.6 km	Operating time (hours:minutes)	Schedule Speed (km/h)	Remarks
LC1 (express	20:20	→	01:20	→	06:10	09h50	29.9	11-car
LC2 passenger)	04:45	←	23:50	←	18:30	10h15	28.6	formation
V2-LC3 (express	04:40	→	10:45	→	15:35	10h55	26.9	Direct to Vinh,
V1-LC4 passenger)	20:15	←	15:15	←	09:40	10h35	27.8	9-car formation
YB1 (ordinary	14:00	→	18:35			04h35	33.9	9-car formation
YB2 passenger)	11:05	←	06:30			04h35	33.9	
YL1 (ordinary			06:40	→	12:25	05h45	24.1	8-car formation
YL2 passenger)			20:15	←	14:15	06h00	23.1	
71 (ordinary passenger,	08:45	→	16:20			07h35	20.5	8-car formation
72 suburban line)	14:45	←	07:40			07h05	21.9	

Freight Trains

Train Type	Y. Vien 10.9	T. Kien 90.7	Y. Bai 155.3	P. Lu 261.7	L. Cai 293.6	Operating time (hours:minutes)	Schedule Speed (km/h)	Remarks
423-6 (2p)	O	- -			O	-		(General freight)
321/2	O	- - - - - - - - - - -	O			08h30	17.0	"
421/2	O	- - - - -	O			05h00	16.0	"
231-6 (3p)		O	- - - - - - - - - -	O		11h30	14.9	(Apatite 11 cars)
427-30 (2p)	G. Bat	O (Via the western suburban line: 107.3 km)				05h30	19.5	(General freight)

Note: All freight trains are temporary services.

The formations and nominal passenger capacities of the trains are as follows.

[LC1/2] Direct Express Train

• Formation	:	1HL	+	2B	+	4B	+	2Bn	+	1A	+ 1C ..... 11 cars
• Capacity	:	Luggage car		78		64		(?48)		24	Long seat Sleeping Total
• Total	:			156		256		96		24	80- ..... (96) / 610 = 16%

[YB1/2] Inter-regional Express

• Formation	:	1HL	+	6B	+	1A	+ 1C ..... 9 cars
• Capacity	:	Luggage car		64		24	Long seat
• Total	:			384		24	80- ..... / 490 -

[V1-LC4/V2-LC3] Direct Express Train

• Formation	:	1HL	+	3B	+	2Bn	+	1B	+	1Bv ..... 8 cars
• Capacity	:	Luggage car		64		48		64		Mail car
• Total	:			234		96		64		..... (96) / 394 = 24%

[71/72] Local Passenger Train

• Formation	:	1HL	+	3B	+	4C ..... 8 cars
• Capacity	:	Luggage car		64		Long seat
• Total	:			192		80- ..... / 510 -

(2) Operation control system

As well as the railway facilities such as track, etc. and the operating rolling stock, train operation management and safety systems are indispensable to the operation of trains on a railway.

Operation control on the Hanoi - Lao Cai Line is the same as for the other lines in that it is carried out by the VNR Head Office and the Union 1 Operation Dispatching Room. In this sense, the method of operation control is the same as that adopted in other countries of the world.

The dispatching telephones, which are used as the dispatching-related equipment, are in a deteriorated state, however, the renewal of them is being carried out on a successive basis.

Regarding the contents of the dispatching work, examination is being made on the utilization of train diagrams in line with the expected increases in train services towards the year 2000. This issue is further described in the sections on problem points and countermeasures.

(3) Operation safety system

1) Blocking system

The currently used system is the tablet block system.

2) Signaling system

Mechanical semaphore signals are currently used. As for the signaling aspect system, the two aspects of (G) for go and (R) for stop are used. Moreover, many stations are not installed with departure signals, and the immediate remedy of this situation is required for safety reasons.

3) Interlocking system

The Class 2 interlocking devices are used, and these control individual points on site.

4) Other Safety Equipment and Facilities

Automatic train stop devices and other warning devices, which are required to ensure safe train operation, are not installed. In particular, various types of warning device need to be immediately installed starting with high-risk areas as a means of preventing accidents caused by disasters.

Regarding measures for countering the over-running of trains, these are discussed in the sections on problem points and countermeasures.

(4) Passenger and freight handling volumes at each station and transportation staffing setup

Table 9.3.2 indicates the transportation staffing setup.

Appendix 9.3.1 shows the passenger and freight handling volumes at each station as well as the staff deployed between the stations.

Regarding passenger volumes, 50% of the stations on the line handle more than 100 boarding and alighting passengers per day, and it can thus be said that this line is busy compared to other lines. It is thought that this is due to the road conditions around the line and the fact that the line is used in the daily lifestyles of the surrounding area residents.

The overall transportation-related staffing setup is as indicated in Table 9.3.2.

Table 9.3.2 Transportation-related Staffing Setup (1993)

Head Office 220	Union Offices	Dispatching Personnel: 5	Freight: 4	Passenger: 4	Operation: 4	Management: 3	Transport-related: 20 (staff)

Union	① Office	Dispatchers Staff		② Station		③ Drivers	④ Conductors		⑤ Total	⑥ Other (track, signals, etc.)
		North-south Line	North Part	North-south line	North Part		Passenger	Freight		
I 21,000	342	14	58	2,267	1,670	363	600	506	5,748	15,252
II 6,730	200	25	--	1,261		280	400		2,141	4,589
III 6,520	225	25	--	1,024		253	420 362	476	2,760	3,760
Grand Total 34,250	767	64 (122)	58	4,552	1,670	896	820 962 2,764	982	10,649	23,601

Note 1) Figures are provided by VNR (TEDI, VRDI).
2) Dispatching staff gives a breakdown of the union office staff (①).
3) The station staff (②) shown is for the North-south Line, Lao Cai Line and Cai Lan Line only.
4) Drivers (③) and Conductor (④) numbers are for all lines.
5) The total (⑤) gives the combined total of ① to ④.
6) The grand total column gives the combination of ⑤ and ⑥ (track, bridge, signal and communication staff outside of Head Office).

(5) Operation accident, etc. situation and analysis

The improvement of safety and reliability levels is the most important point in railway and all other modes of transportation, and the analysis of past accident occurrences, combined with investigation of effective accident countermeasures in terms of both software and hardware, is vital.

The accident occurrence situation in the case of VNR is as indicated below.

1) Accident Categories

Operation accidents that have occurred on VNR are divided into the following six categories.

Category 1: Extremely serious accidents: Transportation obstruction (24 hours or more)
Fatalities (two people or more)
Rolling stock damage (major damage)

Category 2: Serious accidents: Transportation obstruction (12 - 24 hours)
Fatalities (less than two people)
Rolling stock damage (damage)

Category 3: General accidents: Transportation obstruction (less than 12 hours)
Fatalities (none)
Rolling stock damage (none)

Category 4: Other accidents

Category 5: Accidents due to breach of regulations

Category 6: Technically light accidents

2) Accident occurrence situation

Table 9.3.3 shows the total number of accidents, by category, that occurred between 1989 and 1994.

Table 9.3.3 Accident Occurrence Situation (all accidents)

Year	Accident Category							%
	1	2	3	4	5	6	Total	
1989	7	7	143	267	40	3,804	4,268	100.0
1990	2	11	141	269	20	2,737	3,180	74.5
1991	3	4	99	288	25	2,031	2,450	57.4
1992	0	5	58	198	16	2,040	2,317	54.3
1993	0	1	55	201	20	1,602	1,879	44.0
1994	2	1	61	214	16	1,354	1,648	38.6

The number of accidents is steadily declining and has reached as low as 40% of the number in 1989. This can be said to be a reflection of efforts made.

However, accidents involving fatalities and other tangible damage (categories 1 to 4), have hardly shown any decline at all. Appendix 9.3.2 shows the accidents and consequent train delays that have occurred in the past two years.

Category 4 accidents are largely due to externally caused factors (level crossing accidents and damage).

Accidents in Category 1 to Category 3 comprise train collisions and derailings. Table 9.3.4 and Table 9.3.5 give breakdowns of such accidents by section and cause for 1993 and 1994 respectively.

Table 9.3.4 Section and Cause-separate Accident Occurrence Situation

(1993) (Accident categories: 1, 2 and 3)

Category	Type	Cause	North-south Line	Lao Cai	Cai Lan	Other Lines	Total
Internal	Collision	Station	4	2			6
	Derailing	Locomotive	2				2
		Rolling Stock	3	1			4
		Track	4	3		5	12
		Signaling					-
		Works		1		3	4
	Subtotal		13	7	-	8	28
External	Disaster		1				1
Unknown (derailing) Total			1	1			2
Derailing Accident Total			15	8	-	8	31
External	Level Crossing		20				20
	Obstruction, etc.		5				5
Total							56

Note: All data provided by VNR.

Table 9.3.5 Section and Cause-separate Accident Occurrence Situation

(1994) (Accident categories: 1, 2 and 3)

Category	Type	Cause	North-south Line	Lao Cai	Cai Lan	Other Lines	Total
Internal	Collision	Station	2	1		2	5
	Derailing	Locomotive	1	1			2
		Rolling Stock	3	5		1	9
		Track	6	2		1	9
		Signaling	1				1
		Works	3				3
	Subtotal		16	9	-	4	29
External	Disaster		1				1
Unknown (derailing) Total			5	1		1	7
Derailing Accident Total			22	10	-	5	37
External	Level Crossing		20				20
	Obstruction, etc.		7				7
Total							64

Note: All data provided by VNR.

From Table 9.3.4 and Table 9.3.5, it can be seen that locomotive or rolling stock derailings account for many of the accidents, and many such accidents occur on the North-south Line and the Lao Cai Line. On the Lao Cai Line in particular, even though its length is one-sixth that of the North-south line, the number of accidents on its is approximately half of the number on the North-south Line, and a further strengthening of track improvement and other countermeasures is thus desired.

Almost all of the externally caused accidents (Category 4 accidents) occur on level crossings. Moreover, almost all accident-caused fatalities, which amount to more than 200 people each year, occur in level crossing accidents. It is therefore necessary to install level crossing safety mechanisms and advance software side measures such as PR campaigns, etc. to the public, in addition to taking track improvement measures.

The disaster-caused accidents are as follows.

- September 18, 1994: Mud and sand flowed onto the North-south Line at the 1,249 km point following heavy rain and this led to the overturning of an S8 locomotive and two cars. Locomotive large-scale repair cost 500 million dong, the minor rolling stock damage amounted to 100 million dong and the lost time due to line restoration was 34 hours (800,000 dong/ hour).

- May 17, 1994: Sudden flooding at the 1,509 km point of the North-south Line between Song Luy and Long Thanh destroyed 144 m of track, and a HBN train together with eight freight wagons overturned. The locomotive and three wagons were badly damaged and five wagons had to be scrapped. The cost of the repairs and the line restoration time are unknown.

Table 9.3.6 Cause-separate Fatalities (Category 4)

Cause	Number of Accidents	Fatalities	Injured	Total
Level crossing accidents (pedestrians)	192	87	123	210
Fall accidents	5	2	3	5
Boarding of moving trains	3	2	1	3
Stone throwing	2	–	2	2
Train fires	–	–	–	–
Others	12	8	4	12
Total	214	99	133	232

Note: All data provided by VNR.

9.3.2 Problem Points and Direction of Countermeasures

(1) Operation control system

As train speeds become faster, operating train numbers increase and train types become more diverse, the management of trains over the whole line becomes more and more important in raising the quality of rail transportation. It is thus necessary to give full examination, from the basics up, to the purposes and methods of transportation control.

(a) Regarding dispatching duties for transportation control

In order to effect the comprehensive management of trains, it is necessary to have a thorough grasp of daily operation plans including field bodies. It is thus important for not only station staff but also level crossing personnel, etc. to be aware of the operation plans of trains, and so on. The Head Office should know the operation plans for all trains on all lines and the union offices should adopt similar setups. The dispatching rooms should maintain daily train diagrams and have an accurate grasp of all areas relating to train operation such as the setting of line closures, and so on.

The basic train diagram is the diagram that is used and acted upon by dispatcher. The main duty of dispatcher is not just the keeping of operation records, but is the control of non-regular train operations, train cancellations, train stand by, interchange revisions and other operation ordering work. In order to enable the staff to perform such important duties, they should not be using train diagrams of a blank form but should be provided with execution diagrams that give the operating plans for each day. The preparation and utilization of such diagrams is a matter requiring urgent attention.

(b) Improvement of train operation reliability and appropriate handling

Having an accurate grasp of train operation conditions is extremely important (in terms of operation control, too), especially at times of diagram confusion. On single track lines, as the number of operating trains increases, the slight delay of one train can have a great effect on other trains. It is therefore necessary for neighboring stations to maintain close communications and always have an accurate grasp of operating conditions, and to be able to take immediate measures in cases where, for example, slight train delays are expected.

Train conductors need to carry each day's timetable and take care to help prevent operating accidents and delays, etc. In particular, the VNR drivers are highly skilled, however, they should present portable timetables (filled with information on emergency slow running, daily instructions and points for attention, etc.) to the driving cab and take more detailed measures, in order to promote the more accurate operation of trains.

(2) Promotion of operating accident prevention measures

Based upon analysis of past accidents, the problem points and required improvements in the approach to accident prevention are considered in the manner described below.

(a) Study of operating accident categories and causes

The proper classification of accidents is required in order to carry out accident cause analysis and establish countermeasures.

In the case of VNR, accidents are classified into six categories depending on size (extent of damage), and this is a necessary measure. What is more important, however, is the classification of accidents into internally caused or externally caused accidents and, in particular, in the case of internally caused accidents, it is important to determine whether or not they have been caused by staff errors (whether or not they are staff responsible accidents).

Staff responsible accidents should be eliminated straight away, and it is necessary to thoroughly investigate causes and take urgent countermeasures in such cases. In such cases, rather than finding out who is responsible, investigating the true causes and using the gained results in forming prevention measures is more important. In software terms, accident prevention should be emphasized in education and training via on the job training and the education activities of the training centers, etc., and it is important to carry this out in unison with hardware countermeasures.

(b) Survey and processing of accidents

In addition to the establishment of an immediate action accident recovery setup and the immediate dispatch of tools, materials and staff to accident scenes, cause investigation in accordance with an accident survey manual is necessary.

Accident survey results should be recorded individually, used in the formation of countermeasures and also put to use in various statistical forms for judging the effects of countermeasures taken.

It is also necessary to give survey sheets a set format to ensure that no delays occur in the execution of surveys and the utilization of survey results.

(c) Establishment of operation regulations and development of an execution setup

With regard to train accidents caused by natural disasters such as flooding, etc., it is considered possible to prevent all but the most unexpected incidents through establishing

operation regulations and developing and strengthening a prevention setup. For this reason, a description shall be given of the policies laid down for the operation regulations of JR.

Operation regulations determine whether or not to cancel train services or limit train speeds in cases where there is a risk of accidents occurring due to heavy rain, strong winds or earthquake, and so on.

Appendix 9.3.3 describes the contents of the operation regulations of JR. The main forms of regulation are as follows:

a) Operation regulations due to heavy rain,

b) Operation regulations due to strong winds,

c) Operation regulations due to earthquake.

(d) Level crossing accident prevention measures

Except for putting railway lines onto different levels from their surroundings, there is no complete measure for preventing level crossing accidents, and such accidents form a major obstruction to railway transportation.

In the case of JR, too, the increased number of train services and rapid motorization that took place from the 1950s resulted in numerous level crossing accidents. In response to this situation, the Road Traffic Law was effected and level crossing improvement measures were implemented, and as a result, the number of level crossing accidents decreased.

The main measures for preventing level crossing accidents (excluding the construction of different levels) are listed below.

① Integration and abolition of level crossings.

② Installation of level crossing safety equipment (level crossing warning systems, installation and automatic barrier, interlocking with signals, obstruction detection devices, installation of accident warning audible signals, fused signals and flash signals, level crossing protection switches, paving of level crossing roads and the appropriate setting of warning times, etc.)

Moreover, accident warning flash signals are also used in areas where rock fall warning devices are installed.

③ Stricter enforcement of temporary stopping by cars, etc. at level crossings.

④ PR activities directed at the general public.

9.3.3 Transportation Plan

(1) Basic conditions

The final products within all transportation bodies are train diagrams. In this Project, it is the duty of the rail transportation body to ensure that accurate (by the day), safe and fast transportation, based on timetables set in accordance with the Train Operation Plan, is carried out. For this reason, in the compilation of plans for improvement, the railway transportation body should place emphasis on this point and should be suited to the needs of residents and other users and act as a basis for the economic development of Vietnam in the future.

Based on this fundamental thinking, the Transportation Plan shall contribute to the improved reliability of transportation, aim to achieve more frequent services and contribute to the improved business management of the railway.

With this in mind, the following items shall be made the basic conditions in compilation of the Transportation Plan for 2000.

1) Project sections and line conditions

The Project line shall be that between Hanoi and Lao Cai (293.6 km). In the F/S, priority transportation capacity strengthening and business management improvement measures shall be carried out together with the provision of more frequent services, in consideration of providing greater convenience for local residents. The maximum train speed on this line shall be raised from the current 60 km/h to 70 km/h.

2) Operation safety systems

The operating safety systems, which form the basic factor in train operation, shall be designed to increase safety levels and shall also allow modernization to be easily carried out in the future by giving consideration to the actual conditions and demand levels, etc. on the line.

(a) Blocking system

Currently, the tablet block system is in use, however, this shall be replaced and improved with the tokenless block system (as in the case of the North-south Line) as a means of improving train operation and transportation reliability levels.

(b) Signaling system

The existing signaling system is a two-position, two-aspect, mechanical semaphore system, and there are many stations that are not installed with departure signals. Through installing

departure signals, the handling of passing trains will become easy and the reliability of train operation will be vastly improved.

Moreover, in those stations where the visual confirmation of home signals is difficult, distant signals shall be installed, and the aspects of all signals shall be unified to the three-aspect system.

In line with the improvements to the blocking system, electric colorlight (multiple colorlight) signals shall be adopted in order to again raise reliability and also improve efficiency.

This signaling system is the same as that to be introduced on the North-south Line and is illustrated in Figure 9.3.2.

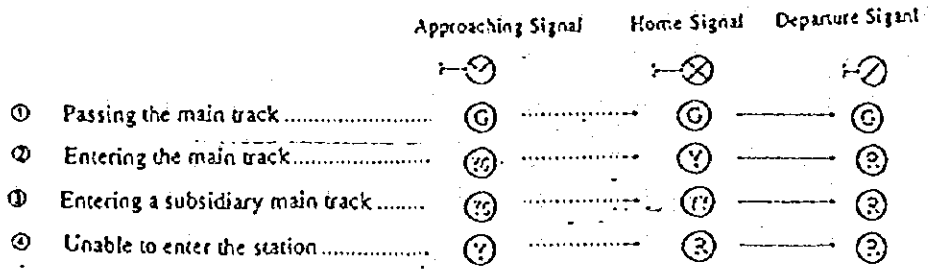


Figure 9.3.2 Signal Aspect System

(c) Interlocking system

The existing interlocking system is the Class 2 mechanical interlocking system whereby points are controlled on site and linkages with signals are carried out individually. This system shall be renewed and improved to the Class 2 relay interlocking system in line with the improvements to the blocking system as a means of improving the reliability of train operation and in-station work (rolling stock changeover, and so on).

(d) Others

Warning systems such as level crossing warning devices and rainfall warning devices shall be introduced in an attempt to prevent the occurrence of the very frequent level crossing accidents and accidents caused by heavy rainfall disasters (see Appendix 9.3.3).

3) Business management improvement

Through carrying out marketing improvement measures, freight stations with only minor handling loads shall be absorbed into nearby major freight stations. Moreover, in the implementation stage, it is considered as necessary to simplify operation handling at stations with few inter changes (as a result of the train diagram setting) by carefully looking into the effectiveness of turnouts and using spring points.

4) Train types and train operation, etc.

(a) Train types

The following table shows the types of trains that will be operating in 2000.

Table 9.3.7 Set Train Types and Operating Speeds

Train Type		Maximum Operating Speed	Remarks
Passenger Trains	Express train	70 km/h	D4H improved model-W, traction
	Local train	"	Same model-S or -W
Freight Trains	Ordinary freight train	"	D12E-S traction
	Exclusive freight train	"	D12E-W traction

Note 1: D4H-W is multiple connected and D4H-S is single locomotive.
Note 2: D4H includes D5H.

(b) Train operation

Passenger trains shall be manned by drivers and conductors, while freight trains shall basically be manned only by drivers (including assistance drivers).

5) Rolling stock and rolling stock performance

Regarding the passenger cars for express trains, existing rolling stock that has received improvements to accommodation, and so on, shall be used.

Passenger trains shall use remodeled D4H traction locomotives and freight trains shall use D12E traction locomotives.

The operating performance for each train type will differ according to plan, however, Appendix 9.3.4 indicates the running resistance and other criteria. Engine output shall be 90% of the design output and, in the case of multiple connected engines, the auxiliary engine output shall be 95%

6) Boarding efficiency, etc.

Boarding efficiency, etc. shall basically be in accordance with the M/P and the main items shall be as follows:

① Boarding efficiency: 80 - 85% (for handling transport waves of approximately 130%)

② Load factor: 85% (this shall be 100% on exclusive freight trains)

③ FC return period: 8 days
(according to rolling stock operation for exclusive freight trains)

④ Empty car ratio: 30% (all wagons shall be loaded on exclusive freight trains)

(2) Transportation plan

1) Formation and hauling capacity, etc. by train type

(a) Passenger trains

The formation of passenger trains shall be set upon giving consideration to running speeds through gradient sections, etc. Moreover, sleeping cars shall account for around 25% of total passenger capacity in the case of long-distance trains, based on careful consideration of the current ratio of sleeping cars.

Table 9.3.8 Formations and Boarding Capacities of Passenger Trains (2000)
(Hanoi - Lao Cai)

Train Category, etc.		Seating Cars (A)			Sleeping Car (B)			Restaurant, luggage, mail cars	(C) Total	B/C %
		3rd	2nd	1st	3rd	2nd	1st			
Express (D4H-W) (Middle-distance)	Cars	–	3	2	2		1	1	9	
	Capacity		78	64	48		24		120/480	25
	Weight								390 ton	
Express (D4H-W) (Short-distance)	Cars	–	5	2	–	–	–	1	8	0
	Capacity		78	64					510	
	Weight								350 ton	
Local (D4H-S, D5H-S)	Cars	4	–	–	–	–	–	1	5	0
	Capacity	80							320	
	Weight								220 ton	

Note: The short-distance express trains shall basically operate in the daytime and so sleeping cars shall not be connected.

(b) Freight trains

The gross tonnage and net tonnage of each type of freight train are indicated below:

- General freight trains: $X = A/36$ (X: Number of freight wagons), A: Gross tonnage)
  $[A = 0.7 \times (17 + 32 \times 0.85) + 0.3X \times 17)]$

(See Appendix 9.3.4)

- Exclusive freight trains: $X = A/47$ (X: Number of freight wagons, A: Gross tonnage)
  $[A = X\ (17 + 30)]$

The gradient-separate and haulage capacity-separate operating speeds shall be calculated based on rolling stock performance. The calculation results are shown in Appendix 9.3.5.

2) Train operating times, etc.

The operating times and allowance times by train type are as indicated in the following table.

Table 9.3.9 Estimated Operating Times for Each Main Train Type

Station	Distance (km)	Express Passenger (DL)		Ordinary Passenger (DL)		Through Freight	
		Standard time	Stopping time	Standard time	Stopping time	Standard time	Stopping time
Hanoi							
	2.0	8'		–			
L. Bien			–		–		
	3.5	17'		17'			
G. Lam			5'		3'		
	5.4	10'		11'		25'	
Y. Vien			5'		3'		30'
	42.6			1h 20'			
V. Yen			–		3'	1h 20'	–
	19.2			32'			
V Tri			–		3'		30'
	18.0	3h 15'		35'		30'	
T. Kien			–		3'		30'
	8.5			14'			
P. Tho			–		3'	1h 45'	–
	56.1			1h 45'			
Y. Bai			15'		20'		50'
	31.0			58'			
Mau A			–		3'		–
	50.7	3h 10'		1h 52'		3h 20'	
B. Ha			–		3'		–
	24.7			47'			
P. Lu			5'		3'		30'
	31.9			1h 15'		1h 15'	
L. Cai							
Total		485'	30'	586'	47'	515'	170'
Allowance time		25'		87'		95'	
G. Total	293.6	9h 00'		12h 00'		13h 00'	

Note 1: Times in the diagram are standard times and allowance times (maintenance, interchange allowance) are added.
Note 2: Ordinary trains have been assumed to stop at all stations (3').

3) Philosophy behind train setting and train operation plan

(a) Setting of passenger trains

The setting of passenger trains shall be done through setting transportation capacities to match with the number of persons passing through the section obtained from demand forecasts (see Appendix 9.3.6).

In particular, in the case of middle-distance and long-distance passenger transportation, examination needs to be made of passenger demands regarding day and night trains, limited express and express trains, seating carriages and sleeping cars, and also departure and arrival times, and so on. Passenger demands in such areas change over time and this makes train settings very difficult, however, the results of examination made in the case of JNR shall be described for reference purposes.

① Day train and night train preference ratio

The susceptibility of passengers to prefer night trains in terms of the required traveling times of limited express and express trains is 50% when the traveling time is 10 to 12 hours and almost 100% when the traveling time exceeds 16 hours. This data is the result of surveys carried out in the 1960s and is partly no longer applicable to existing conditions.

In the case of VNR, as long traveling times will still be required even following the speeding up of trains, it will be necessary to increase the ratio of sleeping cars.

② Passenger demands regarding departure and arrival times

- 48% of passenger demands indicate a preference for between 8:00 and 10:00 for the departure time.
- The most preferred arrival times range between 07.00 and 10.00 with the demand for 08.00 arrival being especially strong. In terms of afternoon arrival, 90% of customers prefer between 16.00 and 18.00, indicating a stronger degree of concentration than in the case of morning arrival. (JNR Labor and Science Research Institute, Study Materials 71-20, etc.)

③ Limited express train preference ratio

It is said that middle-distance and long-distance railway passengers use limited express or express trains most of all, and the preference for such trains is stronger than the preference concerning day trains or night trains.

In the case of JNR, speeding up has been aimed for through the raising in status of semi-express trains to express trains, and so on, each time the timetable has been revised. Before the commencement of Shinkansen services, it is said that the preference for limited express trains on trips in excess of six hours was more than 50%. Moreover, depending on the ratio of actual trains running, the preference ratio, including the above -mentioned issues, is apt to fluctuate greatly.

The above points shall be given careful consideration in the setting of the train plans for VNR, however, the main emphasis shall be placed on achieving improved reliability, modernization and transportation efficiency based on the existing train services.

b) Setting of freight trains

In the case of freight trains, choices do exist in wagon grade (including small loads), the use of containers and piggy-backs, etc., however, there is no useful data relating to preferences in these areas and so the planning shall be advanced with consideration mainly being given to operating as many exclusive freight trains as possible. Moreover, in the event of greater use of containers in the future, some direct freight trains shall be converted to container trains.

Based upon the above considerations, the Train Operation Plan shall be as indicated in Fig. 9.3.3 and Fig. 9.3.4.

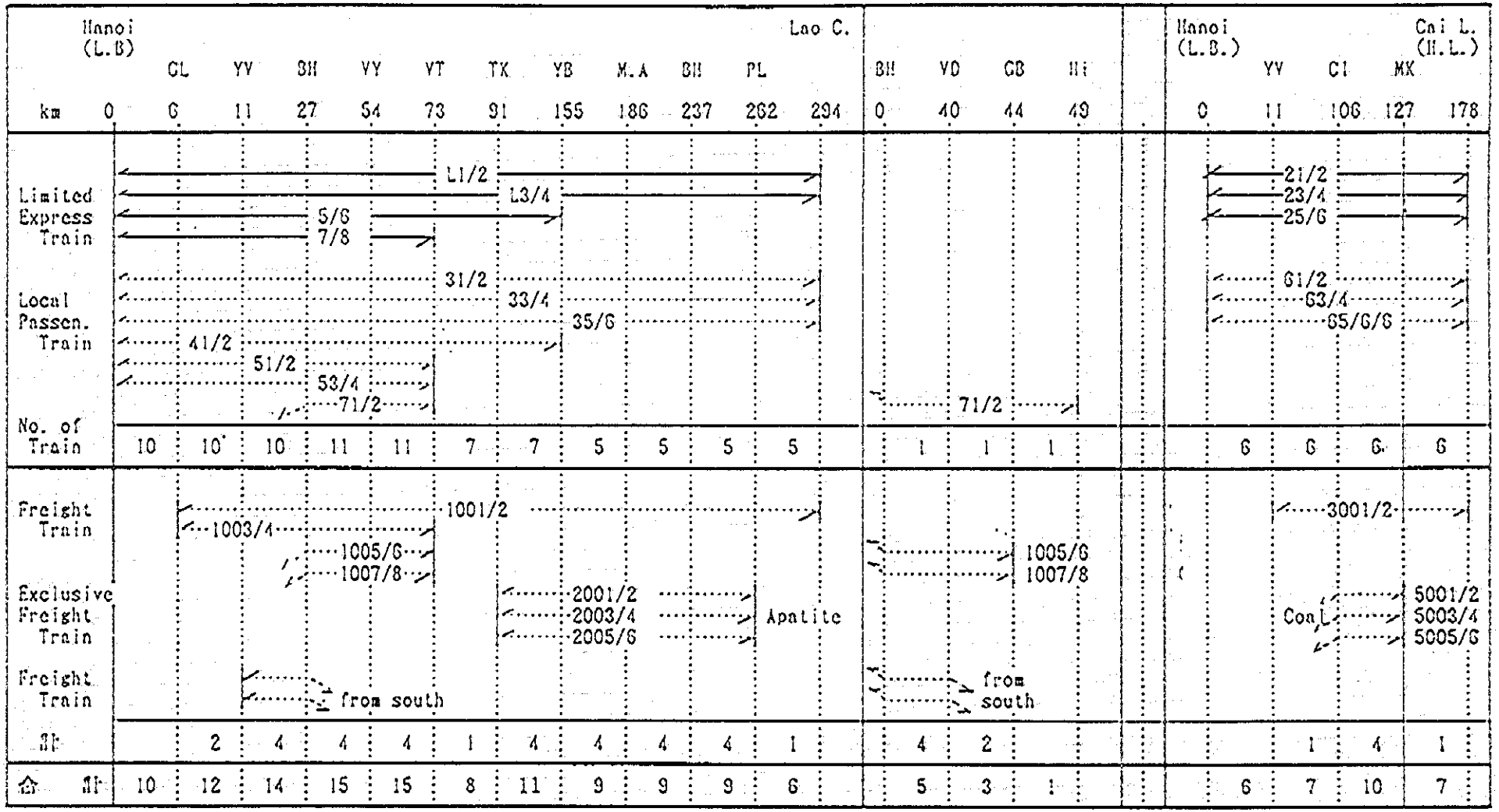


Fig. 9.3.3 Train Operation Plan (Hanoi - Lao Cai, Cai Lan): 2000

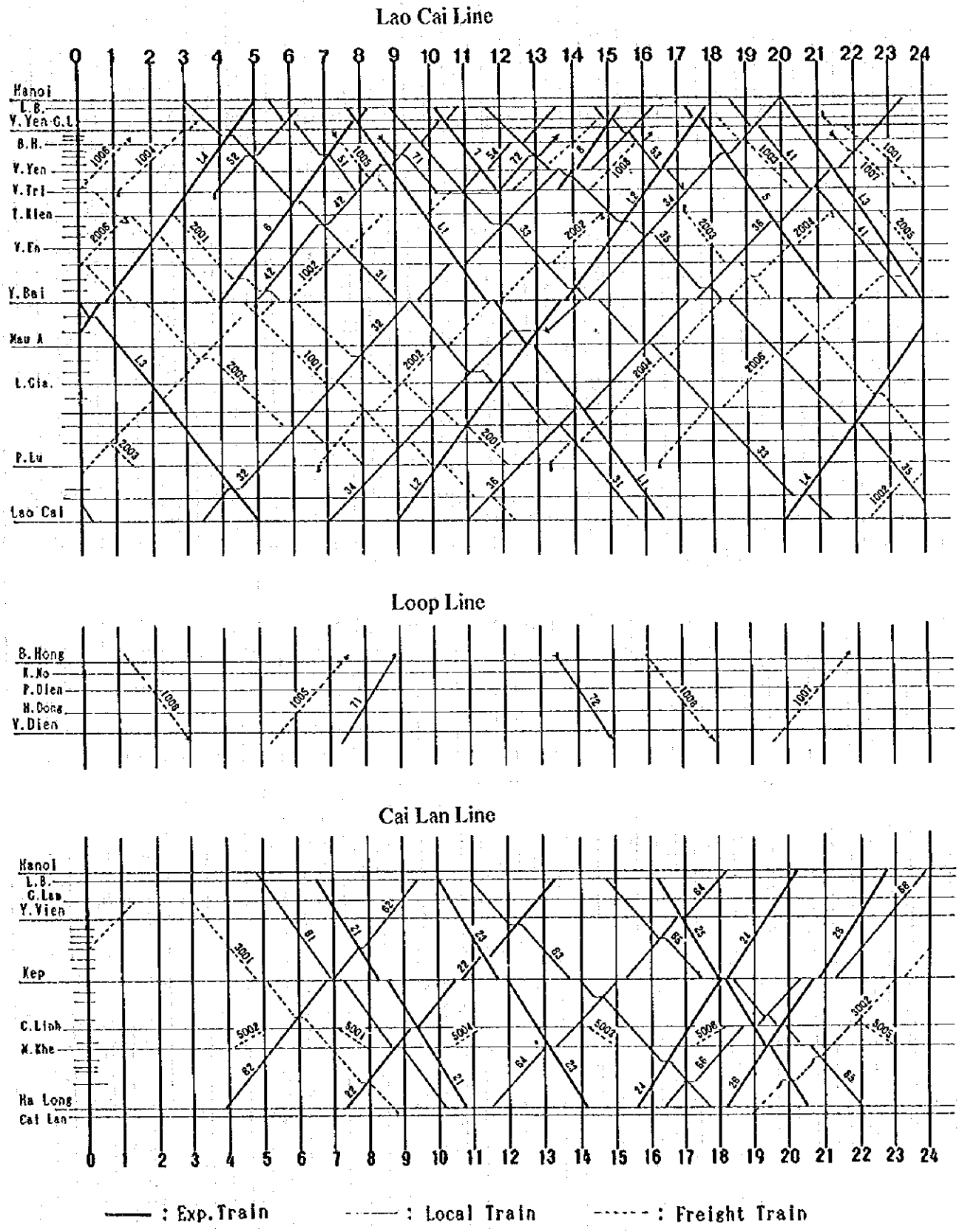


Fig. 9.3.4 Train Diagram (2000)

4) Train kilometers and rolling stock kilometers

Train kilometers, etc., based on the Train Operation Plan, are as indicated in Table 9.3.10.

Table 9.3.10 Train Kilometers and Rolling Stock Kilometers (2000)

(Lao Cai Line) (Unit: km/day)

	Train Kilo meters (km)	Rolling Stock Kilometers (km)				Remarks
		D4H, etc.	D12E	PC	FC	
Express	1,180	2,360	–	10,620	–	D4HW + PC: 9
Express	460	920	–	3,680	–	D4HW + PC: 8
Ordinary	2,530	2,530	–	12,650	–	D4H + PC: 5
Subtotal	4,170	5,810	–	26,950	–	
General freight	1,070	–	1,690	–	12,870	D12ES, W + FC 8-15
Exclusive freight	1,330	–	2,650	–	18,560	D12EW + FC: 14
Subtotal	2,400	–	4,340	–	31,430	
Total	6,570	5,810	4,340	26,950	32,890	

5) Required rolling stock

The required rolling stock, based on the estimated train kilometers, etc. and outline train diagram setting, is as indicated in Table 9.3.11.

Table 9.3.11 Required Rolling Stock (2000)

(Lao Cai Line) (Unit: cars/wagons)

Train Type	D4H or D5H	D12E	PC				FC	Remarks
			Number of Trains	Cars/Wagons		Total cars		
				Passenger cars	Luggage cars			
Express	(W) 8	–	3	24	3	27	–	Linked with sleeping cars
Express	(W) 2	–	1	7	1	8	–	Seating cars only
Ordinary passenger	(S) 10	–	7	28	7	35	–	
General freight	–	13				–	310	
Exclusive freight						–	98	For Apatite: 14-car formation
Reserve cars	4	3				20	32	
Total	24	16	11	59	11	90	440	

Note 1: D4H shall all be remodeled and include D5H.
Note 2: Cafeteria cars are included in the luggage car column.
Note 3: D4H (50 km/h) shall be the locomotives used for rolling stock shunting (4 or 5 locomotives).

6) Examination of improvements to be made in line with the train operation plan

Based on the Transportation Plan, compiled in accordance with transportation demand, it is imagined that the following kinds of improvements will be necessary.

① Yen Vien station

It is estimated that no problems should exist regarding the handling of passenger and freight trains in 2000, however, following 2000, in line with the flow of freight (mainly containers) to and from Cai Lan Port and the transportation of coal, etc. on the Lao Cai Line, it will become necessary to examine the installation of freight handling facilities that include ICD based around Yen Vien B. Station.

② Additional freight siding at Lao Cai station

It is planned to make Lao Cai Station into the terminal arrival station for two express trains, three ordinary trains and one freight train (all return trains) by 2000. Therefore, the formation of three passenger trains (one 8-car and two 5-car trains) as well as the daytime storage of a maximum of four trains will become necessary.

Regarding freight handling, this was just a few cars in 1993, however, it is expected that this will increase to roughly 20 cars by 2000.

It is thought that the station will be just about able to handle the handling volumes concerned, however, it may become necessary to examine the addition of a passenger train storage track or a freight formation track (one track) in the future based on consideration of transportation volume trends.

9.4 Track and Station

9.4.1 Track Standards

(1) General

The Lao Cai Line (Yen Vien - Lao Cai) was constructed between 1901 and 1906 and is a very old section. This line branches off from Yen Vien Station, which is situated 10.9 km to the north of Hanoi, and proceeds north along Red River to Lao Cai Station on the border with China.

Separate track standards are upheld for the standard gauge and meter gauge.

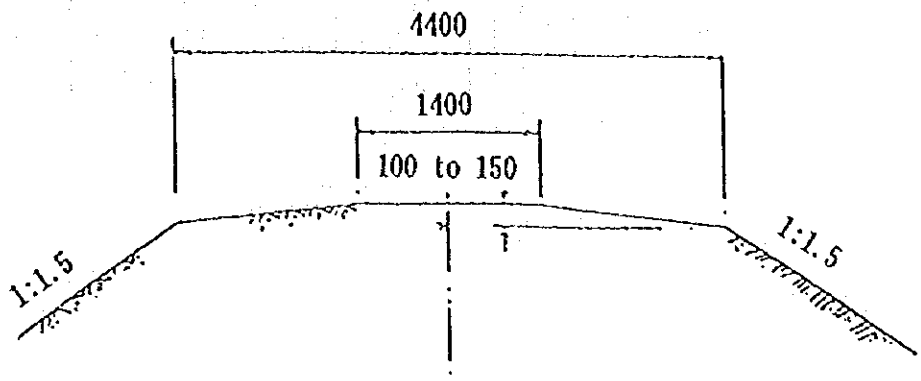
Yen Vien - Dong Anh Railway is using the mix gauge.

Dong Anh - Lao Cai Railway is using the meter gauge and details of the line standards are given below.

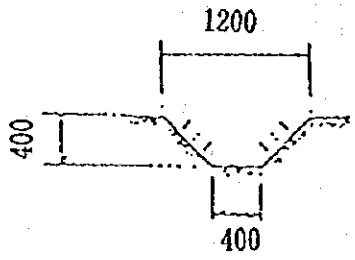
- Maximum Speed : 60 km/h
- Gauge : 1,000 mm
- Minimum Radius Curve : 100 m
- Speed Limit at Curve : $V = 3.5\sqrt{R}$
- Super-Elevation : $h = \frac{6.6 \times V^2_{Max}}{R}$
- Maximum Cant : 95 mm
- Maximum Slack : 25 mm
- Maximum Grade : 12‰
- Vertical Curve Radius : 5,000 m or 3,000 m inserted at grade change over 4%

(2) Roadway diagraph

The roadway diagraph for the Yen Vien - Lao Cai Railway is shown in Fig. 9.4.1.



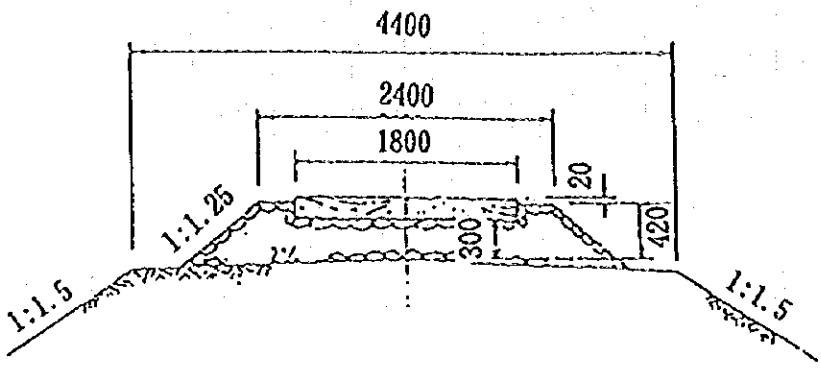
Embankment



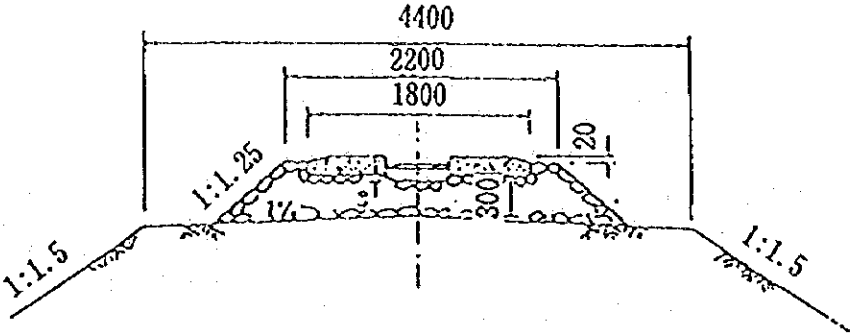
Side Drain in Cutting

All Dimensions are in Millimetres.

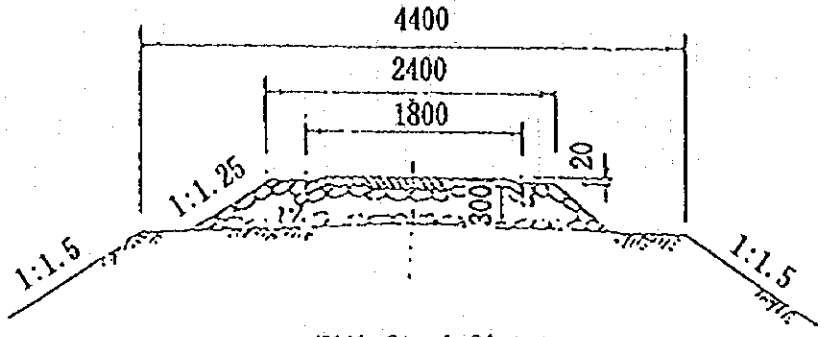
Fig. 9.4.1 Typical Profile of Formation



With Wooden Sleepers



With Tow Block Concrete Sleepers



With Steel Sleepers

Fig. 9.4.1 Typical Profile of Formation (Continued)

9.4.2 Track

(1) Current conditions and problem points

1) Track maintenance

The Lao Cai Line is 239 km, 600 m from Hanoi to Lao Cai and its maintenance is carried out by three management enterprises. The management enterprises are as shown in Table 9.4.1.

Table 9.4.1 Railway Management Enterprises

Union	Name of Enterprises	Section in Charge			Remarks
		From (km)	To (km)	Extension	
Union 1	Hanoi	0.0	29.0	29.0	
	Vinh Phu	29.0	144.75	115.75	
	Yen Lao	144.75	239.6	94.85	

Track maintenance work is carried out with poor machinery and tools, therefore, almost work is performed manually. Workers get to the work sites by bicycle or on foot, especially in Lao Cai Line, there are some sites which are inaccessible even to bicycle.

Track inspection and measurement (gauges, levels, lines and surfaces) and other inspections and measurements are carried out visually.

Approximately 50% of the section between Viet Tri Station (72 km, 700 km) and Doan Thuong (140 km, 500 m) consists of track with a curve radius of between 150 mm and 200 mm, and the remaining part of the line up to Lao Cai Station (239 km, 600 m) consists of track with a continuous curve radius of between 150 mm and 200 mm, except for just a small section.

As the line is laid between Red River and mountain bases, the gradient is less than 10% throughout, except for some sections with a gradient of between 10% and 12%.

2) Track, level crossings and others

The rails on the main line and its turnouts are 43 kg/m rails and are between 20 and 25 years old.

The length of the 43 kg/m rails is 12.5 m and this forms the weak point of the track. There are many joints where the rate of maintenance work is high.

Slowing of speed due to turnout only takes place on the turnout side of Yen Vien Station (11 km, 700 m).

Sleepers are mostly 2-block concrete, however, iron sleepers are used on sharp curve sections. The sleeper laying density is 1,440 sleepers/km on sections where R $\leq$ 200 m, and indeed 1,440 sleepers/km is standard.

The fastening used (K3 type) consists of a tie plate placed on the rubber pad, with the actual fastening being performed by a T bolt, stopper, spring washer and nut, however, elasticity is poor and warps are apt to appear.

Because ballast is manufactured through manual operation, its grading is not uniform. If quality control in the area of ballast grading distribution is not carried out, the amount of track maintenance will increase in future in line with the faster train speeds and increased passing tonnage.

The average ballast thickness ranges between 15 cm and 25 cm, however, there are areas where the thickness is less than this. The mud-pumping of ballast is a common occurrence. Table 9.4.2 shows the areas where such damage is particularly common.

Table 9.4.2 Areas with Large Mud-pumping Damage

Kilometre			Remarks
From	To	Extension	
53km000m	65km000m	12km000m	
136km000m	137km000m	1km000m	
200km000m	210km000m	10km000m	
213km000m	214km000m	1km000m	
234km900m	235km250m	0km350m	
259km000m	260km000m	1km000m	

Sidings consist of 24 kg/m rails and wooden or iron sleepers.

There are currently some 100 level crossings registered and, although the busy ones are manned by guards who operate the cutout devices, the other ones are unmanned and are not even fitted with alarm systems, and so on.

Level crossings on national roads which are crossed by automobiles are paved, however, the remaining level crossings are not paved.

(2) Countermeasures

1) Track maintenance

Track mechanized maintenance gangs shall be deployed at roughly 30 km intervals and maintenance machinery and tools shall be provided. Table 9.4.3 gives the details concerning the track mechanized maintenance gangs.

The maintenance machinery and tools to be provided are as indicated in Table 9.4.4. As a high speed track inspection car is scheduled to be deployed on the Hanoi - Ho Chi Minh Railway, it will be possible to operate this on the Lao Cai Line.

Appendix 9.4.1 gives an outline of the high speed track inspection car.

Of the machinery and tools to be provided to the track mechanized maintenance gangs and to be used in the execution of works, that required for training and education purposes shall be provided to the training centers, and higher technical levels among personnel shall be aimed for through the implementation of education and training in theory and handling.

Table 9.4.5 shows the machinery ad tools planned for provision.

However, the budget for machinery and tools is given in the plan for the Hanoi - Ho Chi Minh Line.

Table 9.4.3 Track Mechanized Maintenance Gang

Union	Name of Enterprise (Section in Charge)	Mechanized Maintenance Gang	Kilometre	Remarks
Union-1	Ha Noi (29.00 km) (0.00 - 29.00 km)	Yen Vien Nam	10.9	
	Vinh Phu (115.75 km) (29.00 - 144.75 km)	Phuc Yen	39.0	
		Viet Tri	72.7	
		Phu Tho	99.2	
		Am Thuong	131.0	
	Yen Lao (94.85 km) (144.75 - 239.60 km)	Yen Bai	155.3	
		Mau A	186.3	
		Lang Khay	218.8	
		Thai Van	247.5	
		Lao Cai	293.6	

Table 9.4.4 Machinery and Tool for Maintenance

Machine and Tool	Unit	Number	Remarks
Truck	Set	1	
Track Motor Car	Set	1	
Tie Tamper	Set	2	
Engine Generator	Set	2	
Rail Jack	Set	4	
Rail Saw	Set	1	
Rail Drill	Set	1	
Push Car	Set	1	
Track Irregularity Measurement	Set	1	Gauge measure, Curve Lining Calculator, Alignment and Level measure, etc.

Table 9.4.5 Training Machinery and Tools to be Provided

Machine and Tool	Unit	Number	Remarks
Gas Pressure Welding Machine	Set	1	
Jack Traverser (Rail)	Set	2	
Jack Traverser (Turnout)	Set	1	
Track Jack	Set	6	
Tie Tamper	Set	2	
Engine Generator	Set	2	
Rail Jack	Set	4	
Rail Saw	Set	2	
Rail Drill	Set	2	
Push Car	Set	2	
Track Irregularity Measurement	Set	1	Gauge measure, Curve Lining Calculator, Alignment and Level measure, etc.
Rain-gauge	Set	1	
Wind velocity gauge	Set	1	

Concerning the area of continuous minor curves north of Yen Bai.

Cycloid curves and sign curves shall be adopted for gentle curves and cant reduction, and a new alignment shall be designed while giving consideration to the local track bed. Attention shall also be paid to straight length between deficient curves.

For curves of R ≦ 300 m, curve alignment shall be carried out and curve alignment pegs and track center pegs shall be put into place. The curve alignment pegs shall be placed in the following manner:

(a) At 5 m intervals in areas 10 m - 20 m beyond the curve start points,

(b) At a set distance (normally G/2 + 1 m = 1.5 m) outside the outer rail gauges.

The track center pegs shall be placed at intervals of 20 m.

Wooden pegs made from old sleepers, etc. and riveted in the centers for identification shall be used as the curve alignment pegs and the track center pegs.

2) Track, level crossings and others

The length of the 43 kg/m rails shall be doubled from the current 12.5 m to 25 m by welding two rails together at a time on the track sites. When replacing rails, 25 m rails that have been welded in the bases or on site shall be used. Elastic fasteners shall be adopted as the fastening equipment. Improved elastic fasteners (see Appendix 9.4.3) shall be used.

The plate spring making equipment at Dong Anh Railway Material Engineering Factory is being remodeled and used in the manufacture of double elastic fastening for the Hanoi - Ho Chi Minh Line plan.

Ballast renewal and track improvement shall be carried out to secure a minimum ballast thickness of 25 cm.

In areas where mud-pumping damage is great, the roadbed shall be replaced and drainage equipment shall be installed.

Ballast making machines shall be introduced and the quality control of ballast grading shall be carried out. Appendix 9.4.2 gives an outline of a ballast making facilities.

The ballast making machines (including the quality control of ballast grading) and hopper cars shall be provided to the Lam Giang rock crushing plant.

Rails shall be generated from the main line and the 24 kg/m siding rails shall be replaced with them.

In line with the road bed/track improvement work the level crossing will be paved with asphalt.

Curve adjusting and curve alignment peg placing, etc. shall be carried out together with other improvement work.

Table 9.4.6 details the improvement plan units and quantities.

Table 9.4.6 Improvement Plan for Track

Item	Unit	Number	Remarks
Rail Welding	Thousand Share	24.0	
Ballast Thickness ≧ 25cm	km	100.0	included ballast renewal
Re-alignment of Curve	km	70.0	included alignment peg, etc.

9.4.3 Stations

(1) Current conditions and problem points

Appendix 9.4.4 shows the station kilometer and distribution diagram.

There are 36 stations between Hanoi and Cai Lan and the average distance between stations is 8.4 km with the minimum distance being 3.4 km and the maximum distance being 15.6 km.

(2) Countermeasures

A new storage track shall be provided at Lao Cai Station in line with the Train Operation Plan described in 9.3.3. Table 9.4.7 outlines the provision of new storage track.

Table 9.4.7 Outline of New Storage Track Provision

Item	Unit	Number	Remarks
Track	m	600	
Turnout	Set	4	

9.5 Other Civil Engineering Structures

(1) Current situation of this line

The current track structures of Hanoi - Lao Cai line are consisted with 0.7 % of bridges and 99.3 % of earth structures such as cutting and embankment. On the cutting and embankment sections, a number of disaster caused by heavy rain occurs every year. During the rainy season from May 1 to October 15, efforts are made to prevent flood disaster in advance through fixed precaution watchers at 30 sites and patrols. Bulldozers and other machinery are maintained in readiness for disaster. The transport means of these machines is only by mortar car on rail.

The alignment of this line is insufficient condition. There are many small curve sections and some weak bridges. Between Yen Vien to Lao Cai, there are 2 bridges that cause to restrict train speed, and those restricted speed is 30 km/h.

(2) Countermeasures

According to the role of Lao Cai line, large investment should be avoided and only indispensable improvement for stable and safe train operation shall be executed. Inspection of bridges and submerge sections are necessary. The execution of improvements and disaster recovery works is not complicated in the case of earth structures. As train speed becomes faster and train density comes to increase, it will be more and more necessary to maintain the track safety.

The disaster prevention system needs to change to ensure controlled and advanced one. Further more the poor alignment of the line means that examination needs to be made on alignment improvement or rerouting. As the line is laid between Red river and the base of mountains, it needs much cost to improve sufficiently.

A system of train regulations based on the amount of rainfall and wind velocity shall be introduced in order to forecast disasters before they occur and thus prevent train accidents from occurring in advance. Regarding the method of train regulations, VNR needs to create original regulation to match the line with referring the JR operation regulations which were established after the long-term research of relationships between natural phenomena and disasters. The contents of the JR operation regulations are as indicated in Appendix 9.3.3.

In the line with the introduction of operation regulation system, the necessary rain gauges and wind velocity gauges shall be installed. Table .9.5.1 shows the sites where rain gauges and wind velocity gauges should be installed.

Table 9.5.1 The List of Rain Gauge and Wind-velocity Gauge

Enterprise	Number	Installation Site
Vinh Phu	2	Viet Tri(72.7km), Am Thuong(131.0km)
Yen Lao	2	Mau A(186.3km), Lao Cai(293.6km)
Total	4	

(3) Establishment of structure inspection center

It is recommendable to establish a structure inspection center that takes charge of the inspection and plan of improvement about bridges, tunnels, slopes and drains with providing inspection device.

(4) Precaution against disaster system

To prevent a train accident from natural disaster cause of heavy rain, it is necessary to measure the amount of rain fall every one hour during heavy rain.
If the amount of rainfall exceeds the set up amount , it should take the precaution against disaster.
In the precaution against disaster, a watch patrol on foot makes the round of appointed place every one hour. Trains are restricted their speed or stopped according the amount of rainfall.

9.6 Signaling

9.6.1 Description of Existing System and Problems

(1) Block system and blocking devices

The tablet block system is adopted in the greater part of Lao Cai Line, while equipping with the tokenless block system in some tracks.

(2) Controlling line for the tablet blocking device

1 bare wire is used, hanging on poles and ground earthing circuit is substituted for one more wire as a return circuit. This circuit will be operated in less power source, for instance in batteries, but supervision, of earthing resistance, battery conditions and insulation state of overhead wire is essential. We are afraid of malfunction owing to such change as lowering the insulation resistance of wire to the ground and varying the earth resistance of return circuit. This implies to have such disadvantages as more manpower for maintenance.

(3) Signals

Semaphore signals are used in both tablet block system and tokenless block system. As starting signals are not installed in the stations with tablet blocking, train operation is executed through transferring a token from a driver to a station master, and vice versa. In some stations distant signals are installed, while they have been not used yet.

(4) Power source

AC power source are equipped in Co Loa and Viet Tri, but there are some stations with no power source or low power capacity in this line.

9.6.2 Countermeasures

(1) Change of block system

As 16 trains (passenger or freight ones) a day are operated in this line, tablet block devices have been used frequently. Current tablet block devices and interlocking devices are superannuated and lack their repair parts. Worse is forecast to progress year by year. Therefore, in this project investment to replace current block system with new token less block system should be executed by 2000.

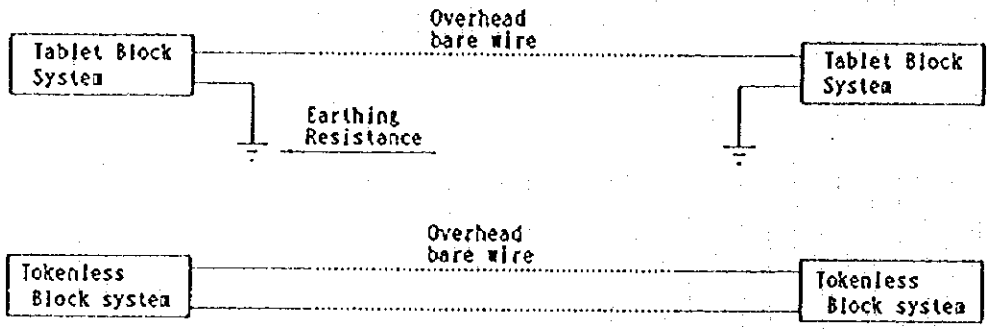


Fig. 9.6.1 Controlling Line for the Block System

As for 2 kinds of the block system, their schematic diagram of the controlling line for the block system is shown above. As 2 wires are laid between stations in tokenless system, conditions of lines are improved and malfunctions are also removed.

(2) Power supply and color light signal

We are hearing that AC power will be supplied to all stations in the Hanoi - Lao Cai Line by 2000. Anew installing power source, renewal of power source and increase in its capacity will be needed at the same time as electrification of signals. Replacement of semaphore signals with electric color light signals should be, therefore, executed in an adequate timing. If necessary, distant signals will be also added in some stations.

(3) Signal aspect

3-position/2-aspect system is applied for the tokenless block sections. The details of aspect pattern are as follows:

Table 9.6.1 Current Signal Aspect

Kind of Trains	Entrance Route	Home Signal	Starting sig.
Stopping Train	Home Track	Y	R
	Siding Track	YY	R
Passing Train	Home Track	G	G

Note: Y, R and G are expressive of yellow, red and green light respectively.

(4) Change of the station layout and improvement of tracks

At the same time as modernzation of signaling system, the improvement of some stations should be execute. As traffic in Lao Cai Line is so small that station layout should be simplified. 2 tracks are remained and another unused track should be eliminated except some exception. Spring point devices are installed to both turnouts and then, point men will be deleted. As a result, saving manpower, increased train operation efficiency and simplicity of signal operation will be achieved.

(5) Others

Some items for safe train operation are required from train operating division. They are:

- Automatic warning device for railway crossing
- Warning system in much rainfall

As for execution, it is necessary to decide adequately which item to execute and which section of line to select.

9.7 Telecommunications

(1) Current conditions

(a) Telecommunication line
Bare wire line is used between Hanoi and Lao Cai, and cable is used on the section between Hanoi and Yen Vien.

(b) Transmission facilities
A new digital micro radio system is scheduled for completion by VNR on the section between Hanoi and Dong Dang by the end of 1995. In line with this, the equipment between Hanoi and Yen Vien will be renewed.

Since transmission devices are out of date, currently, supplying of parts is difficult. As a result, available components and second-hand components are borne from old facilities purchased from the national telephone company.

(c) Exchange facilities
Exchanges are installed at Yen Vien, Viet Tri, Yen Bai, Pho Luu and Lao Cai and a set at Yen Vien is the step-by-step exchange.
As an exchange is connected with only 1-2 transit trunks, an exchange already is fully used. Switching of telephones are executed by manual. An exchange is connected to the public telephone company's line.

(d) Terminal facilities
Terminal facilities are telephones for train blocking, dispatching telephones, railway, a central telephone at a station, telephones to manned level crossings.
The reliability and communication quality are low due to deterioration of them.

(e) Power source facilities:
The transmission uses an AC 220V electricity and the exchange uses DC 24V and DC 48V. The DC power is supplied through rectifiers and batteries. Some of the main stations have manually operated emergency generators.

(f) Maintenance system;
There are 3 maintenance companies at Hanoi, Viet Tri and Yen Bai and maintenance staff are deployed at each station

There are night shifts for emergency repair in 24-hour maintenance.

Overall deterioration can currently be seen throughout the telecommunication facilities. Some facilities are in terminal state of disrepair and there are a lack of repair parts and measuring instrument. The current superannuated telecommunication system and facilities are maintained with the efforts of qualified engineers and skilled technicians. The present technical levels of maintenance staff are sufficient for handling the existing facilities.

(2) Countermeasures

The large part of the telecommunication facilities will need to be renewed by 2010. The target for investment into equipment and facilities for up to 2000 is planned according to the following principles:

- Equipment investment that satisfies the demand for telecommunications in term of both quality and quantity shall be carried out.
- The equipment investment shall match with the objectives of securing more safety, more income and improved services by 2000.
- Consideration shall be given to 2010 by investing in equipment that does not eventually prove to be wasteful or surplus to requirement by that time.

There are 2 kinds of systems for long-distance transmission to be newly installed.
-Optical fiber system:
The optical fiber cable does not receive external influence. The quality of the system is very good and would be optimal for such communications as high speed data transmission and other communications that are expected to be used by modern railway systems in the near future. As the cable is laid underground, the maintenance of cable will be easy.
However, the cable line would be affected by natural disasters of the railway track.

-Digital microwave radio system
The wireless system would not be affected by any accident or disasters on the railway lines because there are no facilities between antennas. However, the system is vulnerable to phasing and other environmental effects, so that it is not really suited to high speed transmission in particular.

Combination the above-mentioned two systems are the most fundamental system because the communication lines are simultaneously or supplementary used the wire and digital microwave radio networks.

However, in the present situation, the replacement of the existing facilities must take priority up to 2000. The replacement of bare wire by underground-cable will be selected as an earlier project.
The construction of combining system with cable and should be implemented as a long term project.

(a) Communication line
The communication line between Hanoi and Yen Vien will be converted from bare wire line to 100 pairs of metal cable, and the line between Yen Vien and Viet Tri will be replaced with 30 pairs of metal cable. This cable shall be laid underground.
A new digital micro wave system is scheduled for completion by VNR on the section between Hanoi and Dong Dang by the end of 1995. In line with this, the equipment between Hanoi and Yen Vien will be renewed.

(b) Transmission equipment
Existing equipment between Yen Vien and Viet Tri shall be replaced with new models. It will be necessary to use the old equipment as maintenance components. For this reason, the installation of new equipment should be implemented as soon as possible.

(c) Exchange facilities
Current exchanges are not replaced up to 2000.

(d) Seat reservation system
Since the existing transmission equipment would not be able to cope with on-line terminals throughout the country, seat reservation systems for closed individual stations will be installed at Viet Tri, Yen Bai and Lao Cai stations.
A seat reservation system will improve current manual ticket sailing at stations to a computer system with printing out attractive tickets. The sale of advanced tickets will be expanded to handle more increased seat reservations and terms in advance.

(e) Power source facilities
It will not be possible to use the existing power facilities for the renewed exchanges and transmission facilities.
New rectifiers, batteries and generators will be installed at Viet Tri and Phuc Yen stations. Generators installed will be the type that detects power cut and automatically operates and supplies power.

(f) Auxiliary facilities

As the facilities installed newly require strict temperature and humidity control, air conditionings should also be installed.

(3) Maintenance system

There are 2 kinds of maintenance methods that preventive maintenance and posterior maintenance. Preventive maintenance is preventing the occurrence of breakdowns according to the forecasting and posterior maintenance is repair after breakdown occurred It is recommended to introduce above-mentioned maintenance methods based on the study of reliability.

Training on general electrical and railway communication curriculums should be provided for beginners at the railway training center.

The basic theory of digital differs from that for analog technology. It is necessary to provide training in basic digital technology for all technicians.

The project to install new digital facilities should include a development of training for engineers and technicians, installation of training facilities and preparation of user's manuals in Vietnamese version.

The following facilities are necessary to be installed at the training center:

-Optical fiber telecommunication
-Switching devices
-Auxiliary facilities
-measuring devices

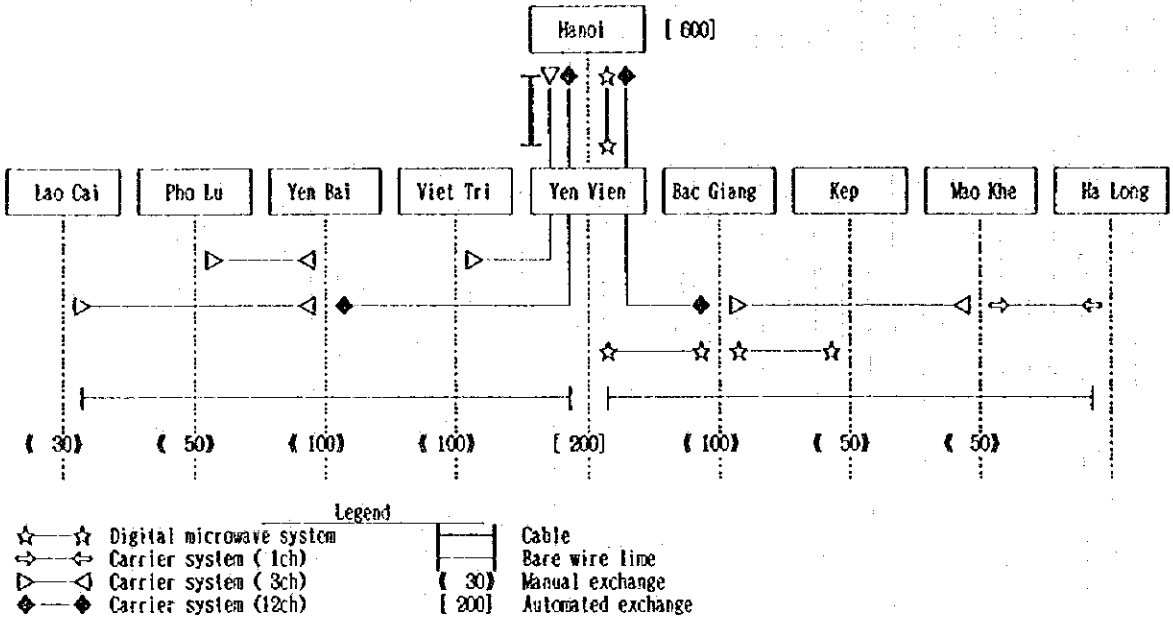


Fig. 9.7.1 Communication Network

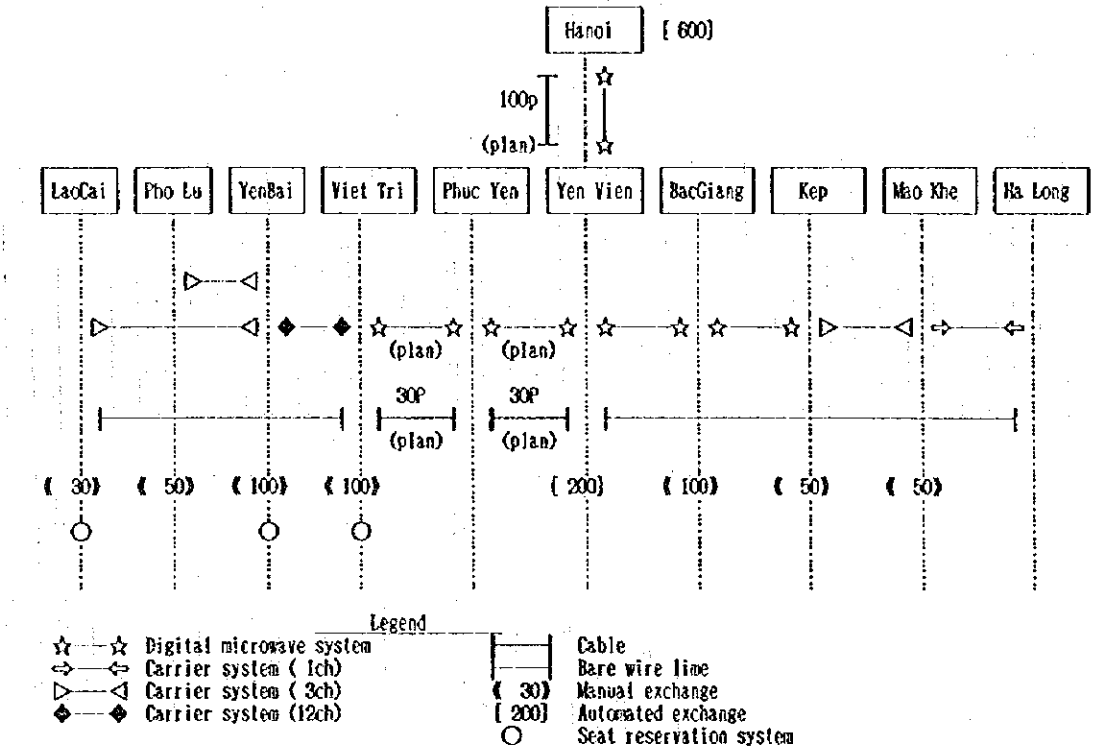


Fig. 9.7.2 Communication Network 2000

9.8 Rolling Stock

9.8.1 General

Almost all of the current conditions, problems and countermeasures of rolling stock for Hanoi - Lao Cai Line are already described in the Clause "8.12 Rolling Stock of Volume 2." However, the specific matters for Hanoi - Lao Cai Line will be repeated.

9.8.2 Collected Data and Information on Current Conditions

Collected data and information are rearranged as follows.

Table 9.8.1	Locomotive (1993)
Table 9.8.2	Number of Locomotives by Situation in Dec. 1993 and Dec. 1994
Table 9.8.3	Number on Book of PC and FC (1000mm) (Dec. 31, 1993)
Table 9.8.4	PC by Manufacturing Year (1000mm)
Table 9.8.5	FC by Manufacturing Year (1000mm)
Table 9.8.6	Classification of PC and FC of Union 1 for Hanoi - Ho Chi Minh Line and Northern Other Lines (1000mm) (Dec. 31, 1993)

9.8.3 Estimation of Existing Number of Rolling Stock in 2000

(1) Locomotive

1) D4H

It is said that D4H will be gradually replaced by larger output power locomotive or condemned by 2010, due to the small output power and the large fuel consumption. It is recommended, however, that D4H should be kept by cannibalization as long as possible for passenger trains and for shunting locomotive.

The remarkable declining tendency of D4H can not be found, but the available number of D4H may gradually decrease by cannibalization. Table 9.8.2 shows the number of locomotives by situation in Dec. 1993 and Dec. 1994. 80% of actually available number 190 of D4H will remain in 2000 under the condition that the condemnation by cannibalizing 20% of the actually available number is optimistically assumed. Namely, 150 D4Hs will remain in 2000.

2) D5H

Number on book of D5H was increased to 13 in 1995 from 3 in 1994, and there are no problems for spare parts. Therefore, 13 D5Hs will be available in 2000. D5H will be used only for passenger train on Hanoi - Lao Cai Line.

(2) Passenger coach (PC) and wagon (FC)

1) PC

(a) Calculation is made, assuming that PCs manufactured before 1970 will be condemned before 2000.

(b) Table 9.8.7 shows the list of PC to calculate existing number in 2000 (1000mm) (Dec. 31, 1993) for Hanoi - Ho Chi Minh Line and for northern other lines resulted from Tables 9.8.3, 9.8.4 and 9.8.6.

(c) Because it is not clear how many condemned PCs before 2000 belong to northern other lines, number of condemned PCs is proportionally allotted for Hanoi - Ho Chi Minh Line use and for northern other lines use as shown in Table 9.8.8.

(d) Table 9.8.9 shows existing PCs in 2000 (1000mm) for northern other lines, which number is 124.

(e) Table 9.8.10 shows line-wise figures of operating PCs, passenger-km and ton-km in northern lines (1993). Number of operating PCs for each line of northern lines, except Hanoi - Ho Chi Minh Line, is given from calculation result of JICA Transportation Planning Team based on the present train operation diagram of each line. Passenger-km and ton-km are one of the collected data.

(f) Excluding Cai Lan Line use and adopting 63.8% of total PCs of northern other lines in Table 9.8.10, existing number of PCs in 2000 for Hanoi - Lao Cai Line is 79.

(g) All 1st sleeping cars, 2nd sleeping cars and 1st coaches for northern other lines are assumed to be used only on Hanoi - Lao Cai Line.

(h) Then, total 2nd and 3rd coaches are 57.

(i) According to Table 9.8.9, 57 of 2nd and 3rd coaches are divided to each 35 of 2nd coaches and 22 of 3rd coaches. Calculation example is $57 \times 63 / (63+39)=35$.

(j) As conclusion, existing PCs for Hanoi - Lao Cai Line in 2000 are as follows.

A_N	B_N	A	B	C	S
5	9	8	35	22	0

2) FC

(a) Calculation is made, assuming that FCs manufactured before 1970 will be condemned before 2000.

(b) Table 9.8.11 shows the list of FC to calculate existing number in 2000 (1000mm) (Dec. 31, 1993) for Hanoi - Ho Chi Minh Line and for northern other lines resulted from Tables 9.8.3, 9.8.5 and 9.8.6.

(c) Because it is not clear how many condemned FCs before 2000 belong to northern other lines, number of condemned FCs is proportionally allotted for Hanoi - Ho Chi Minh Line use and for northern other lines use as shown in Table 9.8.12.

(d) Table 9.8.13 shows existing FCs in 2000 (1000mm) for northern other lines, which number is 1020.

(e) Excluding Cai Lan Line use and adopting 67.1% of total ton-km of northern other lines in Table 9.8.10, existing number of FCs for Hanoi - Lao Cai Line in 2000 is 684.

(f) As conclusion, existing FCs for Hanoi - Lao Cai Line in 2000 are as follows.

G	H	V	M	MVT	P	XT
182	437	0	32	0	7	26

9.8.4 Rolling Stock Plan upto 2000 for Hanoi - Lao Cai Line

(1) Preconditions

1) D4H and D5H are used for both express and local trains, and not used for freight train because of their small output power. D4H for express train is assumed to have the performance of maximum speed of 70km/h.

2) D12E is used for freight train, even though there are surplus D4Hs upto 2000. Surplus D4Hs should be also used for northern other lines than Hanoi - Lao Cai and for shunting locomotives of all VNR.

3) PCs for Hanoi - Ho Chi Minh Line and Hanoi - Lao Cai Line are together examined.

4) Passenger train configuration is assumed as follows.

Express (Middle distance) : $DL+1\times A_N+2\times B_N+2\times A+3\times B+1\times S$

Express (Short distance) : $DL+2\times A+5\times B+1\times S$

Local : $DL+4\times$(B and/or C)$+1\times S$

(2) Rolling stock plan upto 2000 for Hanoi - Lao Cai Line

1) Summarization of existing number of rolling stock in 2000

(a) Locomotive

D4H	D5H
150	13

(b) PC

A_N	B_N	A	B	C	S
5	9	8	35	22	0

(c) FC

G	H	V	M	MVT	P	XT
182	437	0	32	0	7	26

2) Necessary number of rolling stock in 2000 for Hanoi - Lao Cai Line given by JICA Transportation Planning Team is shown in Table 9.8.14.

3) Rolling stock plan upto 2000

(a) Table 9.8.15 is explanatory table on calculation of necessary number of DL and FC for Hanoi - Lao Cai Line.

(b) Table 9.8.16 is explanatory table on calculation of necessary number of PCs for Hanoi - Ho Chi Minh Line and Hanoi - Lao Cai Line.

(c) Based on Table 9.8.14, the summarization of existing number of rolling stock in 2000 as before-mentioned, and the above Tables 9.8.15 and 9.8.16, rolling stock plan upto 2000 for Hanoi - Lao Cai Line is shown in the following table along with the investment cost.

(Million US$)

	Unit Price		Number	Price		Total
	F	D		F	D	
D12E (New)	0.98		16	15.7		15.7
PC (Remodelling)		0.06	14		0.8	0.8
Total				15.7	0.8	16.5

Remarks : Remodelled PCs are explained in Table 9.8.16.

Table 9.8.1 **Locomotive (1993)**

(Revised : Aug.1995)

Loco	Wheel Arrangemen	Total Weight (t)	Axle Weight (t)	Output (CV)	Max. Speed (km/h)	Max. Tractive Effort(kg)	Yen Bai					Hanoi					Vinh					Union 1 Total				
							1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
SL (1000)	131, 141 231	50.05~63	10.5	750~1100	67~79	8000~14000	33	11	0	4	18	58	32	13	18	8						91	43	13	22	26
SL (1435)	141	79.3	13.2	1780	80	19,400						17	7	2	6	4						17	7	2	6	4
D4H	Bo-Bo	24	6	400	50/70	7,200	68	65	36	3	0	55	42	22	13	0	46	31	17	15	0	169	138	75	31	0
D5H	B-B	40.64	10.16	500	65	8,964	3	3	2	0	0											3	3	2	0	0
D11H	Bo-Bo	56	14	1100	100	16,200																				
D8H(1435)	Bo-Bo	78	19.5	900	90	21,000						5	3	3	2	0						5	3	3	2	0
D9E	Bo-Bo	52	13	900	114	15,600																				
D12E	Bo-Bo	56	14	1200	80	14,600						15	15	9	0	0						15	15	9	0	0
D13E	Co-Co	72	12	1350	96	21,600																				
D18E	Co-Co	84	14	1800	105	25,500											16	16	9	0	0	16	16	9	0	0

Loco	Usability 2 / 1	Operativity 3 / 1		Manufact. Country	Year of Manufacture	Age (Dec.1993)	Da Nang					Saigon					Enterprise					Grand Total				
							1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
SL (1000)	0.47	0.14		JPN, FRC, VIETNAM																		91	43	13	22	26
SL (1435)	0.41	0.12		CHINA																		17	7	2	6	4
D4H	0.73	0.36		RUSSIA	1985-1989 1981	4~8 (161) 12 (87)	57	32	14	23	2	4	4	1	0	0	18	7		11	0	248	181	90	65	2
D5H	1.00	0.67		AUSTRALIA	1966-1970	23~27																3	3	2	0	0
D11H	0.20	0.10		RUMANIA	1978	15	9	2	1	7	0	1	0	0	1	0						10	2	1	8	0
D8H(1435)	0.60	0.60		RUSSIA	1986	7																5	3	3	2	0
D9E	0.74	0.49		USA	1963	30						39	29	19	0	10						39	29	19	0	10
D12E	1.00	0.68		CZEKO	1985	8	25	25	18	0	0											40	40	27	0	0
D13E	0.80	0.33		INDIA	1985	8						15	12	5	2	1						15	12	5	2	1
D18E	1.00	0.56		BELGIE	1983	10																16	16	9	0	0

REMARKS : 1 on Book, 2 Usable, 3 Normal Use, 4 Waiting Repair, 5 Waiting Condemnation

Table 9.8.2 Number of Locomotives by Situation in Dec. 1993 and Dec. 1994

Locomotive	Depot	Yen Bai				Hanoi				Vinh				Da Nang				Saigon				Enterprise				Total			
	Year	1	2	4	5	1	2	4	5	1	2	4	5	1	2	4	5	1	2	4	5	1	2	4	5	1	2	4	5
SL (1.000)	1993	33	11	4	18	58	32	18	8																	91	43	22	26
	1994	10	10	0	0	43	16	3	24																	53	26	3	24
SL (1.435)	1993					17	7	6	4																	17	7	6	4
	1994					13	7	3	3																	13	7	3	3
D4H	1993	68	65	3	0	55	42	13	0	46	31	15	0	57	32	23	2	4	4	0	0	18	7	11	0	248	181	65	2
	1994	80	78	0	2	54	44	0	10	31	31	0	0	57	33	0	24	4	4	0	0	-	-	-	-	226	190	0	36
D5H	1993	3	3	0	0																					3	3	0	0
	1994	3	3	0	0																					3	3	0	0
D11H	1993													9	2	7	0	1	0	1	0					10	2	8	0
	1994													9	2	7	0	1	0	1	0					10	2	8	0
D8H (1.435)	1993					5	3	2	0																	5	3	2	0
	1994					5	3	2	0																	5	3	2	0
D9E	1993																	39	29	0	10					39	29	0	10
	1994																	39	28	1	10					39	28	1	10
D12E	1993					15	15	0	0					25	25	0	0									40	40	0	0
	1994					15	15	0	0					25	25	0	0									40	40	0	0
D13E	1993																	15	12	2	1					15	12	2	1
	1994																	15	12	2	1					15	12	2	1
D18E	1993									16	16	0	0													16	16	0	0
	1994									16	16	0	0													16	16	0	0

1. On Book 2. Usable 4. Waiting Repair 5. Waiting Condemnation

Table 9.8.3 No. on Book of PC and FC(1000mm) Dec. 31, 93)

Revised : Aug. 1995

	TOTAL	UNION 1						UNION 2						UNION 3						Total	Assumption	
	Dec.31. 92	R	P	TOTAL	D	I	Dec.93	R	P	TOTAL	D	I	Dec.93	R	P	TOTAL	D	I	Dec.93	Dec.31. 93	R	P
PC (1000) TOTAL	748	242	205	447	58	17	406	52	64	116	3	12	125	179	42	221	22	23	222	753	504	249
Sleeping (1st)	48	23		23	2	1	22	4		4			4	21		21			21	47	47	0
Sleeping (2nd)	66	34		34		5	39	2	1	3			3	29		29		3	32	74	73	1
Coach (1st)	68	33		33		8	41	6		6			6	29		29		11	40	87	87	0
Coach (2nd)	287	109	64	173	24		149	29	2	31	1	5	35	69	14	83	16		67	251	210	41
Coach (3rd)	251	11	138	149	26		123	9	58	67	1	1	67	6	29	35	1		34	224	27	197
Dining	25	13		13	2	2	13	2		2	1	6	7	10		10	4	2	8	28	28	0
Baggage	12	3		3	2	1	2	2	1	3			3	3	3	6		7	13	18	14	4
Post	27	11	8	19	2		17							8		8	1		7	24	18	6
Wagon (1000) TOTAL	4,466	1546	1617	3163	238	2	2927	297	409	706	13	1	694	322	275	597	18		579	4,200	2168	2032
Covered	1,505	517	260	777	9		768	220	142	362	3		359	228	138	366	5		361	1,488	965	523
Open (High Side)	1,680	869	585	1475	147		1307	47	77	124	2		122	57	45	102	5		97	1,526	973	553
Open (Low Side)	388	47	249	296	6		290	13	57	70	3		67	2	21	23			23	380	62	318
Open (Flat)	526	67	275	342	64		278	14	117	131	1		130	7	46	53	4		49	457	88	369
Open (High Capacity)	27		25	25	1		24								2	2			2	26	0	26
Tank	213	30	144	174	5		169	3	7	10			10	17	12	29	2		27	206	50	156
Conductor	126	16	79	95	6	2	91		9	9	4	1	6	11	11	22	2		20	117	30	87

[Remarks]

R : Roller Bearing
P : Plane Bearing
D : Decrease (Condemnation or to Another Union)
I : Increase (from Another Union or New Manufacturing)
Assumption : Number of cars of R and P is assumed in decrease of P and increase of R.

Table 9. 8. 4 PC by Manufacturing Year (1000㎜) (Dec.31, 1993) (Revised : Aug.1995)

Kind / Year / Mfg. Country	R	P	R	P	R										Total	
	Before1970		1971		1978	1979	1980	1984	1986	1987	1988	1991	1992	1993 1994		
A_N (First class sleeping car)																
TQ (China)																
Ru (Rumania)					11										11	
AN (India)																
VN (VietNam)									10		2	7	4	4	27	
FAP(France)	9														9	
S. Total	9				11				10		2	7	4	4	47	47R+0P
B_N (Second class sleeping car)																
TQ																
Ru					31		4								35	
AN																
VN					3	3	3	2		7	13	5			36	
FAP	2	1													3	
S. Total	2	1			34	3	7	2		7	13	5			74	73R+1P
A (First class coach)																
TQ																
Ru						54									54	
AN							21								21	
VN											12				12	
FAP																
S. Total						54	21				12				87	87R+0P
B (Second class coach)																
TQ			60	31											91	
Ru					52										52	
AN							25								25	
VN		3		7	18						30				58	
FAP	25														25	
S. Total	25	3	60	38	70		25				30				251	210R+41P
C (Third class Coach)																
TQ			6	90											96	
Ru																
AN															65	
VN	15	50														
FAP	6	57													63	
S. Total	21	107	6	90											224	27R+197P
HC (Dining car)																
TQ																
Ru						8									8	
AN							4								4	
VN										10				1	11	
FAP	2					3									5	
S. Total	2					11	4			10				1	28	28R+0P
HL (Baggage car)																
TQ			5												5	
VN				4					9						13	
S. Total			5	4					9						18	14R+4P
BV (Mail car)																
VN		6			18										24	
S. Total		6			18										24	18R+6P
Total	59	117	71	132	133	68	57	2	19	17	57	12	4	5	763	504R+249P

Table 9.8.5 FC by Manufacturing Year (1000㎜) (Dec.31,1993)
(Revised : Aug.1995)

Kind \ Year	R	P	P	P	P	R											
Kind	Before 1970		1971	1972 ~74	1975	1978	1979	1980	1984	1986	1987	1988	1991	1992	1993		
G Covered	190	100		300	123	175	210	300				15		75		1488	965R+523
H Open (High Sid)	107	100	103	250	100	235	100	380	151							1626	973R+653
V Open (Low Side)	62	318														380	62R+318P
M Open (Flat)	88	254			115											457	88R+369P
MVT Open (Hi-Capacity		26														26	0R+26P
P Tank	35	141		15					15							206	50R+156P
XT Conductor		20	10	42				3		21	6	15 (Plain Bearing)				117	30R+87P
TOTAL	482	959	113	607	338	410	310	683	166	21	6	30		75		4200	2168R +2032P

[Remarks] (1) Manufacturing countries
Most of all : China, Rumania, India
Few : Viet Nam, USA, France, Japan, Belgium, Russia

(2) R : Roller bearing
P : Plain bearing

Table 9. 8. 6 Classification of PC and FC of Union 1

for Hanoi-Ho Chi Minh Line and Northern Other Lines (1000mm)

(Dec. 31, 1993)

	Grand Total	Total		HN-HCM Line		Northern Other Lines		Remarks	
		R	P	R	P	R	P		
PC(1000) Sub. Total	406	248	158	180	40	68	118		
AN :1st Sleeping	22	22		16		6			
BN: 2nd Sleeping	39	39		30		9			
A : 1st Coach	41	41		33		8			
B : 2nd Coach	149	108	41	69	10	39	31		
C: 3rd Coach	123	11	112	5	30	6	82		
HC: Dining	13	13		13					
HL: Baggage	2	2		2					
BV : Post	17	11	6	11			6		
FC(1000) Sub. Total	2927	1548	1379	840	415	708	964		
G : Covered	768	517	251	330	100	187	151		
H : High Side	1307	869	438	430	120	439	318		
N : Low Side	290	47	243	15	80	32	163		
M : Flat	278	67	211	17	60	50	151		
MVT: Open High Capasity	24		24		5		19		
P: Tank	169	30	139	30	27		112		
XT: Conductor	91	18	73	18	23		50		

R: Roller Bearing

P: Plane Bearing

Table9.8.7 List of PC to Calculate Existing Number in 2000 (1000mm) (Dec. 31, 1993)

	Union 1						Union 2 and Union 3		Total		Condemnation before 2000		
	HN-HCM Line		Northen Other Lines		Subtotal								
	R	P	R	P	R	P	R	P	R	P	R	P	Total
An : 1st Sleeping	16	0	6	0	22	0	25	0	47	0	9	0	9
Bn : 2nd Sleeping	30	0	9	0	39	0	34	1	73	1	2	1	3
A : 1st Coach	33	0	8	0	41	0	46	0	87	0	0	0	0
B : 2nd Coach	69	10	39	31	108	41	102	0	210	41	25	3	28
C : 3rd Coach	5	30	6	82	11	112	15	86	26	198	21	107	128
HC : Dining	13	0	0	0	13	0	15	0	28	0	2	0	2
HL : Baggage	2	0	0	0	2	0	12	4	14	4	0	0	0
BV: Post	11	0	0	6	11	6	7	0	18	6	0	6	6

R : Roller bearing

P : Plane bearing

Table 9.8.8 Number of PCs to be Condemned in or before 2000 (1000mm)

	HN-HCM Line	Northern Other Lines	Remarks
AN	9× (16+25) /47 ··· · 8	9×6/47 · · · · · 1	Roller
BN	2× (30+34) /73 ···· 2	2×9/73 · · · · · 0	Roller
	1	0	Plane
A	0	0	R and P
B	25× (69+102) /210··· 20	25×39/210 · · · 5	Roller
	3×10/41 · · · · · 1	3×31/41 · · · · 2	Plane
C	21×(5+15) /26 · · · · 16	21× 6/26 · · · 5	Roller
	107× (30+86) /198 · · 63	107×82/198 · · · 44	Plane
HC	2	0	Roller
HL	0	0	R and P
BV	0	6	Plane

Table 9.8.9 Existing PCs in 2000 (1000mm)

	HN-HCM Line			Northern Other Lines			Grand Total
	R	P	Total	R	P	Total	
AN	33	0	33	5	0	5	38
BN	62	0	62	9	0	9	71
A	79	0	79	8	0	8	87
B	151	9	160	34	29	63	223
C	4	53	57	1	38	39	96
HC	26	0	26	0	0	0	26
HL	14	4	18	0	0	0	18
BV	18	0	18	0	0	0	18
Total	387	66	453	57	67	124	577

Table 9. 8. 10 Line-wise Number of Operating PCs, Passenger-km and Ton-km in Northern Lines (1993)

	PC								FC							
	Include Cai Lan				Exclude Cai Lan				Include Cai Lan				Exclude Cai Lan			
	No.	%	pkm $\times 10^6$	%	No.	%	pkm $\times 10^6$	%	No.	%	tkm $\times 10^6$	%	No.	%	tkm $\times 10^6$	%
Lao Cai	74	592	230	602	74	638	230	605			167	601			167	671
Hai Phong	19	152	83	217	19	164	83	219			43	155			43	173
Dong Dang	16	128	59	155	16	138	59	155			34	122			34	136
Quan Trieu	7	5.6	8	2.1	7	6.0	8	2.1			5	1.8			5	2.0
Cai Lan	9	7.2	2	0.5	—	—	—	—			29	104			—	—
Total	125	100	382	100	116	100	380	100			278	100			249	100

Source

Number of Operating PCs : Calculation of JICA Transportation Planning Team

Passenger-km, Ton-km : Trading Dept., Union 1, VNR

Table 9.8.11 List of FC to Calculate Existing Number in 2000(1000mm) (Dec. 31, 1993)

	Union 1						Union 2 and Union 3		Total		Condemnation before 2000		
	HN-HCM Line		Northern Other Lines		Sub total								
	R	P	R	P	R	P	R	P	R	P	R	P	Total
G : Covered	330	100	187	151	517	251	448	272	965	523	190	100	290
H: High Side	430	120	439	318	869	438	104	115	973	553	107	100	207
V: Low Side	15	80	32	163	47	243	15	75	62	318	62	318	380
M: Flat	17	60	50	151	67	211	21	158	88	369	88	254	342
MVT: High Capacity	0	5	0	19	0	24	0	2	0	26	0	26	26
P: Tank	30	27	0	112	30	139	20	17	50	156	35	141	176
XT: Conductor	18	23	0	50	18	73	12	14	30	87	0	20	20

R : Roller bearing

P : Plane bearing

Table 9.8.12 Number of FCs to be Condemned in or before 2000

	HN-HCM Line	Northern Other Lines	Remarks
G	190×(330+448)/965·····153	190×187/965·····37	Roller
	100×(100+272)/523·····71	100×151/523·····29	Plane
H	107×(430+104)/973·····59	107×439/973·····48	Roller
	100×(120+115)/553·····42	100×318/553·····58	Plane
V	30	32	Roller
	155	163	Plane
M	38	50	Roller
	254×(60+158)/369·····150	254×151/369·····104	Plane
MUT	0	0	Roller
	7	19	Plane
P	35×(30+20)/50·····35	35×0/50·····0	Roller
	141×(27+17)/156·····40	141×112/156·····101	Plane
XT	0	0	Roller
	20×(23+14)/87·····9	20×50/87·····11	Plane

Table 9.8.13 Existing FCs in 2000 (1000mm)

	HN - HCM Line			Northern Other Lines			Grand Total
	R	P	Total	R	P	Total	
G	625	301	926	150	122	272	1198
H	475	193	668	391	260	651	1319
V	0	0	0	0	0	0	0
M	0	68	68	0	47	47	115
MVT	0	0	0	0	0	0	0
P	15	4	19	0	11	11	30
XT	30	28	58	0	39	39	97
Total	1145	594	1739	541	479	1020	2759

Table 9.8.14 Necessary Number of Rolling Stock in 2000 for Hanoi - Lao Cai Line

		No. of trains	DL		PC						FC		Remarks
			D4H D5H	D12E	A_N	B_N	A	B	C	S	H	Others	
PT	Express (Middledistance)	3	20 4*		3	6	6	9	—	3			
	Express (Short distance)	1			—	—	2	5	—	1			
	Local	7			—	—			28	7			
	Reserved cars	—			1	2	2	4	8	3			
	Subtotal		24		4	8	10	18	36	14			
FT	Apatite			13 3*							98		Including reserved cars
	Others											342	Including reserved cars
	Subtotal			16							98	342	

Remarks PT : Passenger train

FT : Freight train

* : Reserved locomotives

Table 9.8.15 Explanatory Table on Calculation of Necessary Number of DL and FC for Hanoi - Lao Cai Line

	DL		FC		Remarks
	D4H D5H	D12E	H	Others	
Necessary number	24	16	98	342	Table 9.8.14
Existing number	163	0	437	247	Clause 9.8.3- (1)and(2)
Surplus or shortage (Δ)	139	Δ 16	339	Δ95	
Substitute			All to Others		Surplus 220 FCs are to be transferred to Hanoi-Cai Lan Line (1000mm)
Remodelling					
New Manufacturing	0	16	0	0	

Table 9.8.16 Explanatory Table on Calculation of Necessary PCs for Hanoi - Ho Chi Minh Line and Hanoi-Lao Cai Line

Item	Line		AN	BN	A	B	C	S	Total
Necessary number	HN-HCMC	LE	20	60	40	40	-	20	180
		Others	10	28	29	108	70	49	294
	HN-LC		4	8	10	18	36	14	90
	Total		34	96	79	166	106	83	564
Existing number	HN-HCMC		33	62	79	160	57	62	453
	HN-LC		5	9	8	35	22	0	79
	Total		38	71	87	195	79	62	532
Surplus or Shortage	HN-HCMC		3	△26	10	12	△13	△7	△21
	HN-LC		1	1	△2	17	△14	△14	△11
New manufacture	HN-HCMC		20(AC*)	12(AC*)					32
	HN-LC								0
Surplus or shortage	HN-HCMC		23	△14	10	12	△13	△7	11
	HN-LC		1	1	△2	17	△14	△14	△11
Transfer	HN-HCMC		△13	14	△2	3		△13	△11
	HN-LC		13	△14	2	△3		13	11
Surplus or shortage	HN-HCMC		10	0	8	15	△13	△20	0
	HN-LC		14	△13	0	14	△14	△1	0
Remodelling	HN-HCMC		10 to S		8 to S	2 to S			20
	HN-LC		13 toBN 1 to S						14
Surplus or shortage	HN-HCMC		0	0	0	13	△13	0	0
	HN-LC		0	0	0	14	△14	0	0

Final Number of PCs

			AN	BN	A	B	C	S	Total
HN-HCMC	LE	AC*	20	12					32
			0	48	40	40		20	148
	Others		10	28	29	121	57	49	294
HN-LC			4	8	10	32	22	14	90
Total			34	96	79	193	79	83	564

Remarks (1) AC* : Air-conditioned PCs
(2) LE : Limited Express
(3) Other than the above table, 50 air-conditioned PCs for new high speed train are newly manufactured.

9.9 Rolling Stock Maintenance

9.9.1 Current conditions and Problems

(1) Almost all of the current conditions and problems on the rolling stock maintenance are already described in "8.13 Rolling Stock Maintenance of Volume 2". However, the important points for Lao Cai - Cai Lan Line will be repeated.

(2) Current conditions and problems

1) Washing and cleaning work is not sufficient
2) Flaw detecting work is not sufficient
3) No consideration is given to dust proofing and moisture proofing
4) Maintenance takes too many days
5) Maintenance man hours are too long
6) Inventory control system for exchange spare parts is insufficient
7) Post-maintenance performance testing is insufficient
8) Maintenance machinery and equipment is insufficient
9) Maintenance buildings are deteriorated
10) Some shops require transfer of maintenance site
11) Work site environments are poor
12) Necessary documents for rolling stock management are insufficient

9.9.2 Recommendations

The following recommendations are to be realized upto 2010. However, it is recommended that the items realizable without any investments should be immediately improved in order to level up the quality of maintenance.

(1) Maintenance work mechanization and labor saving

Most of the works including washing, cleaning, processing and flaw detecting etc. are carried out manually and visually and many works are ineffective despite the large amounts of labor put into them. By mechanizing these works, it would be possible to improve finishing precision levels and also save on man-power.

1) Washing and cleaning work

Depending on the sort of item to be washed and cleaned, good results can be obtained by selecting the optimum methods or combinations of such methods.

(a) Jet washing : The jet spraying of chemicals or hot water.

(b) Rock washing : The shaking objects around inside chemical or hot water tanks.

(c) Kerosene washing : The spraying kerosene or dipping items into kerosene.

(d) Ultrasonic cleaning : Using ultrasonic liquid in chemicals.

(e) Soda bath : The dipping of items into chemical tanks.

(f) Soft blast cleaning : The jet spraying of polishing material.

(g) Air blow cleaning : The jet blowing of compressed air.

(h) Flushing : Washing engine interiors with flushing oil.

(I) Other methods

2) Flaw detecting work

Depending on the item under examination, the optimum methods of flaw detecting should be selected.

(a) Ultrasonic flaw detection

The use of ultrasonic waves makes the detection of flaws on axle and shaft interiors possible. The judgment work requires high level technology (axles, rotating shafts, etc.).

(b) Magnet particle flaw detection

This is the detection of surface flaws through the use of magnetism, magnet particles and fluorescent lamps (axle, crank shaft, connecting rod, gear, bogie frame and other iron material).

(c) Fluorescent penetrant flaw detection

This is the detection of surface flaws through the use of liquid penetrant, liquid developer and fluorescent lamps.

(d) X-ray flaw detection

This is the detection of flaws on internal parts of iron material through the use of X-rays.

(e) Color check

This is the detection of surface flaws on engine body, casting frame, pistons and large equipment, etc. through the use of washing liquid, liquid penetrant and liquid developer.

3) Engine repair work

This is the repair work on engine and in particular the fitting of valves and valve seats.

4) Electric rotating machine repair work

This is the repair and insulation work of electric rotating machine rotor and stator.

5) Performance testing

This is the performance testing of engine and traction motors after maintenance.

6) Bearing replacement work

This is the disassembling, cleaning and assembling of bearing.

7) Car body repair work

This is the cutting, processing and welding of car body frame and external plate.

8) Parts production work

This is the domestic production of air brake valve, brake shoe, coil and leaf spring, etc.

9) Painting work

This is the painting of car body equipment and parts.

10) Other works

Other works include the transfer of rolling stock equipment, etc.

(2) Replacement of deteriorated facilities

1) Replacement of facilities

Deteriorated articles should be replaced with high performance items in order to improve the precision and efficiency of maintenance work.

(a) Wheel-axle repair facility

(b) Lathe turning machine

(c) Drilling or boring machine

(d) Milling machine

(e) Planing or shaping machine

(f) Sawing or cutting machine

(g) Shearing machine

(h) Others

2) Rebuilding of maintenance buildings

Buildings that are badly deteriorated with much damage and rain-leaks should be rebuilt in order to improve the safety of the work and raise the work efficiency level.

Moreover, it is desirable that some shops be relocated due to deterioration in the working environment caused by geographical and topographical changes.

When rebuilding or relocating shops, they should be made into modern, safe and pleasant work areas installed with electric overhead traveling cranes (EOTC).

(3) Improvement of working environments

The improvements of work environments will make possible the carrying out high quality and reliable maintenance in a safe and pleasant working area.

1) Installation of dust proofing and moisture proofing equipment

Working areas for repair on engines and bearings, etc., which must be kept away from dust and rust, have to be partitioned off as separate rooms in order to prevent dust and moisture entering from other work areas.

Moreover, for axle journals, it is desirable that rustproof grease and other oils be coated and that protectors be attached in order to prevent scratching.

2) Improvement at working area environment

As well as removing oil, dust and other sediment from working floors, waste water, waste oil and sediment shall be removed from pits. Work corridors shall be kept permanently open and house cleaning shall be performed in order to keep clean and safe working environments.

Moreover, natural and artificial lighting shall be improved and working lamps shall be used in order to make the working area brighter places.

(4) Rationalization of maintenance work

The maintenance work shall be rationalized in order to reduce the maintenance days and man hours.

1) Examination of maintenance periods, etc.

Rolling stock maintenance periods, maintenance methods and procedures, etc. shall be examined and revised to match the actual conditions. (In order to achieve this, long-term data on rolling stock maintenance results and breakdowns, etc. need to be accumulated).

2) Utilization of circulating spare parts

Circulating spare parts shall be effectively utilized as a means of reducing maintenance days. (Further description of circulating spare parts is given in a separate section).

3) Provision of instruments and tools

By using electric or compressed air instruments in the disassembly, processing and assembly work, faster and more reliable work can be performed and more precise maintenance work can be achieved. This will enable maintenance man hours to be reduced.

4) Concentration of maintenance work of main DEL equipment

By concentrating the overhaul work on main equipment of DEL such as engine, main generator and traction motor, etc. in the Gia Lam Workshop, it will be possible to supply equipment which has completed performance testing, to each of the depots and thus contribute to rationalization of the overall management of VNR.

5) Concentrated manufacture of castings and springs, etc.

By concentrating the manufacture of casting (air brake valve, brake shoe, etc.) and spring (coil spring and leaf spring) in one or two workshops (for example, Gia Lam and Dian workshops) and distributing them to the using sites, it will be possible to obtain high quality and uniform products and thus contribute to rationalization of the overall management of VNR.

(5) Promotion of reliable maintenance

By checking the function of individual equipment when conducting DL overhaul through engine performance testing and a traction motor running test, etc., it will be possible to guarantee quality. By fitting such performance checked equipment to locomotives, wasted work caused by the failure of such equipment can be eliminated and rational maintenance can be made possible. Moreover, by carrying out performance testing on locomotives after they have been fitted with the checked equipment, it will be possible verify overall locomotive performance and ensure reliability.

(6) Inventory control system for spare parts

Parts that require replacement in rolling stock maintenance should be systematically procured in advance and stored as spare parts. Moreover, replaced parts should immediately be repaired and restored to their complete states for use at any time as spare parts and kept on permanent store to act as circulating spare parts.

It is therefore necessary to decide the part name and quantity of parts to be kept in permanent store as circulating spare parts and to maintain full control of the maintenance process in order to ensure that parts neither run out nor are idle due to excess storage.

By carrying out such control properly, it will be possible to shorten the maintenance processes, reduce maintenance man hours and improve quality levels.

(7) Domestic production of rolling stock parts and equipment

The biggest bottleneck in rolling stock maintenance is caused by the procurement of parts from overseas. Many problems exist in terms of currency framework, cost and procurement period, etc. However, as the domestic technical level is high, efforts should be made to domestically produce the rolling stock parts and equipment that are currently imported. Even though materials may not be suitable or the useful life may be short in the initial stage, the experience accumulated through research and testing will eventually allow parts that are just as good as imported items to be domestically produced.

(8) Maintenance system and others

Regarding the preparation of documents on the maintenance system, maintenance standards and limits, and rolling stock management, the following recommendations are made.

1) Concerning the maintenance organization and system

VNR is divided into Union 1 (north), Union 2 (central) and Union 3 (south) and each union manages the depots, while the workshops are under the direct control of the head office. Seen in terms of rolling stock maintenance, this is considered to be an appropriate form of management organization. (Management of rolling stock maintenance in the case of JNR, too, is a similar system).

(a) Charge of Gia Lam Workshop

a. Overhaul of the Union 1 DL (excluding standard gauge DL)
b. Overhaul of DL and PC of all VNR high speed trains
c. Concentrated overhaul of main DL equipment (engine, main generator, traction motor, etc.) of all VNR.
d. A portion of PC and FC overhauls
e. A portion of PC and FC manufacture and remodeling

(b) Charge of Haiphon Workshop and Dian Workshop

a. A portion of PC and FC overhauls
b. A portion of PC and FC manufacture and remodeling

(c) Charge of the Depots

Except for the overhaul of the DL, PC and FC belonging to each union, the depots are responsible for all other maintenance work. (Overhaul is possible at some of the big depots, for example, Thuan Hai Shop, etc.).

2) Maintenance standards and limits

Manuals, which form the basis for maintenance, are followed, however, repair standards and limits, etc. should be clarified and thoroughly put into effect in order to improve quality.

(a) Repair work standards

Technical specific items and prohibited items such as finishing tolerances, sectional adjustment allowances and numerical limits, etc. should be established for the purpose of rolling stock repair.

(b) Repair limit standards

These are limit levels relating to such conditions as shape, dimension, hardness, insulation resistance and fitting clearance, etc., which must be conformed with upon the completion of repair work.

(c) Service limits

These are limit levels set for abrasion and deterioration growing from the start of use of parts after their fitting to rolling stock, and the use of parts is prohibited in cases where these levels have been reached.

3) Preparation and utilization of materials required for rolling stock management

As well as preparing materials giving all VNR's, statistical data on running kms, car failures and accidents, and maintenance results to act as the basic materials for rolling stock management, it is important to feed back such data into actual rolling stock management and make full use of it. Statistics should be prepared each year in an easy to understand manner by rolling stock kind; maintenance kind, maintenance place and causes of failure or accident.

(a) Cause-wise totaling of car failures and operating accidents

(b) Maintenance records by maintenance place and rolling stock kind

(c) Control of rolling stock histories

Histories relating to rolling stock operation (name of depot in change and running kms etc.) and maintenance (main part repair and replacement, etc.) after manufacturing should be kept for each rolling stock and utilized in future maintenance work.

(9) Lubricating oil control

Regarding the lubricating oil used for diesel engine, oil sample is taken from each engine depending on running km and oil quality check is made to determine oil exchange time. Oil exchange is also carried out every decided running km.

Needless to say, lubricating oil affects diesel engine function and even influences engine life, and thus the control of lubricating oil has a great effect on the locomotive operation and maintenance. It is therefore desirable that lubricating oil control be carried out in a more rational and practical manner.

(10) Bearing maintenance

Regarding the maintenance of bearing, the aforementioned establishment of separate room and consideration of dust proofing and moisture proofing measures are important. In addition, attention needs to be paid to the following points.

1) Bearing box cover must not be opened or removed for daily maintenance check purpose. This can lead to the unwanted entry of dust and so forth.

2) Only open bearing box cover when there is an obvious defect such as overheat or abnormal noise, etc.

3) When washing, assembling or greasing bearing, always take care not to allow the entry or attachment of dust.

4) As for larger bearing than medium size never detach inner-race from axle or outer-race from case.

5) Applying pressure or heat when detaching bearing not only reduces fitting allowances, but also may causes inner race deformation or non-conformity of usable bearing. Inner races must, therefore, never be detached, except in case of bearing replacement.

6) As the small bearings used in supercharger, blower and charging generator lack good durability for given load and rotating speed, it is desirable that they are all replaced at each regular maintenance.

(11) Training and education

The education and training system for rolling stock maintenance is provided for the engineers and workers of VNR. Rolling stock technology is constantly evolving and new techniques in such areas as mechanical and electrical engineering and even electronics are always being introduced.

It is desirable that the training and education system be fully utilized so that personnel may learn new technologies and skills, and may keep the rolling stock in best condition.

(12) Maintenance of facilities used in rolling stock maintenance

The long-term use of maintenance facilities naturally results in falling precision and performance levels. Such facilities must therefore be continually maintained and kept in normal working order.

The lowering of precision and performance levels and failures of maintenance facilities have serious consequences for rolling stock maintenance processes and quality. Therefore all necessary measures must be taken to ensure maintenance facilities in good condition on a daily basis through the establishment of maintenance systems for maintenance facilities and through the training and education of specialists for that.

(13) Effluent treatment plants

The effluent from all workshops and depots is currently discharged in an untreated manner. As this can be expected to lead to environmental problems, the installation of effluent treatment plants for the oil separation and PH treatment, etc. of effluent is necessary.

9.9.3 Improvement Plan

The improvement plan is divided into the First Stage (1996 to 2000), the Second Stage (2001 to 2005) and the Third Stage (2006 to 2010). The phased improvement plan on all VNR's rolling stock maintenance work is indicated in Table 9.9.1. It can thus be seen that, except for the plan for improvement of Gia Lam Workshop, no other improvements are planned in the First Stage. The improvement work planned for the later stages in this area are as follows:

- Improvement of Hai Phong Workshop in the Second Stage
- Improvement of Yen Bai DL Depot in the Second Stage
- Improvement of Yen Vien DL Shop in the Second Stage
- Improvement of Yen Vien FC Depot in the Third Stage

The installation of effluent treatment plants at each site will be carried out in the Third Stage.

Table 9.9.1 Phased Improvement Items

★ First Stage (1996 to 2000)

1. Gia Lam Workshop

(1) Workshop improvement for DEL maintenance

1) Working area improvements and new provisions

* Partitioning of work areas, roofing, floor paving and painting, etc.

* Introduction of engine performance testing room and painting shop, etc.

2) Improvement of maintenance installation and other facilities

* Pits, rails, work scaffolding, roads, etc.

3) Introduction of maintenance facilities

* Engine maintenance facilities
(Washing, repairing, painting and testing equipment, etc.)

* Electrical instrument maintenance facilities
(Washing, repairing, insulation and testing equipment, etc.)

* Car body maintenance facilities
(Washing, repairing and painting equipment, etc.)

4) Improvement of maintenance tools and instruments, etc.

(2) Introduction of PC maintenance equipment and others

1) Introduction of maintenance equipment for air conditioning equipment of new high speed trains

2) Partial improvement of PC maintenance work areas

* Partitioning, paving and painting, etc. of work areas

3) Introduction of sewage treatment facilities for PC of new high speed trains

(3) Provision of spare parts for DEL maintenance (1)

* Provision of engine assembly, generator assembly, motor assembly, etc. and their parts with the aim of reducing DEL maintenance days

2. Station yards in Hanoi, Vinh, Da Nang, Nha Trang and Saigon

(1) Installation of sewage treatment facilities for PC of new high speed trains

(Note) EOTC = electric overhead traveling crane

★ Second Stage (2001 to 2005)

1. Gia Lam Workshop

(1) Provision of spare parts for DEL maintenance (2)

2. Dian Workshop

(1) Improvement of maintenance mechanical facilities
(Washing, repairing and painting equipment, etc.)

(2) Improvement of maintenance tools and instruments, etc.

3. Hai Phong Workshop

Same items as for Dian Workshop

4. DL maintenance depots (Hanoi, Vinh, Yen Bai, Yen Vien, Da Nang and Saigon)

(1) Improvement of DEL maintenance facilities
(Washing, repairing, painting and general performance testing equipment, etc.)

(2) Improvement of maintenance tools and instruments, etc.

★ Third Stage (2006 to 2010)

1. Gia Lam Workshop

(1) Provision of spare parts for DEL maintenance (3)

2. PC and FC maintenance depots (Hanoi, Yen Vien, Vinh, Da Nang, Saigon, Thuan Hai, Song Than)

(1) Rebuilding of main maintenance buildings
(Hanoi and Da Nang)

Rebuilding to allow higher heights for the installation of EOTC

(2) Installation of EOTC (2 sites)

(3) Improvement of maintenance facilities
(Washing, repairing and painting equipment, etc.)

(4) Improvement of maintenance tools and instruments, etc.

3. Installation of effluent treatment plants in all maintenance workshops and depots

9.10 Natural Conditions

Ha Noi - Lao Cai line is located in plains, low mountains, and hills and high mountains. In the section from Ha Noi to Viet Tri, the formation is mostly banking, the average height was 2.0 m to 4.0 m. In the section from Viet Tri to Co Phuc, the formation is banking(1/2) and cutting(1/2), the height of cutting slope was less than 4.0 m. In the section from Co Phuc to Lao Cai, the formation is in high mountains, steep hills and bushy trees along the left bank of Red river. In generally there are partitions by many river and stream branches.

The line had suffered various natural disasters; slope failure, cutting slope failures, erosions (banks), collapse and settlement of banks, and bear land slope.

The current serious problems of natural disaster in this sections are shown as follows:

- Collapse and settlement of banks;	252km+500 - 253km+500
	270km+700 - 271km+300
	273km+650 - 274km+000
- Erosion (banks);	153km+100 - 153km+200
	230km+750 - 231km+250
	243km+600 - 243km+800
	246km+400 - 246km+600
	252km+500 - 253km+500
	254km+850 - 255km+100
	268km+700 - 268km+800
	285km+400 - 286km+100
	290km+150 - 291km+020
- Slope failure;	270km+700 - 271km+300
- Cutting slope failure;	241km+450 - 243km+000
	245km+000 - 245km+500
	252km+500 - 253km+500
	258km+100 - 258km+410
	268km+180 - 269km+150
	285km+400 - 286km+100
	290km+150 - 291km+020
	295km+000 - 295km+100

- Seismography

Map of seismic intensity distribution is shown in. However, there is no earthquake recorded in Viet Nam, during last fifty years.

9.10.1 Current Problems of Natural Disasters and Recommended Priorities of Countermeasure

Ha Noi - Lao Cai line is separated following two sections on study of natural disaster.

- Ha Noi - Yen Bai (155.35km, Union I); 0km+000 - 155km+350
- Yen Bai - Lao Cai (238.23km, Union I); 155km+350 - 293km+586

There are no submergence problems of the tracks, but freeboard of bridge shall be studied separately when superstructure of bridges will be planned replacement.

1) Ha Noi - Yen Bai (155.35km, Union I); 0km+000 - 155km+350

The line of this section had suffered few natural disasters; collapse and settlement of banks, erosion of banks and cutting slope failure. There are no serious problems on natural disaster.

The current problems of natural disaster in this sections are as follows:

Collapse and settlement of banks

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
137km+200 - 137km+350			*	

Erosion (banks)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
153km+100 - 153km+200	*			

Cutting slope failure

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
85km+100 - 85km+300				*
86km+700 - 86km+900				*
87km+500 - 87km+800				*

2) Yen Bai - Lao Cai (238.23km, Union I); 155km+350 - 293km+586

The line of this section had suffered various natural disaster; collapse and settlement of banks, erosion (banks), slope failure, cutting slope failure and bear land slope.

The current problems of natural disaster in this sections are as follows:

Collapse and settlement of banks

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
178km+230 - 178km+920		*		
195km+000 - 195km+070		*		
200km+370 - 200km+600		*		
200km+950 - 201km+100				*
215km+060 - 215km+540		*		
217km+010 - 217km+150		*		
218km+025 - 218km+680		*		
219km+670 - 219km+720		*		
228km+680 - 230km+150		*		
252km+500 - 253km+500	*			
265km+100 - 265km+200		*		
265km+560 - 265km+600		*		
270km+700 - 271km+300	*			
273km+650 - 274km+000	*			

Erosion (banks)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
182km+200 - 183km+000		*		
183km+240 - 183km+290		*		
183km+800 - 183km+830		*		
204km+300 - 208km+600		*		
207km+000 - 207km+300		*		
220km+950 - 222km+800		*		
230km+750 - 231km+250	*			
243km+600 - 243km+800	*			
246km+400 - 246km+500	*			
254km+850 - 255km+100	*			
263km+950 - 265km+700		*		
268km+700	*			
271km+600 - 271km+950		*		
285km+400 - 286km+100	*			
290km+150 - 291km+020	*			

Slope failure

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
204km+300 - 208km+060		*		
207km+000 - 207km+300		*		
220km+950 - 222km+800		*		
242km+200 - 242km+300			*	
255km+900 - 256km+200		*		
270km+700 - 271km+300	*			
271km+600 - 271km+950		*		

Cutting slope failure

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
197km+430 - 197km+750		*		
209km+350 - 210km+950		*		
212km+960 - 214km+360		*		
217km+010 - 217km+150		*		
224km+850 - 225km+820		*		
228km+680 - 230km+150		*		
230km+750 - 231km+250		*		
234km+900 - 235km+250		*		
241km+450 - 243km+000	*			
242km+200 - 242km+300			*	
245km+000 - 245km+500	*			
252km+500 - 253km+500	*			
255km+900 - 256km+200		*		
258km+100 - 228km+410	*			
268km+180 - 269km+150	*			
285km+400 - 286km+100	*			
286km+760 - 287km+300		*		
290km+150 - 291km+020	*			
295km+000 - 295km+100	*			

4) Submergence of bridges

Freeboard of bridges will be studied when railway bridges will be planed for preventing submergence. The detail study for replacing or relocating of railway bridge shall be carried out separately.

(2) Slope failure and cutting slope failure

Natural and cutting slope failures had occurred by heavy rain usually. Construction gauge should be keep for safety train operation. Countermeasure for preventing slope failure shall suggest following measures.

1) Reform slope gradient

2) Installation for protecting of slope surfaces as follows:
   - Vegetation
   - Gabion
   - Retaining wall
   - Wet masonry

(3) Erosion (banks)

Erosion of banks had occurred by river water rising and flash flood. Countermeasure for protecting erosion of banks shall be suggest following measures.

1) Installation of longitudinal and traverse drainage

2) Installation for protecting of slope surface as follows:
   - Vegetation
   - Gabion
   - Retaining wall
   - Wet masonry

(4) Settlement of banks

Settlement of banks had occurred by soft ground usually. Countermeasure for protecting settlement of banks shall be suggest following measures.

1) Reform of formation
   - Replacement of soft soil
   - Compacting
   - Selected soil materials

2) Soil stabilization
   - Soil improvement
   - Grouting
   - Reinforced earth

Bear land slope.

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
205km+400			*	
207km+200			*	
208km+800			*	
213km+300 - 213km+400			*	
213km+700 - 213km+900			*	
223km+000			*	
225km+700			*	
226km+200			*	
229km+300			*	
229km+400			*	
233km+400			*	
256km+000			*	
267km+300			*	
271km+900				*
290km+000 - 290km+200				*

9.10.2 Advises for Planning Countermeasure Against the Natural Disasters

The countermeasures of natural disaster shall be planned by each civil engineer, however advises for planning countermeasure shall be suggested based on keep safety train operation. Advises on each kinds of countermeasure for preventing natural disaster are shown as follows.

(1) Submergence of railway facilities

1) In areas where will have a plan of a flood control, conferences shall be held on the countermeasure of railway project with governmental authorities concerned when detail countermeasure of submergence will be planned.

2) Basic direction for preventing submergence of railway facilities are follows:

- Installation of side and cross drainage
- Rising bank formation

The rising bank formation should be used suitable soil materials for banking, but if it will be impossible to use a good material for rising bank, countermeasure plan shall be study method of soil stabilization and shall be compacting method for rising bank formation.

3) Planning relocation of a track for preventing submergence, the detail study shall be carried out separately.

Chapter 10 Project Profiles for Cost-Benefit Analysis in the Feasibility Studies

10.1 General

Passenger and freight demand forecast on the line is rather limited for a commercially oriented railway operation. Consequently, economic evaluation for investments in this line is negative. However this line is a life line for people in Yen Bai and Lao Cai provinces, the railway needs to operate in spite of non profitable railway. The investment scale and purposes of this line will be limited.

The improvement plans in this Chapter exclude stations and the line between Hanoi, Yen Vien and Dong Anh because they should be improved with Hanoi urban area transportation improvement plan.

10.2 Whole Line Rehabilitation on Lao Cai Line

(1) Project Profile: Whole Line rehabilitation on Lao Cai Line

(2) Priority: B

(3) Location: Line between Hanoi- Lao Cai excluding Hanoi, Yen Vien and Dong Anh stations

(4) Cost:

(Unit: US$ million)

	Foreign Currency	Local Currency	Total
Rail Welding	0.33	0.86	1.19
Adding ballast		0.94	0.94
Re-alignment of Curve		1.16	1.16
Tokenless Signaling	0.75	0.74	1.49
Color Light Signals	0.61	0.17	0.78
Power Source	0.65	0.66	1.31
Spring Points	0.80	0.40	1.20
Cable Installation	0.21	0.63	0.84
Wireless Telephones	0.13	0.94	1.07
Rainfall Gauges	0.19		0.19
Weighing Machines	0.08	0.15	0.23
Other Track facilities	0.07	0.37	0.44
Passenger Cars		0.80	0.80
Locomotives	15.70		15.70
Total	19.52	7.82	27.34

(5) Objectives:

1) Modernization of train operation

The signaling system will be modernized. A tokenless blocking system and color light signals will be installed simultaneously. Electric power supply facilities will also be constructed stations with no electricity.

A telecommunication cable will be laid underground between Yen Vien and Viet Tri and a wireless radio system will be installed between Yen Vien and Viet Tri.

Unnecessary sidings and turnouts should be removed. However some sidings will be left in place for emergency use. Points at stations, except for the 4 main stations, will be replaced with spring points.

The above-mentioned improvements will reduce the amount of personnel.

A weighing machine will be installed at Pho Lu Station.

2) Disaster prevention measures

Rainfall gauges will be installed at Viet Tri, Am Thuong, Mao A and Lao Cai.

Landslide detectors will be installed at embankments near by Red River in order to detect embankment washout.

3) Track improvement

A rail by sections of two will be welded. As a result, track maintenance productivity will be raised. Alignment of curves at the sections that continue with small radius of curves will be revised and pegs that indicate designed positions of a curve will be installed.

(6) Implementation Schedule

Implemetation Year	1997	1998	1999
Approval of Project	—		
Detailed Design	—		
Manufacturing of Equipment		—	—
Construction			—
Unmanned Stations			—

(7) Components:

Investment Item	Unit	Quantity
Rail Welding	spot	15,600
Ballast Adding	km	100
Re-Alignment of curves	km	70
Tokenless Blocking Systems	station	33
Color light Signals	station	33
Electric Power Sources	station	33
Replacement with Spring Points	station	29
Underground Cable Laying	km	71
Wireless Radio equipment	set	1
Rainfall Gauges	set	4
Weighing Machine at Pho Lu Station	set	1
Remodeling of Passenger Cars	piece	14
Locomotives(D12Es) and others	piece	16

(8) Investment Efficiency

Lao Cai Line will be modernized and productivity increased. As a result, the Lao Cai Line will be become a commercially oriented railway management and operation.

(9) Relation with Other Projects:

The following projects will affect mutually:

-Track Maintenance Modernization

-Overall Rationalization

(10) Others:

10.3 Track Maintenance Modernization

(1) Project Title: Track Maintenance Modernization

(2) Priority: B

(3) Location: Yen Vien-Lao Cai

(4) Cost

	Foreign Currency	Local Currency	Total
Crushed Stone Machines	0.80	0.03	0.83
Ballast Hopper wagons	0.01	0.09	0.10
Track Maintenance Machines	0.66		0.66
Total	1.47	0.12	1.59

(5) Objectives:

Each of the following improvements will be implemented in order to achieve the modernization and upgrading of track maintenance.

1) Ballast manufacturing machines and facilities will be installed, and hopper wagons for haulage ballast will be provided.

2) Track mechanized maintenance gangs will be stationed and provided with maintenance machinery and tools, in order to ensure the implementation of efficient track maintenance.

(6) Implementation Schedule:

Implemetation Year	1997	1998	1999
Approval of Project	—		
Detailed Design	—		
Manufacturing of Equipment		—	—
Construction			—

(7) Components:

Track maintenance gangs of 10 will be located as follows taking in consideration the living surroundings:

Yen Vien Nam, Phuc Yen, Viet Tri, Phu Tho, Am Thoung, Yen Bai, Mau A, Lang Khay, Thai Van, Lap Cai.

The following machines and equipment will be purchased for each gang:

Machines and tools	Unit	No.	Remarks
Truck (2-tons)	set	1	Track irregularity
Track Motor Car	set	1	Measuring tools:
Tie-Tamper	set	2	Gauge measure
Engine Generator	set	2	Curve lining calculator
Rail Jack (5-tons)	set	4	Alignment & level
Rail Cutting Machine	set	1	Measure, etc.
Rail Drilling Machine	set	1	
Push Car	set	1	

(8) Investment Efficiency:

As a result of modernization and improvement the efficiency of track maintenance work, maximum speed in view point of track maintenance and structure will be raised to 80km/h and approximately 260 manpower for track maintenance will be eliminated.

(9) Relations with Other Projects:

The following projects will affect mutually:
-Whole line Rehabilitation
-Overall Rationalization

10.4 Overall Rationalization on Lao Cai Line

(1) Project Profile: Overall Rationalization on Lao Cai Line

(2) Priority: B

(3) Location: Line between Hanoi-Lao Cai excluding Hanoi, Yen Vien and Dong Anh stations

(4) Cost:

(Unit: US$ million)

	Foreign Currency	Local Currency	Total
Innovation of Station Buildings	0.04	0.32	0.36
Installation of Seat Reservations	0.09		0.09
Installation Loading Machines	0.40	0.04	0.44
Construction of Oil Terminals		0.35	0.35
Total	0.53	0.71	1.24

(5) Objectives:

The road network along the Lao Cai Line is not adequately developed, especially between Yen Bai and Lao Cai.
The line is therefore an important mean of transport for residents between Yen Bai and Lao Cai. The railway needs also to prepare adequate transportation services to beyond Yen Bai.
The prospects for demand and revenue on the Lao Cai Line are not bright, since it is forecasted that depopulation of this region might be progressed according to the development of Viet Nam.

The Lao Cai Line needs to reduce cost in order to modify for a commercially oriented management. One of the important strategy of investment is to contribute for saving operation cost in the future.

The railway will provide more frequent service than currently to Viet Tri and Yen Bai. High-grade service is planned for international passengers and tourists in order to attract and increase the number of profitable passengers.

General cargo will not increase much. Loading machines will be installed at the Viet Tri, Yen Bai, Pho Lu and Lao Cai. Freight operation at other stations should be closed.

Petroleum terminals with sidings, oil pumping systems and oil tanks will be constructed at the Yen Bai and Lao Cai stations.
Transportation of apatit will be carried out using the current spare of transport capacity.

(6) Implementation Schedule

Implemetation Year	1997	1998	1999
Approval of Project	—		
Detailed Design	—		
Manufacturing of Equipment		—	—
Construction			—
Unmanned Stations			—

(7) Components:

Investment Item	Unit	Quantity
Improvement of Station Buildings	station	4
Seat Reservation Systems	station	4
Loading Machines	station	4
Oil Terminals at Yen Bai, Lao Cai	station	2
Unmanned Stations	station	29

(8) Investment Efficiency

This will make the Lao Cai Line a commercially oriented railway management and operation.

(9) Relation with Other Projects:

The following projects will affect mutually:
-Whole line Rehabilitation
-Track Maintenance Modernization

(10) Others:

Section 2 Feasibility Studies on the Rehabilitation and Improvement of the Hanoi - Cai Lan Line

Chapter 11 Long-Term Development Perspective up to 2010

11.1 Regional Development Perspective

Part of this Hanoi - Cai Lan railway line had been railed for a military purpose, and been planned to abolish up to 1990 since there is no significant industry except coal mining and since this line had recorded the deficit.

Plan of a new deep seaport; the Cai Lan Port has completely changed the situation. As a supplementary deep seaport of the Hai Phong, the port expected to induce the industrial development in the surrounding area and to form a exit of the freight from/to Hanoi and other inland areas.

The most important economic activities are shown in the Cai Lan Port as well as the Hanoi and its adjacent area. The development plan of Cai Lan Port has a great impact on the railway demand of the freight. So its plan are summarized below as a long-term perspective of this region.

Table 11.1.1 GDP Projection

	GDP (million US$)		
	1994	2000	2010
Ha Gian	46	69	183
Ha Bac	345	489	1,168
Hai Hung	540	1,101	3,505
Quang Ninh	318	620	1,891
Hanoi	1,037	2,175	7,159

Source; SPC, and the JICA study Team's projection

Table 11.1.2 Populations

	Population (000 persons)		
	1994	2000	2010
Ha Gian	530	603	726
Ha Bac	658	762	925
Hai Hung	2,246	2,470	2,777
Quang Ninh	905	1,004	1,158
Hanoi	2,186	2,348	2,536

Source; SPC, and the JICA study Team's projection

Construction stages are devided into three:

first stage (up to 2000);	7 berth and its related facilities, road construction
Second stage (2000-2010);	EPZ, High-tech industry, extension of railway, cement factory, fertilizer factory etc.
Third stage (2010- afterward);	international airport, reallocation of coal mining related facilities

Railway extension from the Ha Long station to a new Cai Lan station is planned at the period 2000-2010, while the road construction is planned to complete up to the year 2000.

Freight volume handled at this port is projected at 2.7 million tons at 2000, and reaches 14.3 million ton per year. However, there are various projections, and its freight handling volume is varying from 14 million to 25 million tons per year at 2010.

Size of major industries at the Cai Lan Port and its surrounding area is summarized in Table 11.1.3 below:

Table 11.1.3 Size of Major Industries Related with Cai Lan Port

Industry	Present Production	Production in 2010	Labor Force (000 pns)
Coal	1 (mil. ton)	1.8 (mil. ton)	11.6
Cement	50,000 (ton)	5 (mil. ton)	10
Brick	5.5 (mil. pieces)	400 (mil. pieces)	10.5
Export Industry	-	200 ha	90
Shipping	5,000 (dwt)	50,000 (dwt)	1,500
Hi-tech Industry	-	100 ha	30
Commercial Services	-	-	18
Welfare	-	-	7
Tourists Visited (persons)	0.8 (mil. persons)	2 (mil. persons)	-

11.2 Role of Railway and Hanoi - Cai Lan Line

The Team assumes that the railway has to play a great role in this region, facing a drastic expansion of transport demand attributable to the Cai Lan Port.

- To form a transportation means responsible for an arterial traffic flow
- To share a role to induce the regional development progress along the line
- To induce a international transportation with China

(1) To form a transportation means responsible for an arterial traffic flow

A new Cai Lan Port is expected to handle the freight of 2.7 million tons at the opening year 2000, reaching at 14.3 million tons at the target year 2010 of this Study (JICA; F/S on Cai Lan Port Construction Project). With a link not yet completed between Ha Long and Cai Lan, the transport demand of the railway is limited to a negligible small amount at 2000.

However, with a new extension line in operation, these figures of demand for railway would change drastically. With this extension line, the railway can serve as a most reliable mass transportation mean concerning with the Cai Lan Port related freight.

When the Team considers the road capacity and cost compared with the railway, the railway should share the burden to transport the freight together with the road since two railroad tracks can carry as many people in an hour as 16 lanes of road. In terms of cost, the railway must share this task.

(3) To share a role to induce the regional development progress along the line

It is sure that wherever transportation service is available, it induces the economic activities since it guarantees an access to the market. This kinds of transport access can contribute to attract further investment for industrial estates. Actually Da Phuc industrial estate (north of the Noi Bai Airport) can get a direct benefit attributable to the transportation stability and cheaper transport cost. Since this railway line runs through the North Triangle of Development (Hanoi - Hai Phong - Cai Lan), the railway can induce further allocation of factories in the region.

(4) To induce a international transportation with China

This is related with a cargo from/to the Cai Lan Port. If China prefers the Lao Cai - Yen Vien - Cai Lan route to its domestic route, a rapidly expanding economy of Namming generates a large volume of the transport. This is a quite unknown factor for the demand forecast for this line. However, the VNR has already rehabilitated the Lao Cai station to cope with the international cargo. Once international operation of railway is open, it is sure that this line has to share a heavy burden to transport the international cargoes.

11.3 Outline of Long-Term Railway Development (Hanoi - Cai Lan)

This long-term perspective provides the foundation to formulate a short-term rehabilitation plans up to the year 2000. Since a role of the railway will significantly change after a new Cai Lan port will be open at the year 2000, a short-term rehabilitation should be formulated in line with the railway rehabilitation plan up to the year 2010. Without Cai Lan port, there must be a small scale of rehabilitation required.

Long term perspectives for this railway development is outlined in "The Study on the Transport System of the Northern Part in Viet Nam (JICA, 1994)," which sets a target year at 2010. In this study, some modifications are involved in relation with the Cai Lan Port Plan.

Major tasks of the rehabilitation up to the year 2010 are (1) a restoration of railway function, (2) an improvement of transportation efficiency and (3) a guarantee of valid transportation system for port-related freights.

(1) Restoration of railway function

The railway function can be restored by guaranteeing the services originating at the Cai Lan port since all the facilities of this line are relatively new and well maintained. It is required to commence the railway service between Ha Long station and a new Cai Lan station prior to the open of new port because it is a only way to demonstrate a valid transportation system functioning and to provide an assurance for logistics of investors. New Cai Lan station will have facilities necessary for handling port-related freights efficiently.

(2) Improvement of transportation efficiency

This has two significant elements: first is short-cut line construction at the Yien Ven - Pha Lai, second is a gauge conversion into meter one. The former can shorten the running distance by using the short-cut line and a travel time. Passengers, especially tourists to the Ha Long Bay, will be blessed by this cut in travel time, and the freights will be less blessed. However, if the transport charge will be reduced according to the travel distance, this short-cut line has more significant meaning for the industries along the line.

Gauge conversion into meter one is in a line with the VNR's development strategy. If it will be implemented after 2000, the opening of the Cai Lan port, the replacement works should be conducted without any operation interruption, while it can be stopped if it will be done before the year 2000. However, the latter case will generate some interruption of the regional economic activities even though it has not a wide range of economic linkage over the regional economy there.

(3) Demonstration of valid transportation system for port-related freight.

Actual operation of railway service between Ha Long and Cai Lan can prove the validity of the transportation network, and can contribute to attract a demand of railway transportation, especially for new investors. This must be followed by a punctual and stable operations that are supported by the loading/unloading machines of freight. These can contribute to get a competitive power against the road transportation.

In order to attract the freight at the port, a computerized information system is indispensable to carry out their logistic strategies at a level of international efficiency level. With this facilities, an inland container depot should be established to make the freight handling smooth, and land acquisition should be started at the late 1990s.

In addition, a cement tank transport with cement terminal is one of the target to implement up to the year 2010. This contribute to lessen the transportation cost per unit and easiness to handling.

Some management rationalization is also expected. First is a rationalization on station management. Passenger handling staff should be shifted into other sections at all the stations except Ha Long station. Second is a integration of cargo handling stations. Third is the establishment of the marketing section in the VNR specialized for this line. This manage the contract with the shipping company about the container, inland container depot, and cement terminal. With an appropriate adjustment of charge structure, further promotion of container operation is indispensable to attaining the higher revenue.

The existing Kep - Ha Long line will be maintained at least up to the year 2010. There is some cargo that go through Kep to the direction to Lan Son. For these cargo, it is suggested that the existing line be maintained without huge amount of rehabilitation works.

Chapter 12 Principle, Target, and Technical Standard for Rehabilitation and Improvement up to 2000

12.1 Principle

12.1.1 Principles

Here the Team summarizes the major principles the Team takes into consideration when preparing the rehabilitation and improvement projects.

- To be advantageous and competitive as a transport means for freight
- To commence the railway service prior to an completion of the road grade-up works
- To prove the best timing of a meter gauge installation and a new short-cut line construction

(1) To be advantageous and competitive as a transport means for freight

The Cai Lan Port is planned to complete its first stage construction at the year 2000, and the road improvement projects will also complete by the year 2000 that contains the grade-up of the existing National Road 1 and a construction of new Highway along the National Road 1. The railway service will face the competition with these road transport mode.

How to be competitive and how to keep the advantages of the railway?: these are the tasks in formulating the projects for the rehabilitation and improvement. Commencement of railway service prior to the opening of the roads can have a dominant factor to determine a competitive over the road.

(2) To commence the railway service prior to an completion of the road grade-up works

The Team judges that once the railway establishes its service at the Cai Lan Port prior to the opening of the Cai Lan Port, it can attract the freight transport demand since there is no alternative transport modes available. And the railway features such as safety, stable, and

punctual operation can work to guarantee and to increase the railway demand at the Port. The railway has to keep a diminishing status, and is difficult to compete with the road.

This suggests that the missing link between Ha Long and Cai Lan should be constructed before the year 2000 and starts to handle the freight. This early establishment of railway service can also contribute to attract the further direct investment to this region.

(3) To prove the best timing of a meter gauge installation and a new short-cut line construction

The commencement of Ha Long - Cai Lan section (4 km) faces a problem of gauge. The shift from the standard gauge to the meter gauge is already determined by the government policy. However, it is necessary to examine whether a installation of meter gauge at the Ha Long - Cai Lan section is an appropriate policy or not since it requires at the same time a replacement of the existing standard gauge at the section between Kep and Ha Long. Urgently the VNR has to finish this extension work, and has to minimize the cost. Temporary installation of mixed gauge at this new extension section is also examined.

Furthermore, there is a plan to construct a new short-cut line. Most favorable route alternative seems a Yen Vien - Pha Lai - (Chi Lin), and this is a subject of study of which route to be constructed and of when to construct. This should facilitate a meter gauge.

12.1.2 Priority Section; Its Selection Criteria and Results

(1) Criteria

1) Densely Populated Region and/or New Economic Center

(= highly inter-connected region)

(= near urban area)

These are featured by an agglomerated economic activities, and can generate high demand of transport. With a sufficient access mode within and between those regions, its is sure to further activate and accelerate the economic activities. It also improves a regional integration. Railway can contribute to facilitate this function, especially for medium distance trips.

Analysis on regional integrity shows that Hanoi - Ha Long section has a high inter-regional integration among all the prefectures that railway line runs through in the North.

The best and the only candidate is as follows:

[conclusion]

1. Hanoi - Yen Vien - Ha Long section

2) Area with High Demand of Railway

[Reasons]

1. High level of railway demand at present
2. High level of demand at years 2000 and 2010
3. High level of investment return expected

With the opening of the Cai Lan Port at the year 2000, it is expected to generate the demand of 14 ~ 25 million freight transport according to the various reports. At present there are few demand, however, the VNR has to attract this drastically increasing demand of freight transport.

[conclusion]

1. Ha Long - Cai Lan (new extension) section
2. Yen Vien - Ha Long section

3) Appropriate Section to Compete with Other Modes

[Reasons]

- Rehabilitation has to aim at making the railway service sufficiently competitive with other modes to survive if it can
- To rehabilitate, or to perish

There are two roads plans in this context: first, an up-grade of QL 18, which runs with the railway side by side, is planned to complete up to the year 2000, secondly a new highway construction is under consideration that also aims at transporting freight from/to the Cai Lan Port.

[conclusion]

1. Yen Vien - Cai Lan

4) New Line or Existing Line

(3) To minimize the cost of temporary rehabilitation for the existing line

With a new line between Yen Vien and Pha Lai, a rehabilitation plan of existing line can be a relatively small scale one since no large transport demand is expected on this existing line. If a new line is feasible at the target year 2000, a selection of the priority section is very simple, and the Team will focus on the new line construction study.

[conclusion]

This criteria suggests two conditions;

1 If new line is feasible at the year 2000, the priority section is a new line.

2 If new line is not feasible at the year 2000, the priority section is the existing line; Yen Vien - Kep - Chi Linh and a new extension part; Ha Long - Cai Lan.

(4) Candidates and the Selected Priority Rehabilitation Sections

The Team sets the following section as candidates, and selected one priority rehabilitation section.

1. Yen Vien - Ha Long 164 km
2. Yen Vien - Cai Lan 168 km (priority section)

However, the Team adds one condition in relation with a new railway line construction plan.

1) If a new line is feasible at the year 2000, the priority section includes a new line and excludes the existing line.

2) If a new line is not feasible at the year 2000, the priority section includes the existing line; Yen Vien - Kep - Chi Linh and a new extension section Ha Long - Cai Lan and excludes a new line. It is studied when a new line will be feasible, and the rehabilitation of the existing line will be formulated to cope with the demand up to the year when a new line will turn to be feasible.

12.2 Target

Target to be obtained by 2000 with the program 2000 and perspectives until 2010 are shown in Table 12.2.1 Target of Hanoi-Cai Lan Line.

Table 12.2.1 **Target of Cai Lan Line**

Items	1995	2000	2010
Total Track Length	Kep-Ha Long 106km (Hanoi-Kep 68.5km)		
Cai Lan Port Cargo Transport			
Inland Container Depot(ICD)	None	Temporary ICD at Yen Vien Sta.	New full ICD at Yen Vien
Loading Machines at ICD	None	Top-lifter, chassis, tractor	Machines procured
Freight Information System	None	Digital micro wave system	Full FIS
New Ha Long-Cai Lan Track	Not be constructed	Construction of 4.3km	Finished
Wagon for Container	None	30 new wagons	Total of 200 wagons
Gauge Conversion			
Gauge	1,435mm	Alternative 1 1,000mm	Alternative 2: Mixed gauge
Gauge Conversion		Alternative 1: Meter gauge by 2000	Alt. 2: Meter gauge after 2000
Rolling Stock in Alt.1		7D12Es, 41PCs, 220FCs	
Ha Long Bay Tourist Transport Improvement			
Track Structure	43kg/m, 12.5m rail in length	25m rail	25m rail and long rail
Track Maintenance Machines		A set of track machine for 7 depots	
Rail Welding		Welding into 25m rail	Completed, long rail partially
Ballast Thickness	150-250mm	200-250mm	250mm
Bridge Rehabilitation		Inspection	Being improved
Prevention of Disasters		Train operations are restricted during heavy rains and strong wind	
Maximum Operation Speed	60km/h	80km/h	110km/h by push-pull train
Train Blocking System	Tablet, mechanical interlocking	Tokenless, electric interlocking, color light signals	Same as 2000
Telecommunications	Bare wire	Bare wire	New cable Hanoi-Ha Long
Locomotives	D8H, steam locomotives	(MG)D4H, D12E, (SG) D8H,SL	(MG)D12E,D18E,(SG)D8H,SL
Passenger Trains	Yen Vien-Ha Long 1 round trip	Express 3 RT, Local 3 RT	Express 4, Local 4
Planned Travel Time	Yen Vien-Ha Long 7h05m	Ex 4h30m(Hanoi-Ha Long)	Express 3 hs(Hanoi-Ha Long)
Planned Commercial Speed	23km	39km/h	58km/h
Management Improvement		Unmanned stations excluding main stations. Reduction of track employees	Completed Reduction of track employees

12.3 Technical Standards

(1) Standard gauge

The construction gauge of 1435mm gauge for Kep - Ha Long line is as follows;

1) Gauge	: 1435mm
2) Minimum curve radius	: 800m
	: 600m(special case)
3) Maximum gradient	: 6‰
4) Rail	: 43kg/m 12.5m length
5) Sleeper	: mono-block PC sleeper
6) Ballast depth	: 30cm
7) Turnout on main line	: 1:10
8) Railway formation width	: 6.4m
9) Design live load	: 22 tons/ axle

(2) Meter gauge

The following standards are applied in this Study for the new construction work by 1000 mm gauge of Hanoi - Cai Lan line. In the case of reusing the current structure with repairing, the current technical specifications are applied.

1) Gauge	: 1000mm
2) Minimum curve radius	: 600m
	: 300m(special case)
3) Maximum gradient	: 6‰
4) Rail	: 43kg/m 25m length
5) Sleeper	: 2-block RC sleeper
6) Ballast depth	: 30cm
7) Turnout on main line	: 1:10
8) Railway formation width	: 5.0m
9) Design live load	: 14tons/axle(double locomotives)
10) Maximum cant	: 95mm
11) Allowable cant deficiency	: 50mm
12) Bridge clearance	: The maximum height of passing ship or planned high water level +1m (in case HWL is available)

: More than the water level which has been observed
(in case HWL is not available)

13) Submerged frequency for design at flood prone section
: 1/30 years (in case rainfall data is available)
: Decide the submerge height to the highest level which has been observed (in case rainfall data is not available)

The technical standards of 1 meter gauge for Hanoi - Cai Lan line is basically the same as the standards of Hanoi - Lao Cai line. According to the line situation, some parts are revised.