Pakistan

Diesel Electric Locomotives Rehabilitation Project (1)
and Diesel Electric Locomotives Production Project (2)

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Field Survey: September 2004

1. Project Profile and Japan's ODA Loan

Regional map of project site

Rehabilitated locomotive (GRU-20)

1.1 Background

Pakistan borders the countries of India, Iran, Afghanistan, and China. It is 796,000 km^2 in area, which is roughly double the size of Japan. The population is 150 million people, approximately 1.2 times that of Japan. Pakistan's main industries are agriculture and cotton production.

The country's domestic transportation network is formed mainly around the north-south corridor that connects the major cities where people and industries are concentrated: Karachi, the southern city which handles over 90% of the country's trade; Peshawar, the major northern city; and Islamabad, the capital city. Of these, the railway has approximately 8,600 operating kilometers[1], and the main part of it connects Karachi and Peshawar. In the late 1950s, the railway played an important role in freight and passenger transport in Pakistan, handling 73% of the domestic freight transport and 42% of the domestic passenger transport. However, starting in the 1980s, railway became unable to keep pace with the increasing demand for transportation, and its transport volume ceased to rise as the rate of operation dropped annually[2] mainly due to superannuation and lack of sufficient locomotives[3]

[1]"Operating kilometers" refers to the distance traveled by commercial transportation such as railways and buses on regular routes. The operating kilometers of Pakistan Railway are approximately 30% that of Japan.
[2]The target operation rate (percentage of days in operation annually, excluding the days spent in the factory for maintenance) of Pakistan Railway's locomotives is 85%, but in FY1991, it had dropped to approximately 75%.
[3]In the early 1980s, Pakistan Railway had approximately 490 electric diesel locomotives, which were the main type of locomotive in use, but over half of those had surpassed their durable lifespan.

1.2 Objectives

The project's objective was to boost the capacity of railway transport which plays an important role in long-distance transport by carrying out the manufacture and rehabilitation of electric diesel locomotives, thereby providing infrastructure for economic growth.

1.3 Borrower/Executing Agency: Islamic Republic of Pakistan/ Ministry of Railways

1.4 Outline of Loan Agreement

	Diesel Electric Locomotives Rehabilitation Project (1)	Diesel Electric Locomotives Production Project (2)
Loan Amount/Loan Disbursed Amount	6,011 million yen/5,673 million yen	8,578 million yen/8,578 million yen
Exchange of Notes/Loan Agreement	August 1993/August 1993	October 1995/March 1996
Terms and Conditions -Interest Rate -Repayment Period (Grace Period) -Procurement	 2.6% 30 years (10 years) General Untied	 2.3% 30 years (10 years) General Untied
Final Disbursement Date	November 1999	July 2002
Contractor	Marubeni	Marubeni
Consulting Services	—	—
Project Identification and Preparation Study (such as Feasibility Study (F/S))	1989 Pakistan Railway	1989 Pakistan Railway 1993 First Loan Agreement

2. Evaluation Results

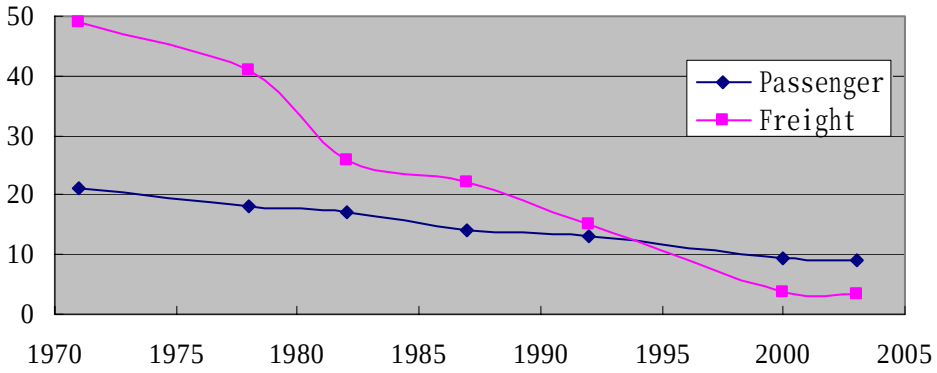
2.1 Relevance

Since the 6th 5-year plan (1983-1988), the securing of rail transport capacity and rational distribution of traffic between railways and roads was emphasized in Pakistan's transportation policy. At the time of appraisal, emphasis was placed on recovery of the share of the railway, which was relatively more dominant than roads in long-distance high-volume transport, and an important issue was to renew the decrepit infrastructure, such as locomotives and rails. These two projects, which were responsive to the above issues, were both included in the 8th 5-year plan (1993-1998). They were given high priority at the time of the appraisal because of its urgency.

In the current 10-year plan (2001-2011), recovery of the railway's share in long-distance, high-volume freight transport continues to be the most important issue in the transportation sector. In this 10-year plan, 46% of the public investment in the railway sector over 10 years is allotted to locomotive-related investment. This is roughly the same level of investment as in the 8th 5-year plan (1993-1998). Therefore, the importance of this project at the national policy level is still retained. However, the railway's freight

transport volume has declined considerably. Causes of the decline include less efficient freight transport as is visible in the reduced train speed, management of train service, and time delays, etc. As a result, the quality of service has declined. Moreover, passenger transport volume increased by only about 1%, but the market share declined (Figure 1).

Figure 1: Trends in Railway's Share (%) of Passenger and Freight Transport



2.2 Efficiency

2.2.1 Output

(1) Diesel Electric Locomotives Rehabilitation Project (1)

In this project, the plan was to rehabilitate a total of 54 locomotives, consisting of 48 US locomotives and 6 Japanese locomotives (including replacement of general parts and equipment such as the engine, generator, brake system, electric controls, and rail trucks). As a result, a total of 54 locomotives were rehabilitated almost according to plan, but there were some changes in model types out of consideration for the physical condition of locomotives or the standardization of model types. Also, because the locomotive manufacturers had stopped producing engines, the project was forced to procure expensive engines from other companies because the locomotive manufactures had stopped producing engines. For that reason, procurement of new parts was reduced in order to keep rehabilitation costs within budget, and the scope of the parts replacement was reduced below the level planned. Furthermore, the rehabilitation work was carried out mainly at Moghalpura locomotive repair factory in Lahore, and part of the rehabilitation work was carried out at Risalpur locomotive factory which was constructed by a different Yen loan project.

(2) Diesel Electric Locomotives Production Project (2)

In this project, it was planned to procure 30 3000-horsepower diesel electric locomotives (including importation of 10 complete locomotives, 10 Partial Knock Downs

(PKD), and 10 Complete Knock Downs (CKD)). In addition, it was planned to provide overseas training concerning assembly and manufacture to Pakistan Railway employees in engineering service. As a result, the project was implemented almost as planned, and 30 US locomotives were procured (model: AGE-30, 3300-horsepower; including 10 complete locomotives, 10 PKD, and 10 CKD). The assembly and manufacturing work was carried out at the Risalpur locomotive factory.

2.2.2 Project Period

(1) Diesel Electric Locomotives Rehabilitation Project (1)

The project period of this project was planned for August 1993 to March 1997 (44 months), but the actual project period was August 1993 to December 1999 (77 months), which represents an increase of 75% over the plan. The following are the reasons of the delay: procurement accompanying the alteration in the scope of the rehabilitation, the payment of customs tax on imported parts, and the time required to procure used parts for the rehabilitation. However, there were no delays in the rehabilitation work itself.

(2) Diesel Electric Locomotives Production Project (2)

The project period of this project was planned for March 1996 to June 2000 (52 months, but the actual project period was March 1996 to September 2003 (91 months), which represents an increase of 75% over the plan. The reasons for the delay include the delay in the payment of customs tax on imported parts, temporary stoppage of shipping company operations due to nuclear tests, and procurement of additional spare parts. However, there were no delays in the assembly and manufacturing work itself.

2.2.3 Project Cost

(1) Diesel Electric Locomotives Rehabilitation Project (1)

The project cost in the original plan was 8,240 million yen, but the actual project cost was 8,810 million yen, which represents an increase of 7% over the plan. The local currency portion on a rupee basis was double the planned amount due to the rise in parts' prices and customs' tax during the delay in the project. The total project cost increased only slightly on a yen basis because the value of the local currency, rupees, dropped considerably against the yen during the project implementation.

(2) Diesel Electric Locomotives Production Project (2)

The project cost in the original plan was 13,360 million yen, but the actual project cost was 14,380 million yen, which represents an increase of 8% over the plan. The local currency portion on a rupee basis was approximately 1.5 times the amount planned due to

increases in customs' tax, etc., but because the value of the local currency, rupees, dropped considerably against the yen during the project implementation, the total project cost increased only slightly on a yen basis.

2.3 Effectiveness

2.3.1 Usage and Operation of Locomotives

The 48 US locomotives (new model: GRU-20[4]) which were rehabilitated in the Diesel Electric Locomotives Rehabilitation Project (1) were gradually put into service between 1996 and 1999. Immediately after the locomotives went into service (1998), the operation rate was 91%, which exceeded the planned rate of 85%. Also, the operational efficiency (i.e. the distance traveled per day by each locomotive), at 550 km/day per train, was more than twice the average operational efficiency of the Pakistan Railways, which was 263 km/day per train. However, because many used parts were used in the engine rehabilitation for 30 of the 48 locomotives, parts replacement became necessary again 2 years after the rehabilitation, and the operational efficiency dropped to 259 km/day per train in 2003, which was close to the average level of the Pakistan Railways. The operation rate of 6 Japanese locomotives was 75%, and the operation efficiency was 283 km/day per train; both exceed the average of the Pakistan Railways.

US locomotive being rehabilitated

Looking next at the 30 US locomotives (model: AGE-30) procured in the Diesel Electric Locomotives Production Project (2), these locomotives were gradually put into service between 1998 and 2001. According to the Pakistan Railway, the AGE-30 has the best performance, with a maximum speed of 125 km/h, among all the diesel electric locomotives owned by the Pakistan Railways. The AGE-30's average operation rate up to now, at 88.5%, exceeds the planned level, and its operational efficiency, at 762.8 km/day (2003), is approximately triple the average. The average number of days spent in maintenance was 42 days annually, which is less than the 55 days that was planned.

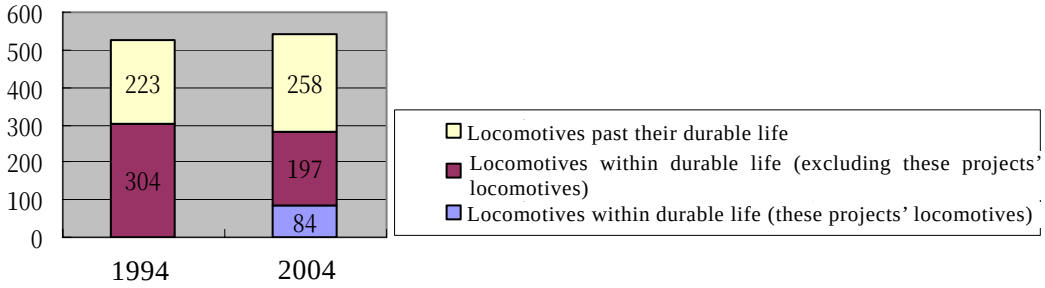
2.3.2 Age Composition of Locomotives Owned by the Pakistan Railway

Of the total number of 527 electric diesel locomotives owned by the Pakistan Railway, 223 locomotives, or 42%, had surpassed their durable life[5] in 1994. In 2004, this figure had increased to 258, or 48%, out of 539 locomotives, and so the superannuation of the

[4]The ALU model was renamed GRU following rehabilitation.
[5]Durable life is 20 years for new locomotives and 15 years for rehabilitated locomotives.

locomotives had increased. This project provided a total of 84 locomotives to the Pakistan Railway, and these constituted 16% of all the locomotives (539 locomotives) owned by the Pakistan Railway in 2004. The locomotives provided by this project constitute 30% of the 281 locomotives whose durable life has not expired, and so these locomotives are playing a large role in slowing the aging of the fleet.

Figure 2: Age Composition of the Pakistan Railway's Electric Diesel Locomotives



2.3.3 Technology Transfer

In the Diesel Electric Locomotives Production Project (2), engineering service of 30 M/M was planned, and also as a part of that, overseas training of 60 M/M was planned. In the project implementation, the engineering service was conducted as planned, and the overseas training was carried out partially. According to the executing agency, the quality of the engineering service by the engine manufacturer at the Risalpur locomotive factory was not very satisfactory[6]. However, the technological level of that factory is high enough that the engineering service did not strongly affect the effectiveness of the project. Also, in the Diesel Electric Locomotives Rehabilitation Project (1), the overseas training (15 M/M to 20 M/M) which was planned for the Pakistan Railway staff was not implemented. For these reasons, the technology transfer carried out by the project was limited.

2.3.4 Economic Analysis

A. Financial Internal Rate of Return (FIRR)

The financial internal rate of return (FIRR) at the time of appraisal was 26.1% for the Diesel Electric Locomotives Rehabilitation Project (1) and 12.6% for Diesel Electric Locomotives Production Project (2). When FIRR was recalculate for the evaluation, the results were 22.0% and 31.3%, respectively. In Diesel Electric Locomotives Rehabilitation Project (1), the FIRR decreased due to the drop in operational efficiency several years after the locomotives were put into service, and in Diesel Electric

[6]There was also a case were a Pakistani technician found a problem that had been overlooked by a US technician.

Locomotives Production Project (2), the fact that the operational efficiency was triple the average of all locomotives appears to be a factor in the higher FIRR. The conditions for the calculation of FIRR at the appraisal are as follow.

Conditions for FIRR Calculation

	Diesel Electric Locomotives Rehabilitation Project (1)	Diesel Electric Locomotives Production Project (2)
Project Life	15 years	20 years
Expenses	Locomotive rehabilitation cost, Running cost, Operation, and maintenance cost	Locomotive procurement and manufacturing cost, Running cost, Operation, and maintenance cost
Benefits	Fare income	Fare income

B. Economic Internal Rate of Return (EIRR)

In addition to recalculation of the FIRR which was calculated at the time of appraisal, the evaluation calculated the economic internal rate of return (EIRR). The result was an EIRR of 38.0% for Diesel Electric Locomotives Rehabilitation Project (1) and an EIRR of 48.6% for Diesel Electric Locomotives Production Project (2). The conditions for calculation of EIRR are as follow[7].

Conditions for EIRR Calculation

	Diesel Electric Locomotives Rehabilitation Project (1)	Diesel Electric Locomotives Production Project (2)
Project Life	15 years	20 years
Expenses	Locomotive rehabilitation cost, Running cost, Operation, and maintenance cost	Locomotive procurement and manufacturing cost, Running cost, Operation, and maintenance cost
Benefits[8]	Fare income	Fare income

2.3.5 Summary

The outcome which this project aimed at was “to boost the capacity of railway transport.” The locomotives manufactured and rehabilitated by these two projects constitute one-third of the main force of locomotives (i.e. those within their durable lives) owned by the Pakistan Railway, and so they are playing an important role in the maintenance of the railway’s transport capacity.

Looking at rate of operation and operational efficiency, the AGE-30 locomotives newly introduced by Diesel Electric Locomotives Production Project (2) are displaying

[7] In the recalculation, fare income was regarded as a benefit that reverted 100% to locomotives, in accordance with the conditions at the time of appraisal. The following results were obtained when the recalculations were done again using more realistic conditions, where 50% of the fare income is a benefit that reverts to locomotives, and the other 50% is invested in areas other than locomotives, such as passenger cars, rails, etc.

Diesel Electric Locomotives Rehabilitation Project (1) FIRR and EIRR were both negative
Diesel Electric Locomotives Production Project (2) FIRR=14.4% EIRR=24.8%

[8] In calculation of the EIRR, shadow rates were used for benefits that were the same an in FIRR.

extremely outstanding performance and are operating efficiently. On the other hand, there was an early decline in the efficiency of the GRU-20 locomotives in Diesel Electric Locomotives Rehabilitation Project (1) where many used parts were utilized in rehabilitation due to budget limitations. These newly rehabilitated locomotives did not display the performance that was expected of them.

2.4 Impact

(1) Contribution to Railway Transport

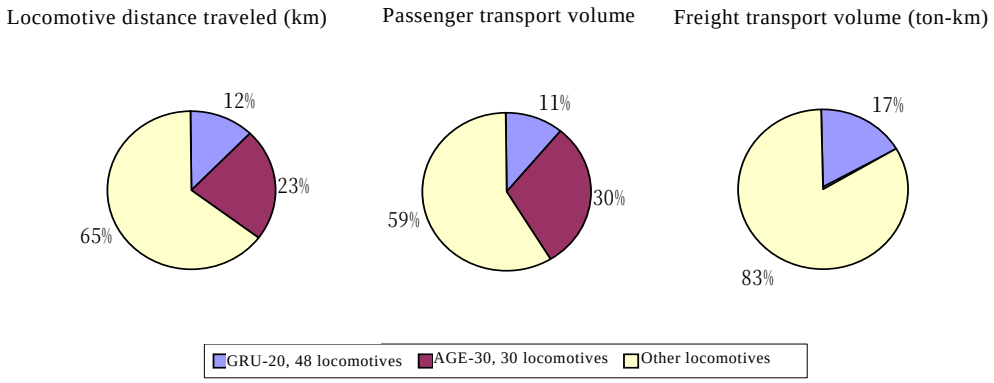
The total annual distance traveled by the 48 US locomotives (GRU-20) that were rehabilitated by the Diesel Electric Locomotives Rehabilitation Project (1) was 4.54 million km (FY2003), which accounts for 12.0% of all Pakistan Railway's diesel electric locomotives. Of the 48 locomotives, 40% are used for freight transport and 60% for passenger transport. The estimated transport volume (FY2003) is 2.45 billion passenger-kilometers (11% of the total) and 820 million ton freight-kilometers (17% of the total). No data could be obtained for the 6 rehabilitated Japanese locomotives.

Meanwhile, the total annual distance traveled by the US locomotives (AGE-30) which were procured in Diesel Electric Locomotives Production Project (2) was 8.35 million km (FY2002), or 22% of the total. Their estimated transport volume is 6.7 billion passenger-kilometers, or 30% of Pakistan Railway's total[9]. Hence, they comprise the core of passenger transport. At the time of appraisal, the 30 procured locomotives were all to be used for freight trains, but currently all 30 are operating as long-distance limited express trains because the Pakistan Railways gives preference to locomotives that have reliable performance to passenger trains, where speedy and timely service is required.

As seen above, the total of 78 locomotives introduced by both projects are contributing considerably to rail transport in Pakistan, accounting for 35% of the distance traveled by locomotives of the Pakistan Railway in FY2002, as well as 41% of passenger transport volume and 17% of freight transport volume (Figure 3). Their contribution to passenger transport volume is particularly large, and it is estimated that a total of 30 million people annually ride on trains pulled by the locomotives procured by these projects

[9]6.7 billion passenger-kilometers is equivalent to approximately one-sixth of the Tokaido Shinkansen's passenger-kilometers in the same year.

Figure 3: Contribution of the Rehabilitated and Manufactured Locomotives for Railway Transport



(2) Promotion of Industry through Domestic Production of Locomotive Parts

In the Diesel Electric Locomotives Production Project (2), promotion of peripheral industries was anticipated through the domestic production of some parts used in the assembly and manufacturing at the Risalpur locomotive factory. However, because the project procured some locomotives by importing as complete, and because the rate of domestic production was low, at 10%[10], it appears that the impact on peripheral industries was small.

2.5 Sustainability

2.5.1 Executing Agency

2.5.1.1 Technical Capacity

There is room for the Pakistan Railway to make technical improvements in its management of operations data and train service management, and this is one factor in the low level of rail transport volume. However, no technical issues that directly affect the sustainability of this project were observed.

2.5.1.2 Operation and Maintenance System

In the latter half of the 1990s, the Pakistan Railways undertook a privatization policy (splitting up infrastructure, passenger, and freight sectors) spearheaded by the World Bank, but this did not lead to an improvement in the efficiency of train service or in operating income and expenditures[11]. For this reason, in 1999 the Pakistan Railways took back the privatization policy, began to explore methods of reform for creating public corporation, and allowing private enterprise to enter into the rail service partially, which

[10]it is the average of the 10 PKD locomotives and the 10 CKD locomotives.
[11]Because the passenger sector was assigned the better-performing locomotives to maintain the timetable, the freight sector fell into greater trouble. Adjustments between the two sectors became difficult, and confusion occurred in the operation of the organization and in train service.

were thought to be more achievable. The Pakistani Government's intentions for the reform are clearer than previously, but resistance from the Ministry of Railways and insiders at the national railway is strong, making the outcome unpredictable.

2.5.1.3 Financial Status

The income and expenditures of the Pakistan Railway are structured so that overspending in passenger transport is supplemented by income from freight transport[12]. In 2000's, there were excess spending of approximately 8 billion rupees annually (Table 1). Excessive spending increased considerably from 3.1 billion rupees in FY1993, and all of it is supplemented with government subsidies. However, in recent years, the income has been increased due to the raise in fares, reinforcement of fast trains[13], and introduction of coaches with new design[14].

2.5.2 Operation and Maintenance Status

Rawalpindi Central Repair Shop

For the operation and maintenance of Pakistan Railway's electric diesel locomotives, regular inspections are conducted at the 10 regional maintenance yards across the country, and overhauls and repair work that cannot be handled by the maintenance yards are carried out at the Rawalpindi Central Repair Shop. Moreover, repairs that cannot be handled at the Central Repair Shop (e.g. car bodies damaged in accidents and repair or manufacture of rail trucks, etc.) are handled at the Risalpur locomotive production factory.

The Pakistan Railways has a high level of technological capacity as shown by the fact that it also has the capacity to manufacture some spare parts by itself. However, due to the large number of models and financial limitations, it is not easy to procure the necessary spare parts for overhaul and repair, and so used parts are often utilized in the maintenance and repair of electric diesel locomotives. Nevertheless, with the improvement of financial status, as stated above, there are no major problems for the sustainability of the

[12]Fare income per kilometer traveled in 1996 was 155.2 rupees for passenger transport and 469.6 rupees for freight transport. The reasons why the earnings of passenger transport are low include the fact that Pakistan Railway suppresses the passenger fare so that it is competitive with bus fare and the fact that unprofitable train lines have not been closed.

[13]The fast trains which were reinforced during 2002 to 2004 are: 1) Lahore – Karachi, 2) Lahore – Faisalabad, 3) Rawalpindi – Quetta, 4) Sialkot – Rawalpindi, 5) Lahore – Rawalpindi, 6) Faisalabad – Karachi, 7) Multan – Faisalbad.

[14]The total income in FY2004 was 18 billion rupees, which is 27% increase of that in FY2003. Above all, the income from the passenger transportation was 9.3 billion rupees, the highest in the history of Pakistan Railways.

locomotives which are rehabilitated or manufactured under this project.

Table 1: Income and Expenditures of the Pakistan Railway (unit: million rupees)

Item	2000	2001	2002	2003	2004
Income	11,953	13,340	14,607	14,568	18,022
Passengers	5,602	6,395	7,163	7,939	9,285
Freight	4,576	4,751	4,802	4,343	5,285
Postal and Packages	439	576	540	744	910
Other	1,336	1,618	2,102	1,542	2,542
Expenditures	20,254	21,247	22,467	20,579	20,574
General Administrative Costs	1,700	1,693	1,904	2,304	2,207
Maintenance and Repair Costs for Rails, Buildings, Train Cars, etc.	4,225	4,746	5,298	5,357	4,962
Operating Expenses (fuel cost, personnel expenses, etc.)	5,074	4,983	5,644	5,967	6,331
Pension Fund and Health and Welfare Costs	2,858	3,052	3,015	3,094	3,095
Interest Payments	2,513	2,399	3,394	2,096	2,117
Repayment (bank overdrafts, foreign loans)	3,190	4,334	3,071	1,410	1,274
Amortization Fund, etc.	694	40	141	351	588
Difference	- 8,301	- 7,907	- 7,860	- 6,011	- 2,552

Source: Ministry of Railways
Note: 2004 figures are provisional.

3. Feedback

3.1 Lessons Learned

The scope of rehabilitation in this project was reduced because of difficulties in procuring spare parts due to a rise in costs that was hard to predict beforehand. The rehabilitation was technically inadequate, and the expected results were not obtained. These caused a need for parts replacements shortly after the rehabilitation, and that resulted in increase of the maintenance cost. Therefore, in order to effectively carry out rehabilitation of locomotives, it is important to set an appropriate scope for the work and to conduct a sufficient technical study, including the preparation of specifications by an international consultant and strengthening of a check system.

3.2 Recommendations

The Pakistan Railway needs to conduct a market study focused on the recovery of market share in long-distance, large-volume freight transport and to install strategic infrastructure[15], while it steadily promotes administrative reforms such as the formation

[15]Currently the Pakistan Railways is studying the following five policies for improving freight transport.
1) Container and cargo special trains are being run as per time table in 40 to 45 hours between Karachi to Lahore.
2) Agreements with freight forwarders are in process to attract additional traffic on regular basis.
3) Additional 15 locomotives are being inducted in freight pool.
4) Doubling of track from Lodhran to Khanewal (121km) will improve the turn round of coaches, wagons, and locomotives.

of a state-owned enterprise and allowance of partial entry by private companies in train service.

5) Procurement of 1,600 high capacity wagons of new generation will improve the turn round from 21 days to 5 days..
In addition, it appears necessary to install infrastructure for signal lights and communications and to install an MIS to enable collection of data for each sector and each train line, for use in management decisions.

Comparison of Original and Actual Scope

Diesel Electric Locomotives Rehabilitation Project (1)

Item	Planned	Actual Performance
1. Output	Rehabilitation of 54 locomotive total ALU-18[16]：23 locomotives ALU-20：25 locomotives HAU-20：4 locomotives HPU-20：2 locomotives	Rehabilitation of 54 locomotives total ALU-18：21 locomotives ALU-20：27 locomotives HAU-20：6 locomotives HPU-20：0 locomotives
2. Project Period	August 1993-March 1997 (44 months)	August 1993-December 1999 (77 months)
3. Project Cost Foreign Currency Local Currency Total ODA Loan Portion Exchange Rate	 5,324 million yen 2,915 million yen (596 million rupees) 8,239 million yen 6,011 million yen 1 rupees ＝4.9 yen (as of 1992)	 5,673 million yen 3,098 million yen (1,121 million rupees) 8,771 million yen 5,673 million yen rupees＝2.8 yen (average of 1994 to 1999)

Diesel Electric Locomotives Production Project (2)

Item	Planned	Actual Performance
1. Output	30 3000-horsepower locomotives 10 complete locomotives imported 10 partial knock down locomotives 10 complete knock down locomotives	Same as left
2. Project Period	March 1996-June 2000 (52 months)	March 1996-September 2003 (91 months)
3. Project Cost Foreign Currency Local Currency Total ODA Loan Portion Exchange Rate	 8,338 million yen 5,017 million yen (1,573 million rupees) 13,355 million yen 8,578 million yen 1 rupees＝3.2 yen (as of 1995)	 8,578 million yen 5,779 million yen (2,449 million rupees) 14,357 million yen 8,578 million yen rupees＝ 2.4 yen (average of 1996 to 2002)

[16]The ALU model was renamed GLU after rehabilitation.