JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF TRADE AND INDUSTRY MONGOLIA

THE STUDY ON THE IMPROVEMENT PLAN FOR TRANSSHIPMENT FACILITIES AT ZAMYN-UUD STATION IN MONGOLIA

FINAL REPORT
VOL. 1
SUMMARY

MARCH, 1993

JAPAN RAILWAY TECHNICAL SERVICE
PACIFIC CONSULTANTS INTERNATIONAL

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PREFACE

In response to a request from the Government of Mongolia, the Government of Japan has decided to conduct a study on the improvement plan for transshipment facilities at Zamyn-Uud station and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Mongolia a study team headed by Mr. Masaaki Fujimoto, Japan Railway Technical Service, and composed of members from Japan Railway Technical Service and Pacific Consultants International, three times between August 1992 and February 1993.

The team held discussions with the officials concerned of the Government of Mongolia and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Mongolia for their close cooperation extended to the team.

March 1993

Kensuke Yanagiya
President
Japan International Cooperation Agency

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SUMMARY

Since the railway track gauges of Mongolia and China aredifferent, 1,520 mm in Mongolia and 1,435 mm in China, the Mongolian Railway necessitates cargo transshipment facilities near the border with China. The Government of Mongolia, therefore, requested the Government of Japan in November, 1990, to make a feasibility survey of the cargo transshipment facilities at the border station of Zamyn-uud. In this context, Japan International Cooperation Agency (JICA) made a full-scale survey from August 1992 to February 1993 and established a short term cargo transshipment facilities improvement plan for the station based on the Scope of Work agreed upon between the Government of Mongolia and JICA.

Democratization of Mongolian has been accelerating since the middle of the 1980s. As a result, all the trade shifted from a barter basis to a foreign currency trade basis. In short, Mongolian economy is now in a period of transition from a planned economy to a market economy. Though about 80 percent of Mongolia's trade had been with the former Soviet Union in the past, the northbound trade significantly decreased in 1991 in the wake of the collapse of the USSR and the stagnating economies of East European countries. The democratization of Mongolia also caused a marked reduction in the amount of assistance it had been receiving from these communist countries.

The former Soviet Union made a feasibility study of cargotransshipment facilities at Zamyn-uud station in the past. This feasibility study covered transport demands, transport planning, facilities of track, cargo handling, telecommunication, signal and rolling stock maintenance, architecture and other various fields. On the basis of this feasibility study, construction of 1,435 mm tracks had been promoted until four tracks were completed in 1990, when it was suspended due to the changes in the political and economic situation in the Soviet Union. Since Mongolian economy has undergone drastic changes after this feasibility study was implemented, most of the proposals made in the study report require modifications more or less under the present circumstances.

The Railway is the most important means of freight transportin Mongolia, sharing about 70 percent of the total transport demands in ton-kilometer recorded in export, import and land bridge transport in 1991. The financial status of Mongolian Railway seems to have been sound so far in that its operation has been managed on a profit basis. However, it is now worsening and further deterioration is anticipated in the near future under the severe economic situation of the country, including the effect of everlasting inflation, pressure of increase in the personal cost and other expenditures that are indispensable for its operation.

From 1985 through 1989, the transit freight between Russiaand China occupied 95 % of the total volume of freight that passed Zamyn-uud station. After that, the volume of transit freight substantially decreased to 14 % in export and 4 % in import from the levels in 1985. On the other hand, the volume of freight transported between Mongolia and China originating or terminating in Mongolia is steadily increasing. Compared with 1985, 1991 recorded a 303 % level in export, mostly by fertilizer and copper concentrate, and a 788 % level in import, mostly by cereals and fruits.

Mongolia, once plunged into economic confusion in the wakeof the collapse of the Soviet Union, is now vigorously trying to vitalize the economy. It is believed, therefore, that the railway will play a vital role in the long distance freight transport and that the reconstruction of economy will lead to an increase in the transport volume in the future.

The target year of the demand forecast in this study was setat the year 2000. The estimated freight volumes of export, import and transit and those classified by commodity are all adopted after due consultation with Ministry of Trade and Industry and Mongolian Railway. The future economic indices including GDP, population and amounts of export and import are the statistics obtained from the State Department for National Development. The future growth rates of export and import were determined by the growth rate of GDP from 1995 to 2000 after a consultation was made with Ministry of Trade and Industry and Mongolian Railway.

As for the transport volume of petroleum, it was assumedthat the volume of import from Russia would increase by only 10 % from the present level and the balance would come from China. The volume of transit freight in the year 2000 was estimated by applying the logistic curve to the estimated value for 1991. Through deliberate discussions, the volumes to be transshipped at Zamyn-uud station in the year 2000 were estimated as 448,800 tons of import from China, and 355,200 tons of transit from China, or 803,900 tons in total, which were only 100,900 tons including 81,200 tons of import and 19,700 of transit in 1991.

According to the minutes concluded with the Ministry ofTrade and industry, Mongolia, the study team planned the cargo transshipment facilities to handle only the cargos arriving in Mongolia from China in line with the following priority order of category-wise cargo set forth in the said minutes.

(1) Package cargos of food and consumer commodities
(2) Containers
(3) Petroleum
(4) Others

As for the commodities carried by containers and wagons incommon, calculations were made for three cases where containeriza-tion ratios estimated to range from 20 to 80 %, out of which the most appropriate case was adopted for further calculations. The numbers of necessary cars were calculated based on the estimated containerization ratios and also on the types of cars for different commodities and the average freight loads per car.

Zamyn-uud station consists of eleven divisions for trainoperation, rolling stock maintenance, power generating, track maintenance, signal maintenance, hospital, fire prevention, customs clearance procedures and other related businesses. The station has a power generation plant in the compound equipped with diesel engine power generators, from which power is being supplied to the station compound and the whole community of the area.

In planning the cargo transshipment facilities at Zamyn-uudstation, a major point was the choice of the gantry crane or the combination of reach stackers and truck cranes to handle containers and cargos in gondola cars, which shall be determined taking into consideration not only the advantages and disadvantages from the technical viewpoint but also the results of economic and financial analyses of the facilities.

As for the cargos in wagons, introduction of cargo handlingequipment is limited due to the space constraint in the wagon so that forklifts and belt conveyors will be used together with manual work. Cargos in gondola cars can be handled with a truck crane or a reach stacker.

As the main cargo handling equipment, Plan 1 adopts thegantry crane and Plan 2 the reach stacker. Both Plans necessitate the same amounts of investment for signal, tele-communication, power supply equipment and forklift / conveyor for the transshipment work of cargo in wagons. Plan 1 needs more funds for the crane foundation and less for the platform pavement. As a result, there is only a small difference of the cost for civil structure and architecture work between the two Plans. On the other hand, the cost of cargo handling equipment in Plan 1 is more than twice the cost in Plan 2. Consequently, the cost of Plan 1 is about 10 percent larger than the cost of Plan 2. From the viewpoint of the investment costs, therefore, Plan 2 is more advantageous than Plan 1.

The economic analysis covered a period of 30 years from thestart of construction. If the present practice to transship cargos at Erenhot, the Chinese border station, is suspended for some reason, it may be possible that the cargos bound for Mongolia must be received at Erenhot, transported across the border by Mongolian trucks and transshipped to Mongolian freight cars at Zamyn-uud. Thus, the benefit calculation was made by taking into consideration the additional investment and charges related to the truck transportation. The economic analysis indicates that the EIRR of Plan 2, 26.28 %, is far larger than that of Plan 1, 8.88 %. This means that Plan 2 has larger benefit from the viewpoint of national economy.

In the financial analysis, it was assumed that the mostfavorable loan is available for this project from a foreign source with an interest rate of 0.75 % per annum and a 40-year equal installment for repayment including a 10-year grace period, and that domestic funds are provided at the interest rate of 2 % per annum. It was also assumed that the transshipment fee will be twice as much as the existing rate from 1993 onward and will be raised further by 25 % once in every three years, i.e., in 1966, 1999 and 2002. The financial analysis has proved that the cargo transshipment facilities using reach stackers as the main cargo handling equipment (Plan 2) with an FIRR of 1.91 % is more advantageous in various aspects, particularly when the financial burden on Mongolian Railway is taken into account. Thus, this report adopts the cargo transshipment improvement plan based on the use of reach stackers.

In addition to the cargo handling equipment, the team planned efficient track and civil structures trying to utilize as many existing facilities as possible. At the same time, the team reserve_d allowance for expansion in the future. In case the train operation and the wagon movement management are in disorder,the team planned two sheltered warehouses to store valuable cargos.

The team also planned installation of a relay interlock system with a signal switchboard and power-operated points in the yard. The team also proposes to introduce radio communications equipment for the yard work and between shunting locomotive drivers and the ground crew. The team also planned to introduce a digital exchange to accommodate 500 subscriber lines. The power generating plant should be reinforced with new generators. A necessary lighting system with mercury floodlamps will be provided at the yard, platforms and warehouses.

The team planned efficient management offices and crewhouses, utilizing as many existing facilities as possible. In planning these facilities, the team observed the convenience for future expansion, and also paid due attention to preserve good environmental conditions.

Based on some preconditions and aiming at a minimum construction cost, an urgent project was prepared by selecting part of the facilities and layout envisaged for the year 2000 with a construction cost of US$ 15,200,000 in foreign currency and US$ 2,480,000 in domestic currency or US$ 17,680,000 in total, which is recommended to be implemented as early as possible with the grand aid or soft loans from developed countries.

After the cargo transshipment facilities are commissioned,cargo transshipping work can be done by Mongolia according to the international rule, thereby making Mongolia stand at an equal footing with China. Commissioning the cargo transshipment facilities in Mongolia will also eliminate the freight cars now stagnating at Erenhot in China, to smoothen the rotation of freight cars leased from Russia and save the rental charges Mongolia is now paying to Russia in foreign exchange. The construction work and operation of the cargo transshipment facilities at Zamyn-uud will create employment opportunities and contribute to a reduction of unemployment in Mongolia.

Eventually, the implementation of the project will lead tothe development of industries, improvement of living standards, vitalization of national economy, and enhancement of Mongolia's position in the international society. Thus, it is recommended to urgently promote the project with assistance including grant aid from developed countries.

CHAPTER 1 INTRODUCTION OF THE STUDY

1-1 Background

Since the railway track gauges of Mongolia and China are different, 1,520 mm in Mongolia and 1,435 mm in China, the Mongolian Railway necessitates cargo transshipment facilities near the border with China.

In this context, the Government of Mongolia requested the Government of Japan in November, 1990 to make a feasibility survey of the cargo transshipment facilities at the border station of Zamyn-uud. Thus, Japan sent a project formation survey team to the country, in July 1991, and a mission of Japan International Cooperation Agency (JICA) in April, 1992 to discuss the scope of work of a full-scale survey. According to the results of these surveys, the Governments of Mongolia and Japan concluded an agreement on the Scope of Work for a full-scale survey to establish a short term cargo transshipment facilities improvement plan.

1-2 Objectives

The objectives of this study are to survey the conditions for the transshipment facilities at Zamyn-uud station on the border between Mongolia and China and to establish a short term cargo transshipment facilities improvement plan for the station based on the Scope of Work agreed upon between the Government of Mongolia and JICA.

In the course of this survey, the survey team tries to facilitate technology transfer to the Mongolian counterparts on the survey method, cargo transshipment facilities and related technologies. In addition, the team pays due attention to the preservation of the environment of the area.

1-3 Study Methodology

The team made a survey to establish a short term cargo transshipment facilities improvement plan for the Zamyn-uud station in various fields, analyzed relevant materials readily

available and collected up-to-date information and data in Mongolia. These materials form the basis of the blue print of the transshipment facilities of Zamyn-uud station.

The team also surveyed the current operational conditions at Zamyn-uud station and the natural conditions of the site. The team estimated transportation demands, particularly those with China, up to the year of 2000, which the team incorporated into the cargo transshipment facilities improvement plan. In establishing the plan, a priority was placed on the utilization of existing facilities as far as possible to minimize the construction costs. The team also discussed an optimal management system of the station and evaluated the effects of the project as a whole.

According to the results of the first phase field survey, the team framed the short term cargo transshipment facilities improvement plan for Zamyn-uud station, in which an optimal urgent project plan was incorporated. The team summarized the work up to the end of the first phase work in Japan in the interim report before explaining and discussing it with the Ministry of Trade and Industry and the Mongolian Railway on the occasion of the second phase field survey. Taking into account the responses from Mongolia for the interim report, the team comprehensively evaluated the short term cargo transshipment facilities improvement plan for Zamyn-uud station to draft the final report in the second work in Japan. The team also prepared the basic design for the urgent project. The team visited Mongolia with a draft of the final report including the above basic design for the urgent project to have discussions with the Government of Mongolia including the Ministry of trade and Industry and the Mongolian Railway in the third phase field survey. The team submits the final report by the end of this fiscal year after making modifications where necessary as the result of the third phase field survey.

CHAPTER 2 ANALYSIS OF PRESENT STATUS

2-1 Social and economic conditions

Mongolia, a landlocked country between the former Soviet Union to the north and the northwest and China to the south, has a typical continental climate with little precipitation and extremes of hot and cold weather spanning the year.

Its population has been growing at a relatively high rate of 2.8 percent per year since 1985, and reached about 2.154 million in 1991, of which one fourth is concentrated in Ulaanbaatar.

Democratization of Mongolian politics, triggered by the Mongolian version of perestroika, has been accelerating since the middle of the 1980s. As a result, all the trade shifted from a barter basis to a foreign currency trade basis. In short, Mongolian economy is now in a period of transition from a planned economy to a market economy.

Mongolian principal export commodities are coal, fluorite and other mineral materials, reflecting its abundant mineral resources. Its principal import goods include machinery, vehicles, chemical fertilizer and consumer commodities. Though about 80 percent of Mongolia's trade had been with the former Soviet Union in the past, the northbound trade significantly decreased in 1991 in the wake of democratization of East European countries and the collapse of USSR's economy. The democratization of Mongolia also caused a marked reduction in the amount of assistance it had been receiving from these communist countries.

2-2 Rail transport

Railway is the most important means of freight transport in Mongolia, sharing about 70 percent of the total transport demands in ton-kilometer recorded in export, import and land bridge transport in 1991. To undertake this hefty mission for the country, Mongolian Railway prepares two versions of train operation diagram for summer and winter to operate international trains on different operation diagrams. According to the

transport demands, the planned diagram is modified to operate additional trains or to change the timetable.

There are three train dispatchers for the following three control zones that divide the whole Mongolian Railway lines into three divisions.

Zone 1 : Sukhe-baatar - Zuun-hara
Zone 2 : Zuun-hara - Bagahangai
Zone 3 : Bagahangai - Zamyn-uud

A locomotive operation controller is in charge of locomotive operation in the whole lines of Mongolian Railway. Commands and information are sent through a telephone line exclusively used for this purpose. There are some areas for which the locomotive operation controller can communicate with drivers directly through a radio communication system.

When a station has freight to be dispatched, it requests freight train operation to the Wagon Control Desk of the Train Operation Division. Based on this request, a plan is established to operate freight trains and distribute wagons. The distribution plan of wagons is also sent to the Economic Planning Division. After confirming the numbers of loaded and unloaded wagons of different categories staying at each station, the Division notifies the status of the wagon distribution of the day to the Train Operation Section, Train Operation Division, by 17:00. The Train Operation Section draws a train operation diagram for the day based on the information and inform each station of the diagram by 20:00 to 8:00 through the train operation command telephone.

Since the Chinese track gauge is different from that of Mongolia, Mongolian trains are operated on the 1,520 gauge track to and from Erenhot, the Chinese border station.

Train operation to import petroleum from China started in July 1991 using the Chinese 1,435 mm gauge track laid between Erenhot and the Mongolian border station of Zamyn-uud.

In the Zamyn-uud area, the planned hauling load is 2,600

tons in the direction to Sain-shand for the 2M62 type locomotive and 2,000 tons in the direction to Erenhot for the M62 type locomotive. The hauling load is also 2,000 tons for the 1,435 mm gauge between Zamyn-uud and Erenhot.

Larger numbers of trains are operated around Ulaanbaatar station in the capital and toward the Russian border, and a smaller number of trains near the Chinese border. Comparatively larger fluctuations in freight traffic were seen from January through June in 1990 and also in the same period in 1991. The maximum fluctuation rate was about 120 %.

20-foot containers are used for freight transport between Russia and China. 3-ton and 5-ton containers are used between Mongolia and Russia and within the territory of Mongolia. Average numbers of containers transported per day are six 20-feet containers, 17 3-ton containers and 17 5-ton containers. In general, the volume of container transport is not so large in Mongolia due to a shortage of container cars and flat cars.

In addition to domestic trains, international trains are running between Russia and China through Mongolia. Since the track gauges are different between Mongolia and China, passenger trains exchange bogies at the Chinese border station of Erenhot. For the immigration and emigration procedures for passengers, the trains are required to stay at Erenhot and Zamyn-uud for long hours.

2-3 Review of Past Survey of Zamyn-uud Transshipment Facilities

The former Soviet Union's feasibility study of cargo transshipment facilities at Zamyn-uud station was implemented by All USSR Export and Import Corporation and Ural Transport Facilities Design Institute based on the contract between the said Corporation and Complex Import Corporation in Mongolia which was concluded according to the "Agreement on Economy, Science and Technology, 1986 to 1990" reached on January 15, 1986 between the Soviet Union and Mongolia.

This feasibility study covered transport demands, transport

planning, facilities of track, cargo handling, telecommunication, signal and rolling stock maintenance, architecture and other various fields.

In this feasibility study, the volumes of cargos to be transshipped every year at Zamyn-uud in the 2000s are estimated to be 850,000 tons of import and 1,690,000 tons of export.

On the basis of this feasibility study, construction of 1,435 mm tracks had started. However, the construction work was suspended after four tracks had been completed in 1990 due to the changes in the political and economic situation in the Soviet Union.

Since the economic situation of Mongolia has undergone drastic changes after the feasibility study was implemented by the former Soviet Union, most of the proposals made in the feasibility study report require modifications more or less under the present circumstances.

2-4 Agreement between Mongolia and China

Mongolian Railway has an agreement with China on the cargo transshipping work currently undertaken at the border station in China, based on which both countries are having a meeting every year to discuss related procedures including train operation, communication, operation of wagons and so forth. After the commissioning of cargo transshipment facilities at Zamyn-uud station, the existing agreement is to be amended accordingly.

2-5 MR Management and Operation

The financial status of Mongolian Railway seems to have been sound so far in that operation has been managed on a profit basis. As a result, the Railway has been able to manage without receiving subsidies to be extended to loss-incurring state-owned enterprises. Currently, the Railway has its own funds enough for its payment and has not borrowed money from the government nor from banks. However, its financial position is now worsening and further deterioration is anticipated in the near future under the severe economic situation of the country, including the effect of

everlasting inflation, pressure of increase in the personal cost and expenditures for fuel, electricity and other substantial materials that are indispensable for its operation.

2-6 Facilities and Assets of Mongolian Railway

Starting at the boundary with Russia, about 600 m high from the sea level, the railway climbs along the Orkhon river up to the height of 1,410 m at the 372 km point (372 km from the boundary station of Naushki in Russia), then descends along the Tuur river toward Ulaanbaatar, the altitude about 1,300 m. Around the 372 km point, there are sections of steep gradient, 18/1,000, and curves with radius 290 m, which is a design to avoid construction of tunnels.

After Ulaanbaatar, the line passes a number of gradients, 9/1,000 and small curves, radius 290 m, embankment and cuttings, to ascend up to 1,702 m at the 471 km point, the maximum height of the Mongolian Railway lines, and descends again to Airag and further to Sain-shand in the Gobi desert, before it reaches the boundary station of Zamyn-uud which is 962 m high from the sea level.

Major stations of Mongolian Railway include Sukhe-baatar (23 km point from the Russian border station), Darkhan-1 (122 km point), Erdenet (164 km point), Tolgoit (395 km point), Ulaanbaatar (402 km point) and Zamyn-uud (1,111 km point).

Power is being supplied to Mongolian Railway from power plants in Ulaanbaatar and Darkhan, and also from its own power plants at Sain-shand and Zamyn-uud.

All stations of Mongolian Railway adopt the multiple color light signal system, with the aspects of R, Y, G as the basic signals, and Y-flash, YY, GG and W.

The relay interlock system is adopted at all stations with Russian equipment except for the section between Zamyn-uud station and P52 signal station.

All stations under the relay interlock system except Zamyn-uud station are equipped with power-operated points. There are some side tracks installed with hand-operated points.

Telecommunication lines consist of eight pairs of 4 mm bare wires, i.e., two pairs of steel copper wires and six pairs of steel wires. Steel copper wires are used for 3CH and 12CH frequency division multiplex transmission. Steel wires are used to send train operation commands and signals, and for the communication between stations and other purposes.

Twelve major stations are equipped with automatic telephone exchanges, accommodating 50 to 2,000 lines each.

Radio communication is adopted between train locomotives and major stations in the frequency band of 2130 to 2150 kHz. Radio communication is also in use between shunting locomotives and ground staff in the frequency band of 150 to 156 MHz.

Mongolian Railway has 200 passenger cars including sleeping cars and dining cars and four types of locomotives, 122 numbers in total, all diesel electric, including the most powerful 2M62, with output 4000 HP, hauling capacity 17 passenger cars or 38 freight cars, or tractive load of 4,000 to 5,000 tons on level sections and 1,500 tons at 18/1,000 gradients.

2-7 Natural Conditions at Zamyn-uud Station

Zamyn-uud station is located in the region known as the Gobi desert in the south of Mongolia, where dark brown earth of the desert is distributed and gravels cover the ground surface. The soil in the vicinity of Zamyn-uud station contains more than one percent of water soluble salinity. The loam content in the soil is only 0.3 to 1 %. The ground water is sodium chloride water having a fairly high mineralizing effect and hardness, with extremely weak hydraulic pressure. Belonging to a low humidity zone, this region is characterized by a continental climate with extremely dry air and a scarcity of atmospheric precipitation, 120 to 160 mm per year. The temperature reaches 40.7 ^{0}C in summer and goes down to -37.2 ^{0}C in winter. The wind velocity varies depending on the season, with the annual average velocity of 4.9 m/sec and the maximum velocity of 26 to 34 m/sec. The maximum relative humidity is 60 to 72 % in winter and 44 to 60 % in summer.

In this region, there is an abundance of different grades of sand with low water content and roughly intermediate density, which can be used to make the track bed and prepare the land for the construction site.

2-8 Status of major freight handling stations

Mongolian Railway has 40 freight handling stations. They include loading stations such as Sharyngol and Baganuur for coal, Erdenet for copper concentrate and Borondor for fluorspar. Similar handling work is conducted at different stations for the same categories of freight using cargo handling equipment such as cranes, forklifts and shovel cars depending on the categories and packing styles of cargos. Coal is transported by wagons of special structure of which the floor opens downward on both sides. Ulaanbaatar's coal unloading lines are elevated to facilitate the unloading work. The unloading time length for coal differs to a large extent in summer and winter, since coal freezes in winter to make unloading difficult.

2-9 Status of Zamyn-uud station

There are no industrial products in the Zamyn-uud area, where only railway employees and their dependants live. In the station yard, a power generating plant is in operation. For these reasons, there is little freight dispatched from the station. The freight handled at the station is therefore mostly fuel, construction materials, foodstuff and consumer commodities that arrive at the station. The volume handled at the station increased from 14,000 tons in 1988 to 38,000 in 1990 and 45,000 tons in 1991.

From 1985 through 1989, the transit freight between Russia and China occupied 95 % of the total volume of freight that passed the station. After that, the volume of transit freight substantially decreased to 14 % in export and 4 % in import from the level in 1985.

On the other hand, the volume of freight transported between Mongolia and China originating or terminating in Mongolia is

steadily increasing, though the volume itself is not yet large. Compared with 1985, 1991 recorded a 303 % level in export, mostly by fertilizer and copper concentrate, and a 788 % level in import, mostly by cereals and fruits.

Zamyn-uud station consists of eleven divisions for train operation, rolling stock maintenance, power generating, track maintenance, signal maintenance, hospital, fire prevention and other business purposes. Ninety-two employees belong to the train operation division of the station headed by a station master. Zamyn-uud station features the following.

(1) Customs clearance procedures as a border station.
(2) Stationing staff at the Chinese border station of Erenhot to witness the freight transshipment.
(3) Locally operated points in the yard.

The track bed is made as a flat embankment made of soil with homogeneous properties, mainly sands of Gobi desert. Embankment has been completed for four departure and arrival tracks of 1,435 mm gauge.

Construction of embankment is required at the transshipment site and other areas. Most of the existing facilities are deteriorated and require proper remodeling and repair.

For entry from Ulaanbaatar and Erenhot sides, Zamyn-uud station is equipped with entry signals No. 1 and No. 2.

Trains are operated under the tablet block system between Zamyn-uud and P52 signal station. Communication between the stations is made through telephone. The 1,435 mm track is protected by a semi-automatic relay block system, type 64, with 25-meter track circuits.

Points are all the hand-operated type with two keys for normal and reverse positions. Keys have registration numbers.

Telecommunication into the direction of Ulaanbaatar uses eight pairs of bare wires, of which two pairs are steel copper wires for 3-channel and 3- to 12-channel multiplex transmission and six pairs are steel wires for communications for different

purposes. The station is connected with Erenhot with eight pairs of steel wires used for signal, telephone and exchanging information on cargo movement.

Wireless telecommunication is also in use between shunting locomotives and ground staff in the frequency band of 150 to 156 MHz.

Zamyn-uud station has a power generation plant in the compound equipped with diesel engine power generators, from which power is being supplied to the whole area. In case the power plant fails, a transmission line at 10 KV connects the area with Sain-shand, 230 km distant, to supply power to important facilities in the Zamyn-uud district.

For the maintenance of rolling stock, 47 workers are now working at the station in the daytime and night shifts against the authorized number of 51.

2-10 Capacity for Construction Work and Relevant Laws

Except for Mongolian Railway itself, there are virtually no entities within the country that can undertake railway construction. To promote large scale construction projects, therefore, Mongolia can not help but rely in large part on foreign technologies, machines and materials along with hiring experienced foreign consultants for the time being.

However, basic resources for construction work are available in Mongolia. Ballasts for tracks are produced near the Russian border and crushed stones for concrete are being produced near Ulaanbaatar. Wooden sleepers are also manufactured in the country. There is a factory in Ulaanbaatar that is producing precast concrete for basic building materials such as posts, beams, walls and drains. As for the domestic products, however, strict quality and process controls are required. Sandy earth used to raise the ground level is available in abundance to the north of Zamyn-uud.

Even when they are locally available, construction machines must be transported from Ulaanbaatar or other areas by rail. Some must be procured from China, Russia or other countries.

Workers may probably have to be brought from Ulaanbaatar or other places as well. In this regard, China is keen to co-operate in supplying the necessary work force.

Mongolia does not have any construction standards or regulations of its own. Russian standards and regulations have been applied hitherto to the construction work in the country.

CHAPTER 3 FREIGHT TRAFFIC DEMAND FORECAST

3-1 General Condition of Rail Freight Transport

Mongolia, once plunged into economic confusion in the wake of the collapse of the Soviet Union, is now vigorously shifting to a market economy. In this context, it is believed that the railway will play a vital role in the long distance freight transport and that the reconstruction of economy will lead to an increase in the transport volume in the future.

3-2 Estimate of Rail Freight Transport Volume

The target year of the demand forecast is set at the year 2000. The estimated freight volumes of export, import and transit and those classified by commodity in this chapter are all adopted after due consultation with Ministry of Trade and Industry and Mongolian Railway. The future economic indices including GDP, population and amounts of export and import are the statistics obtained from the State Department for National Development.

The future growth rate of export and import was discussed by three methods. First, the amounts of export and import were estimated by multiplying the per capita amounts in 1995 by the number of population in 2000 to make the ratio of the product to the 1995 value as the growth rate. This did not seem to be consistent, however, with the premises of a stable economic growth. Second, the growth rate was sought by treating the amounts of export and import to follow a simple trend. Since the years up to 1995 are in the economic restructuring period, this

figure gives a fantastically high growth rate. Therefore, the growth rate of GDP from 1995 to 2000 was adopted as a practical value after consulting with Ministry of Trade and Industry and Mongolian Railway.

As the rate of contribution, or the ratio of freight moving between Mongolia and China to that moving between Mongolia and Russia, the values of 1990 and 1991 were adopted in view of the changed trade map of Mongolia in recent years.

As for the transport volume of petroleum, the rate of contribution was determined on the assumption that the amount of import from Russia would increase by only 10 % from the present level and the balance would come from China, thus the ratio becoming 34 to 36, which was also agreed upon by Ministry of Trade and Industry and Mongolian Railway.

The volume of transit freight in the year 2000 was estimated by applying the logistic curve to the estimated value for 1991. The rate of contribution in this case was the value of 1990 or 1991.

3-3 Transshipment Freight Volume at Zamyn-uud

Through the above discussions, the volumes to be transshipped at Zamyn-uud station in the year 2000 were estimated as 448,800 tons of import from China, and 355,200 tons of transit from China, or 803,900 tons in total.

CHAPTER 4 PLANNING CARGO TRANSSHIPMENT FACILITIES AT ZAMYN-UUD STATION

4-1 Basic Policy for Planning Cargo Transshipment Facilities

According to the minutes concluded between the Ministry of Trade and industry, Mongolia, and the study team on September 1, 1992, the team planned the cargo transshipment facilities to handle only the cargos arriving in Mongolia from China.

The team framed the cargo transshipment facilities implementation plan for Zamyn-uud station in line with the following

priority order of category-wise cargo transshipment facilities set forth in the said minutes.

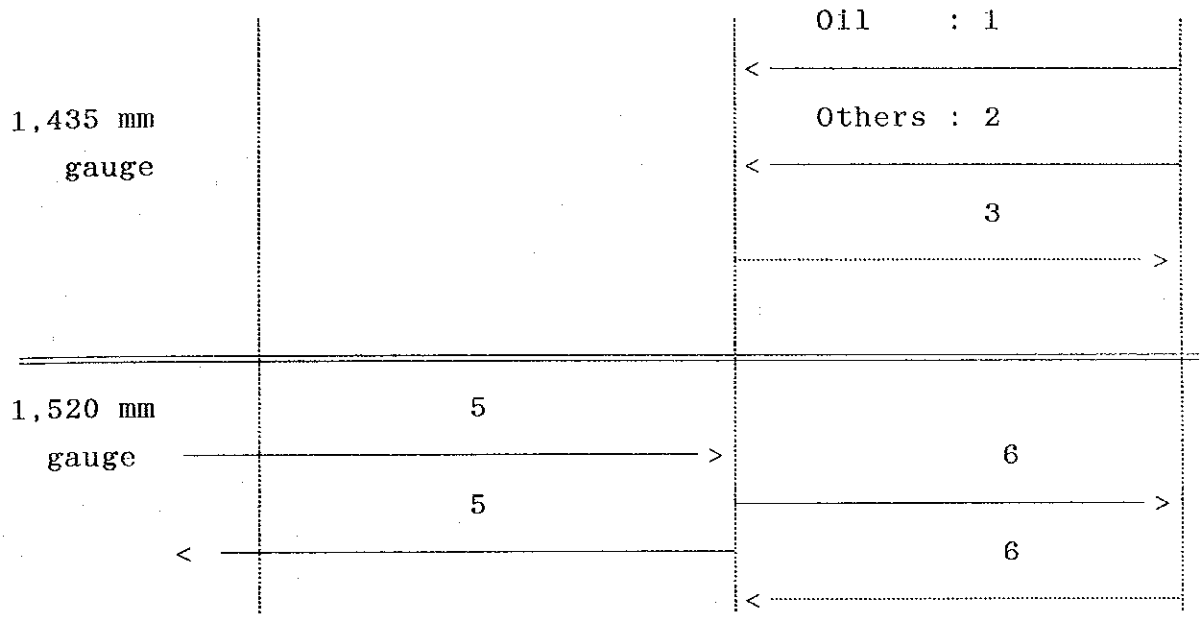
(1) Package cargos of food and consumer commodities
(2) Containers
(3) Petroleum
(4) Others

4-2 Freight Transport Planning

The transport plan was framed to deal with freight arriving in Mongolia from China and that passing through from China to Russia which were estimated for the year 2000. As for the petroleum, the existing facilities can cope with the transport demand up to the year 2000. The traffic fluctuation is assumed to be 120 % of the monthly average. Packing styles of arriving freight and types of cars used were determined based on the past results in Mongolia. The loads of freight per car classified by commodity were adopted from the records of international freight for the five years from 1985 to 1989. The hauling capacity per freight train is in accordance with the Mongolian Railway's regulations and the agreement between the Mongolian and Chinese Railways. The time lengths required to transship a container or cargos on a car are 4 to 5 minutes for a container, 30 to 40 minutes for a gondola car and 2.5 hours for a wagon. As for the commodities carried by wagons and gondola cars, it was estimated that 50 % of each commodity would be carried by each type of car. As for the commodities carried by containers and wagons in common, calculations were made for three cases where containerization ratios estimated to range from 20 to 80 %, out of which the most appropriate case was adopted for further calculations. The numbers of necessary cars were calculated based on the estimated containerization ratios and also on the types of cars for different commodities and average loads of freight per car.

Based on the above assumptions, the train operation plan was established. The chart below summarizes the number of train operation per day for the two different track gauges, where solid

lines represent trains of loaded cars and dotted lines trains of empty cars.



In drawing up the operation schedule of freight trains, care was taken to operate trains at equal intervals as far as possible. The minimum staying time at Zamyn-uud station was set at three hours to prepare for shunting work and customs clearance procedures.

4-3 Track and Civil Structure

The team planned efficient track and civil structure based on the transport plan determined by the transport demands, trying to utilize as many existing facilities as possible. At the same time, the team considered allowance for expansion of the facilities in the future. What the team paid attention to includes the following.

(1) Transport plan
(2) Arrangement to allow efficient transshipment work
(3) Utilization of existing facilities
(4) Possibility for future expansion

(5) Durability against the severe natural conditions
(6) Environmental preservation

The preconditions for planning the track and civil structure are as follows.

(1) Freight car operation plan according to the freight transport plan in 4-2
(2) Train operation plan according to the freight transport plan in 4-2
(3) Standard track profile based on the standards of Mongolian Railway
(4) Track bed structure based on the standards of Mongolian Railway
(5.) Track structure based on the standards of Mongolian Railway

The number and effective length of tracks were determined as shown in Table 4-3-5 based on the number of freight cars handled per day, frequency of train operation (Table 4-3-2) and other relevant factors.

Table 4-3-2 Frequencies of train departure and arrival at Zamyn-uud station

Category	Sain-shand to Zamyn-uud	Zamyn-uud to Erenhot	Total
Arrival	All loaded 5	All unloaded 6	11
Departure	Loaded and unloaded 5	All loaded 6	11
Total	10	12	22

Table 4-3-5 Number and effective length

Name	1,435 mm		1,520 mm	
	Number of track	Effective length (m)	Number of track	Effective length (m)
1. Departure & arrival	3	820	6	850
2. Uncoupling & coupling track	-		2	620
3. Sorting track	3	310	6	400
	1	440		
4. Draw-out track	1	460	2	450
5. Draw-out track for tank car	1	210	1	330
Cargo transshipment platform				
1. Roofed high platform	1	240	1	240
2. Open low platform	1	240	1	240
3. Container platform	1	430	1	430

Lengths of the platforms are 240 m for wagons, 240 m for gondola cars and 430 m for container cars as given in Table 4-3-4.

To design the arrangement of cargo platforms in the

sectional direction, the team reserved allowance for expansion in the future to the side of the low platform to prepare for progress of containerization. For this reason, the team arranged the platforms in the order of roofed high platform, container platform and gondola car platform.

To preserve the good environmental conditions, attention was paid, among others, to the following.

(1) Oil and dirt produced from the rolling stock maintenance work.
(2) Leak oil from the oil filling station
(3) Debris, waste water and dirt produced at the car washing site.

The team planned to install oil reserve tanks for the exhaust in the above paragraphs (1) and (2), and purification facilities for the exhaust in the paragraph (3).

4-4 Cargo Transshipment Equipment

There are a variety of cargo handling equipment to be used for different packing styles and quantities to be handled at different places. In some cases, specially designed machines are required including unloaders and loaders, stackers, reclaimers, gantry cranes, jib cranes, container cranes and so forth. Containers are generally heavy and large in size so that cargo handling machines are installed outdoors at container yards. Machines used at container yards include gantry cranes, reach stackers, forklifts straddle carriers and trailers.

Cargo handling work at railway stations is featured by the fact that various categories of cargos are involved and available spaces are limited in the freight cars.

In view of the specific features of cargo handling work, i.e., transshipment from Chinese freight cars to Mongolian freight cars, the cargo handling equipment to be used at Zamyn-uud station must satisfy the requirements for safety, efficiency and easy maintenance, and have capabilities to cope with

different packing styles and freight car structures.

The objects of transshipment work at Zamyn-uud station are classified largely into the following three categories.

(1) Cases, bags and canned goods of relatively small volume and weight loaded on box wagons.
(2) Heavy, long-size and bulky cargos loaded on gondola cars.
(3) Transshipment of containers loaded on container cars. (In this regard, it must be noted that Mongolian Railway does not have a sufficient number of container cars so that containers are often loaded on flat cars.)

As for the cargos in wagons, introduction of cargo handling equipment is limited due to the space constraint in the wagon so that forklifts and belt conveyors will be used together with manual work. Cargos in gondola cars can be handled with a truck crane, reach stacker or gantry crane. For the transshipment work of containers, adoption of gantry crane or reach stacker is conceivable.

If a gantry crane is adopted, the operator can command a good visibility over the crane bay. Its spreader can be adjusted easily. Mongolian and Chinese tracks can be laid adjacent to each other to reduce the distance of the cargo transfer traffic line. Gantry cranes are widely used and Mongolian Railway is highly experienced in the operation and maintenance.

Reach stackers, on the other hand, handle cargos by extending and contracting the lifting beam, to cover containers placed some distance away. It requires a travelling path of some length in the container yard. Unlike a forklift, it can approach a container diagonally to some extent to the side of the object. It can transport containers to distant places with its own motive power. Though only a few sets are in use in Japan, they are now increasingly being adopted in various countries.

In this report, adoption of gantry crane (Plan 1) and reach stacker (Plan 2) are studied.

4-5 Signal, Telecommunication and Power Supply

The team planned to install home signals, departure signals and shunting signals based on the track layout plan.

In the section between Zamyn-uud and P52 signal station, the team planned to introduce a special automatic block system using the existing lines for the tablet block system. P52 station will be equipped with necessary signals, power-operated points and track circuits. The team planned to introduce AC power-operated points with electric heater and relay interlock equipment at Zamyn-uud station.

For the convenience of shunting work, the team planned to introduce radio communication equipment for communications between the signal operation center, shunting locomotives and ground crew in the yard.

The team planned to install speakers of the talk-back system near the shunting signals and points to facilitate communications between the ground crew for shunting, maintenance and inspection.

The team planned to introduce a digital exchange to replace the step-by-step exchange in the telecommunication center which often fails and is short of spare parts.

The team also planned to introduce the voice call telephone system for communications between the signal operation center and offices for train operation work.

A necessary electric power supply system shall be provided to meet the demands for the new transshipment facilities. In the year 2000, two sets of new 750KW generators shall replace the existing two sets of 630 KW generators, reserving the existing 800 KW generator as a standby unit. Necessary lighting equipment shall be prepared for the transshipment work at the platforms and in the yard.

4-6 Storage

In case the train operation and the wagon movement management are in disorder, the team planned storage facilities. The team also planned two warehouses under the roof at the ends of the high deck platform to store valuable cargos remained in the

freight cars on the 1,520 mm and 1,435 mm gauge tracks. The sizes of these warehouses were determined to allow storage of all the cargos loaded on a wagon.

In case the normal train operation or wagon flow control is disturbed, the team planned two temporary storage spaces, each for cargos in gondola cars and container cargos.

The team also planned to install fences around the cargo transshipment platforms to prevent invasion of unauthorized people and burglary.

4-7 Management Office and Crew Houses

The team planned efficient management offices and crew houses, utilizing as many existing facilities as possible. In planning these facilities, the team observed the convenience for future expansion, and also paid due attention to the following.

(1) Management and operation plan
(2) Facility arrangement to allow efficient station activities
(3) Utilization of existing facilities
(4) Durability against the severe natural conditions
(5) Possibility for future expansion

The preconditions for planning the management offices are as follows.

(1) Employee recruitment plan according to Chapter 9 "Management and Operation Plan."
(2) Existing facilities
Table 4-7-1 in the report shows the possibility of utilization of the existing facilities.
(3) Structure
The team planned the facilities basically according to the standards of Mongolian Railway.

According to the preconditons, the team planned offices and houses to efficiently carry out the cargo transshipment work.

Since it is required to give houses to 165 employees, the team planned to build 70 houses, unit floor space 40 m^2, for family use and 100 houses, unit floor space 20 m^2, for unmarried employees.

Table 4-7-2 below lists major buildings including the offices for freight handling, storage house, signal equipment rooms, site crew houses, and parking and maintenance sheds.

Table 4-7-2 Houses to be built or remodelled

Name	Area (m^2)	Remarks
1 Site office	600	To the side of 1,520 mm gauge marshalling tracks in the cargo transshipment yard
2 Signal operation room	400	Near the station main office
3 Signal equipment room (A)	30	Near the 1,435 mm gauge marshalling tracks
4 Signal equipment room (B)	30	To the side of 1,435 mm gauge marshalling tracks in the cargo transshipment yard
5 Site crew house	40	Near the 1,435 mm gauge marshalling tracks in the cargo transshipment yard

6	Garage for truck cranes	210	15 x 7 x 2 to accommodate two cars
7	Garage for reach stackers	210	To accommodate two stackers
8	Cargo storage house	600	300 m^2 x 2
9	Depot (1,520 mm)	1,708	To be remodelled
10	Depot (1,435 mm)	300	20 x 15
11	Wagon cleaning shed	1,250	50 x 25

CHAPTER 5 ALTERNATIVE PLANS

5-1 General

In planning the cargo transshipment facilities at Zamyn-uud station, the team discussed the methods of transshipment as described in Chapter 4. The major point was the choice of a gantry crane or the combination of reach stackers and truck cranes to handle containers and cargos in gondola cars, which shall be determined taking into consideration not only the advantages and disadvantages from the technical viewpoints but also the results of economic and financial analyses of the facilities.

The difference between Plan 1 (gantry crane) and Plan 2 (reach stacker / truck crane) is only the handling equipment for containers and cargos in gondola cars. Both Plans envisages therefore the same equipment to transship cargos in wagons, access to the cargo transshipment facilities, tracks, signal and telecommunication equipment, rolling stock washing equipment, maintenance equipment, station buildings and others.

Below explained are the methods and facilities adopted in Plans 1 and 2.

5-2 Plan 1 (Gantry crane)

(1) Method of transshipment

a) Cargos in wagon are transshipped with small size fork-lifts and belt conveyors, supplemented by manual work where necessary.

b) Containers are transshipped with a gantry crane with attachements for container transshipment

c) Cargos in gondola car are transshipped with the gantry crane.

(2) Platforms for transshipment work

a) Cargos in wagon : A roofed high concrete platform : width 15 m, length 240 m, height from rail, 1.10 m

b) Containers : A low concrete platform : width 9.5 m, length 430 m

c) Cargos in gondola car : A concrete platform : width 11 m, length 240 m

(3) Civil structure (other than platforms)

a) Foundation for gantry crane

b) Fences, gates and drainage

c) Track facilities : Tracks (gauges 1,520 mm and 1,435 mm), points, car stops and a crossing

d) Roads for operation and access

e) Water supply equipment (an elevated water tank)

f) Rolling stock washing facilities

(4) Architecture

a)	Cargo handling site office	600 m^2
b)	Signal operation center	400 m^2
c)	Signal equipment room	30 m^2
d)	Site crew house (including the signal equipment room)	72 m^2
e)	Residential houses (for 180 employees)	8,100 m^2
f)	Machine storage house	340 m^2 x 2
g)	Cargo warehouse	600 m^2
h)	Depot maintenance shed (existing)	1,708 m^2

- do - (to be newly built) 300 m^2

i) Car washing house 1,250 m^2

(5) Cargo handling equipment

a) RMG container crane (rail-wheel type), span 19 m

b) Gantry crane, 20 t

c) Forklift, 1.5 t

d) Portable conveyor

e) Auxiliary facilities and parts

Oiling facilities

Rolling stock maintenance facilities

Spare parts for operation of two years

(6) Signal and telecommunication equipment

a) Block equipment

b) Signal equipment

c) Interlock equipment

d) Power supply equipment

e) Switching equipment

f) Track circuits

g) Transmission lines

h) Air conditioning equipment

i) Radio communications equipment

j) Talk-back equipment

k) Telephone exchange

l) Voice communication equipment

(7) Power equipment

a) Generator

b) Lighting instruments

c) Power supply lines

5-3 Plan 2 (Reach stacker)

(1) Method of transshipment

a) Cargos in wagon are transshipped by the same method as

in Plan 1.

b) Containers are transshipped with a reach stacker.

c) Cargos in gondola car are transshipped with a truck crane.

(2) Platforms for transshipment work

a) Cargos in wagon : Same as in Plan 1

b) Containers : A low concrete platform : width 36 m, length 430 m

c) Cargos in gondola car : A low concrete platform : width 20 m, length 240 m

(3) Civil structure (other than platforms)

a) Foundation for gantry crane is not necessary.

b) Fences, gates and drainage : Same as in Plan 1

c) Track facilities : - do -

d) Roads for operation and access : - do -

e) Water supply equipment : - do -

f) Rolling stock washing facilities : - do -

(4) Architecture : Same as in Plan 1

(5) Cargo handling equipment

a) Reach stacker

b) Track crane, 35 t

c) Forklift : Same as in Plan 1

d) Portable conveyor : - do -

e) Auxiliary facilities and parts : - do -

(6) Signal and telecommunication equipment : Same as in Plan 1

(7) Power equipment : Same as in Plan 1

5-4 Layout of the cargo transshipment facilities in the year 2000

Figures 5-4-1 and 5-4-2 in the report show the layout of

cargo transshipment facilities in the year 2000 in Plan 1 and Plan 2, respectively.

CHAPTER 6 PRELIMINARY DESIGN

6-1 Track, Civil Structure and Building

After discussing the train operation, departure and arrival frequencies of trains, shunting work to be conducted at the station, the team made preliminary design on the track layout, civil structure and buildings, based on the design standards adopted by Japanese Institute of Civil Engineers and the Railway Facilities Bureau / Construction Bureau. See Tables 6-1-1 to 6-1-4 and Figs. 6-1-1 to 6-1-3.

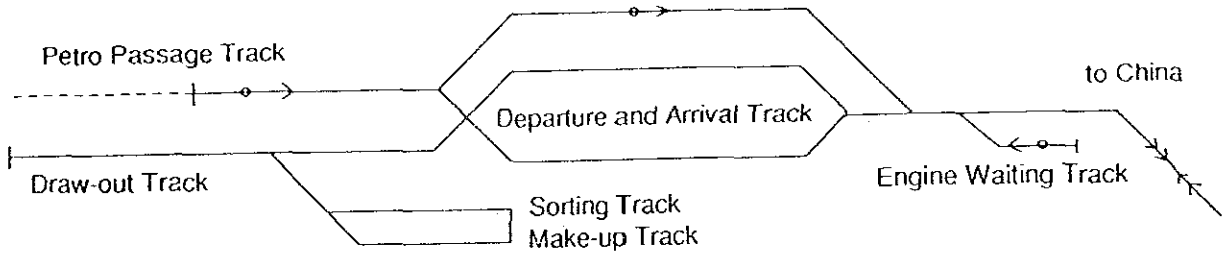


Fig. 6-1-1 Departure and Arrival Tracks (1,435mm)

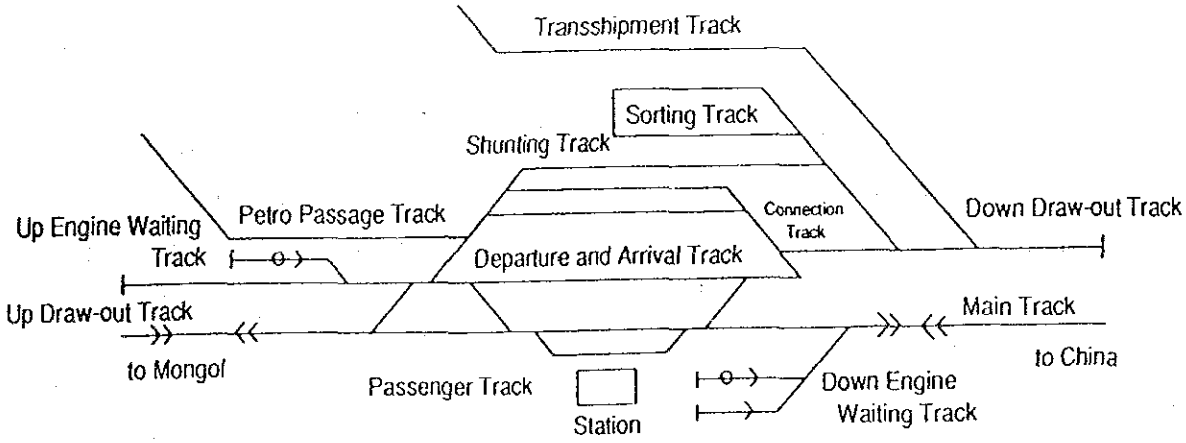


Fig. 6-1-2 Departure and Arrival Track (1,520mm)

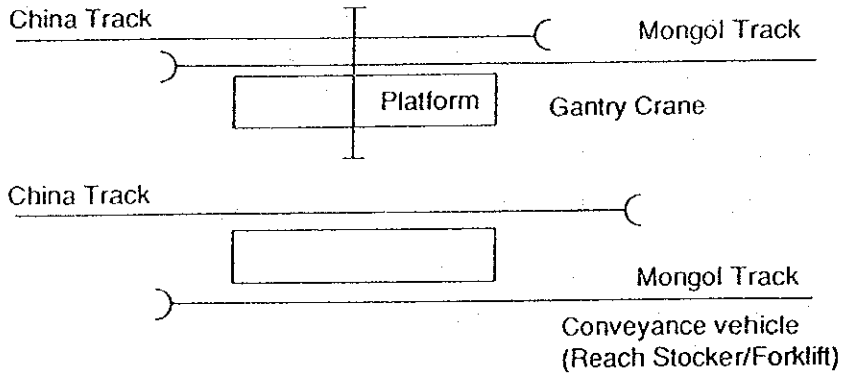


Fig. 6-1-3 Track Layout by Different Transshipment Equipment

Table 6-1-1 Effective length of dept/arr tracks (1,435 mm)

	Existing (m)	Planned (m)
Main track	840	840
Track No. 1	840	840
Track No. 2	830	830
Track No. 3	700	770
East engine waiting track		50

Table 6-1-2 Effective length of dept/arr tracks (1,520 mm)

	Existing (m)	Planned (m)
Main track	761	761
Track No. 1	891	891
Track No. 2	868	900
Track No. 3	769	890
Track No. 4	767	870
Track No. 5	714	845
Track No. 6	714	714
Up engine waiting track	2 x 120	1 x 120
Down engine waiting track	2 x 120	2 x 120
Make-up/break-down track No. 1		650
Make-up/break-down track No. 2		620

Table 6-1-3 Effective length of shunting tracks (1,435 mm)

Draw-out track	460 m
Sorting track No. 1	440 m
Sorting track No. 2	440 m
Sorting track No. 3	360 m
Sorting track No. 4	360 m (Future)
Sorting track No. 5	300 m (Future)

Table 6-1-4 Effective length of shunting tracks (1,520 mm)

Down draw-out track	550 m
Up draw-out track	450 m
Sorting track No. 1	480 m
Sorting track No. 2	430 m
Sorting track No. 3	430 m
Sorting track No. 4	380 m
Sorting track No. 5	380 m
Sorting track No. 6	330 m (Future)
Sorting track No. 7	330 m (Future)
Sorting track No. 8	330 m (Future)

6-2 Transshipment Equipment

Table 6-2-1 summarizes the cargo handling equipment adopted in Plan 1 and Plan 2.

Table 6-2-1

Car type	Equipment	
	Plan 1	Plan 2
Wagon	Forklift x 4 Nos. Portable conveyor x 4 Nos.	
Container car	Gantry crane x 2 Nos.	Reach stacker x 2 Nos.
Gondola	Gantry crane x 1 No.	Truck crane x 1 No.

6-3 Signal, Communication and Power Supply

The team planned to install the following signal equipment.

(1) Departure signal, home signal, calling-on signal and shunting signal
(2) Route indicator for home signal
(3) Track indicator for shunting signal (for three and multiple routes) and track indicator lamp where a large number of shunting signals are installed.
(4) Inspection stand for signal equipment where necessary.

The team also planned to introduce special automatic block system in the section between Zamyn-uud and P52 signal station using the existing lines of tablet block system.

The team planned installation of a relay interlock system with a signal switchboard and the AC NS-A type points for the main line and the AC YS type points for side tracks.

The team planned to adopt a frequency of 50 Hz for the track circuit current.

The team proposes to introduce radio communications equipment, frequency 150 to 156 MHz, for the communications between the station and the signal operating cabin and between shunting

locomotive drivers, yard men, lever operators and other crew in the yard.

The team planned to install talk back equipment near major shunting signals and points for the convenience of shunting and maintenance work.

The team also planned to introduce a digital exchange to accommodate 500 subscriber lines and replace the existing step-by-step exchange, capacity 200 lines, which is superannuated and prone to errors.

Voice call telephones will be used in the offices engaged in train operation.

The power generating plant will be reinforced with new generators driven by medium speed diesel engine along with auxiliary devices. A necessary lighting system with mercury floodlamps will be provided at the yard, platforms and warehouses.

CHAPTER 7 COST ESTIMATE

7-1 Calculation Method

In this study, the project costs have been calculated under several preconditions including the following.

(1) Locally available construction machines are fully utilized. However, Japanese calculation standards are applied to their rental charges and related costs.
(2) Materials available in Mongolia are used on a priority basis. Imported materials are assumed to come from Japan only for the calculation purpose, since the market trends in other countries are unknown or differ from one country to another.
(3) Except for skilled workers, workers are all recruited in Mongolia.
(4) Some rates of overhead charges, managing costs and temporary expenses are surcharged.

7-2 Work Quantities for Outline Calculations

There is little difference of civil engineering work quantities between Plan 1 and Plan 2. See Chapter 11 for the quantities of machines to be equipped.

7-3 Total Construction Costs

For the total construction costs in Plan 1 and Plan 2, see Chapter 11.

CHAPTER 8 IMPLEMENTATION PLAN

8-1 Effectuating Authorities

The effectuating authorities are Ministry of Trade and Industry, Mongolia, and Mongolian Railway.

8-2 Implementation of Construction

In view of the present circumstances of Mongolian Railway, the construction work should be carried out jointly by construction companies from technically advanced countries and their Mongolian counterparts, utilizing the indigenous materials and manpower as much as possible.

8-3 Implementation Schedule

See Fig. 8-3-1 for the implementation schedule for this project.

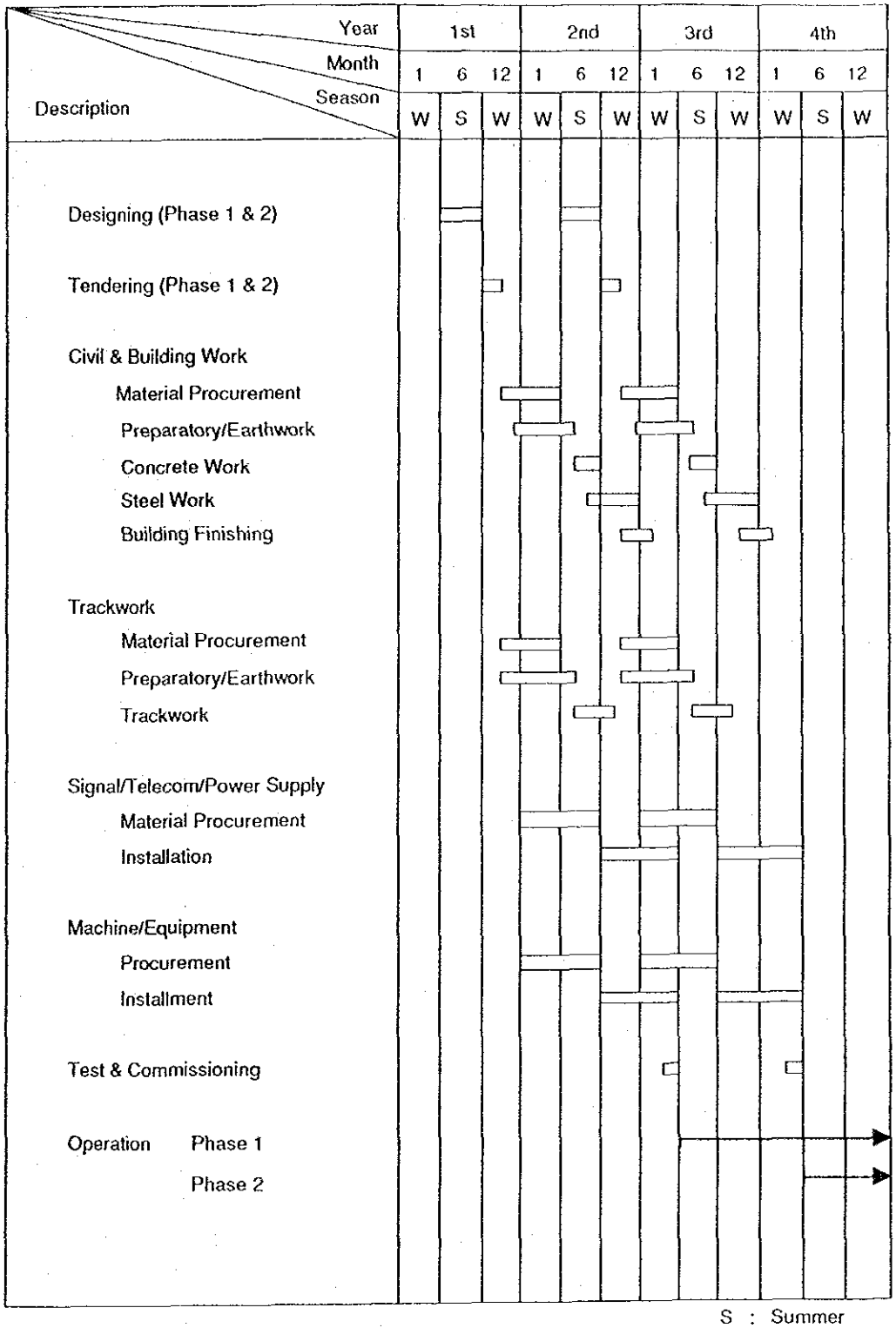


Fig. 8-3-1 Implementation Time Schedule for Zamyn-Uud Transshipment Facility Project

CHAPTER 9 OPERATION AND MANAGEMENT

9-1 Operation

International freight transport between two countries having different track gauges requires transshipment of cargo at the border stations. According to the international practice, it is a rule that the recipient country transships the arriving cargos. In the case of Mongolia and China, however, the transshipment is being carried out at Erenhot in China despite this international practice, since Mongolia does not have transshipment facilities at its border station.

After the completion of the transshipment facilities now planned for Zamyn-uud station, it must be operated efficiently to facilitate smooth cargo transport between Mongolia and China.

9-2 Organization

Since Zamyn-uud station is located near the border with China, a remote place from large towns, the increase of employees must be limited to a minimum, by utilizing the present work force as much as possible. For this reason, it is necessary to:

(1) Operate the station with the present organizational structure without organizing new divisions.
(2) Introduce efficient work procedures for the cargo transshipment work, and
(3) Cope with the increased workloads by improving the efficiency of the present work force.

9-3 Number of employees

To operate the cargo transshipment facilities, 165 employees shall be newly adopted. They include cargo transshipment workers, inspectors of cargo transshipment work, interpreters for Chinese inspectors, yard men for shunting, signal men to handle signals and the relay interlock system, point men, guards for prevention of thefts, staff for the maintenance of rolling stock and facilities, and engine drivers. In case the workload

increases in the future, train dispatchers, errand workers and customs document officers will additionally be recruited.

9-4 Training

Before and after the commissioning of the cargo transshipment facilities, training of the staff is required for operation and maintenance of cargo handling equipment, signal, switching and relay interlock equipment, telecommunication equipment and power supply equipment and others.

Prior to the training of the workers, instructors must be trained. Training of instructors are to be made abroad or in Mongolia depending on the situation. As for the training on the cargo handling equipment, however, the equipment can be brought into the construction site in advance, then the engineers from the manufacturers will be able to train the instructors and transfer the technologies using the equipment. Similar approaches can be adopted for the training of signal, interlock and radio communication equipment, generator and digital exchange.

9-5 Operating and Managing Costs

According to the above operating and managing policy, the team calculated the operating and managing costs in the year 2000 including the personnel cost, and the costs of energy and maintenance of the facilities. Regarding the personal cost, however, the team took into account only the employees increased for the reason of commissioning the cargo transshipment facilities assuming that the monthly salary or wage of an employee is 3,000 Tg.

CHAPTER 10 ECONOMIC AND FINANCIAL EVALUATION

10-1 Economic Evaluation

The evaluation was made by comparing the social cost and benefit that would be generated by the construction of the cargo

transshipment facilities. The project assumes a construction period of three years, from 1993 through 1995. Some of the facilities are expected to begin operation in 1994. The economic analysis covers a period of 30 years from the start of construction. The indices used for this evaluation are the net present value (NPV), ratio of benefit to cost (B/C) and internal revenue rate (IRR), when the exchange rate is taken as 1 US$ = 40 Tg.

Since the purpose of this project is to transship cargos in Mongolia, which is currently being undertaken in China, there is no particular benefits to be brought about by the construction of the facilities except for the saving of the transshipment fees Mongolia is now paying to China. However, there is no guarantee that Mongolia can continuously rely on China in the future for the transshipment work that should be made by Mongolia according to the international rule. If the present practice is suspended for some reason, it may be possible that the cargos bound for Mongolia must be received at Erenhot, transported across the border by Mongolian trucks and transshipped to Mongolian freight cars at Zamyn-uud. Thus, the benefit calculation was made by taking into consideration the additional investment and charges related to the truck transportation.

Benefits and expenses considered in the calculation also include transshipment fees, scrap values and charges to rent facilities in China, personnel costs and the costs of constructing the transshipment facilities and roads, transport vehicles and maintenance of the facilities.

As the result of calculation, only Plan 2, in which reach stackers are the main cargo handling equipment, is feasible, when the rate of discount is set at 8 percent.

In the sensitivity analysis, values of IRR were calculated for a case where the volume of freight handled is reduced by 5 percent and for a case where the construction cost rises by 5 percent, as shown in Table 10-1-6. The Table suggests that the sensitivity analysis for Plan 2 is fully feasible despite some fluctuations and that the impact of demand fluctuations is

greater than that of cost fluctuations.

Table 10-1-6 Sensitivity analysis

Case	Plan 1	Plan 2
Basic	8.88	26.28
Decrease of demand by 5 %	5.46	18.12
Increase of cost by 5 %	5.61	18.42

10-2 Financial Analysis

To evaluate the potential of profit of the project, the financial internal rate of return (FIRR) was calculated by establishing the cash flow from the revenue of the project based upon the demand forecast, investment cost an operating expense of the facilities. The financial analysis was made only for Plan 2 at the exchange rate of 1 US$ = 40 Tg.
since the economic analysis proved that only Plan 2 was feasible.

In the calculation, the project life was assumed as 30 years from the completion of the construction work. The rate of inflation was not considered since inflation has the same effects on revenue and expense and is neutral to both sides to some extent. The exchange rate of Mongolian currency was fixed at 40 Tg. to US dollar according to the agreement between the Mongolian Railway and the study team. All prices were indicated by the market price as of August and September, 1992. The total investment cost was divided into three and the same amount was assumed to be disbursed each year in the three-year construction period. The amount of depreciation for each year was calculated by using the same durable year adopted in the economic analysis. It was also assumed that the most favorable loan is available for

this project from a foreign source with an interest rate of 0.75 % per annum and a 40-year equal installment for repayment including a 10-year grace period, and that domestic funds are provided at the interest rate of 2 % per annum.

According to Mongolian Railway, revision of the existing agreement for transshipment fee is now under negotiation among the concerned countries and it is almost certain that the fee is doubled in the near future. Under the circumstances, the analysis was made on the assumption that the transshipment fee is twice as much as the existing rate from 1993 onward and will be raised further by 25 % once in every three years, i.e., in 1966, 1999 and 2002.

Under these preconditions, the basic analysis was made to check if the project is feasible from the financial viewpoint. In addition, sensitivity analyses were made for three cases in which the following modifications are applied to the basic case.

(1) Investment increase by 10 %
(2) Revenue decrease by 10 %
(3) Investment increase by 10 % and revenue decrease by 10 %

As the result of calculation, major indices are shown in Table 10-2-2.

Table 10-2-2 Indices of evaluation

(Unit : Thousand Tg.)

	Basic case	Sensitivity analysis		
		(1)	(2)	(3)
Financial internal rate of return (FIRR) (%)	1.91	1.26	1.04	0.43
Weighted average interest rate of loans (%)	0.82	0.86	0.90	1.01
Net Loss turned into profit in	1999	2002	2002	2002
Accumulated net loss turned into profit in	2004	2006	2008	2016
Peak balance of local loan	308,620	343,567	314,474	429,779
Peak balance of local loan recorded in	1955	1995	1995	2017

Financial internal rate of return (FIRR) indicates the ability of the project to pay the interest of loans. In other words, funds for the project should be raised at an interest below FIRR. The weighted average interest rate of foreign and local loans throughout the project life is lower than FIRR except for the case of sensitivity analysis (3). In other three cases the project is able to pay the interest.

As the conclusion, this project is feasible provided that the above preconditions are satisfied. Either increase of investment or decrease of revenue by 10 % is permissible. The decrease of revenue gives larger effects on the project than the increase of investment.

CHAPTER 11 DETERMINATION OF THE CARGO TRANSSHIPMENT FACILITIES IMPROVEMENT PLAN

In this Chapter, a comprehensive comparison between Plan 1 (gantry crane) and Plan 2 (reach stacker) is made to determine which is more appropriate as the cargo transshipment facilities for the year 2000.

11-1 Criteria of selection

The following are criteria for the comparison of these two Plans to determine the recommendable plan under the specific natural conditions of Zamyn-uud.

(1) Transshipment work (safety, operation, efficiency, generality of usage and applicability to other categories of work)
(2) Maintenance
(3) Construction work
(4) Total costs and investments to be borne by Mongolian Railway
(5) Economic and financial benefits

11-2 Transshipment work

(1) Plan 1 (gantry crane)

The gantry crane is a motor-driven equipment to handle cargos with wires in principle. When a container handling gantry crane is used for long size or heavy cargos, a hook beam is used in place of the spreader. These devices can easily be exchanged with each other. Then, the crane works like an ordinary crane. It is also possible to use a container handling crane with the spreader as it is, where lifting wires are hung. Mongolian Railway is experienced in operation and maintenance.

(2) Plan 2 (reach stacker)

The reach stacker handles cargos with hydraulic power. When

a reach stacker is used for long size or heavy cargos, the spreader is used as it is, where lifting wires are hung as shown in Fig. 6-2-9. With this composition, a reach stacker can also work in place of a truck crane.

11-3 Construction work

(1) Plan 1 (gantry crane)

It takes a longer time to manufacture a crane and assemble it at the installation site. A crane with a comparatively large capacity is required for the assembling work at the site. Though cranes are standardized to considerable extents, specifications must be discussed to meet the specific conditions of Zamyn-uud.

(2) Plan 2 (reach stacker)

A reach stacker can be assembled in a shorter period. It requires a crane, possibly with a smaller capacity than that of the crane used for assembling a crane at the site. Specifications must be discussed to meet the specific conditions at Zamyn-uud. The assembling work does not involve welding.

11-4 Maintenance

(1) Plan 1 (gantry crane)

a) Inspection and maintenance

A crane has a number of mechanical and electrical movable parts. The control equipment incorporates electronic devices. Attention must be paid therefore to these features in the maintenance work.

b) Frequency of maintenance work

Along with monthly and annual inspections, daily inspection is necessary before the start of operation. Special attention must be paid to the exposed parts including the lifting devices in view of the natural conditions at the site.

c) Trouble shooting

There will be no inconveniences to cope with troubles that are normally conceivable, if appropriate spare parts are stored in appropriate quantities. As for the high-tech control system, however, it is necessary to establish a system to obtain manufacture's cooperation in case a trouble occurs in the electronic parts.

(2) Plan 2 (reach stacker)

a) Inspection and maintenance

Special attention must be paid to the hydraulic devices and the electronic parts incorporated in the control equipment.

b) Frequency of maintenance work

Along with monthly and annual inspections, daily inspection is necessary before the start of operation. A reach stacker requires less maintenance work than a gantry crane, since it has less exposed parts.

c) Trouble shooting

There will be no inconveniences to cope with troubles that are normally conceivable, if appropriate spare parts are stored in appropriate quantities. As for the high-tech control and hydraulic systems, however, it is necessary to establish a system to obtain manufacture's cooperation in case a trouble occurs in the sophisticated parts.

11-5 Investment costs

(1) Investment costs of Plan 1 and Plan 2.

Table 11-5-1 compares the investment costs of Plan 1 and Plan 2, where the exchange rate is taken as 1 US$ = 40 Tg.

Table 11-5-1 (in 1,000 Tg.)

Plan 1 (gantry crane)		
Item	Foreign currency portion	Domestic currency portion
Civil work and architecture	606,942	298,714
Cargo handling equipment		
Container crane (2 sets)	162,560	
Gantry crane (1 set)	55,040	
Forklift / conveyor	9,526	
Auxiliary equipment	58,554	
Subtotal	285,680	
Signal and telecommunication	294,436	1,716
Power supply equipment	177,283	497
Total	1,364,346	300,922
Grand total	1,665,268	

Plan 2 (reach stacker)		
Item	Foreign currency portion	Domestic currency portion
Civil work and architecture	596,094	309,258
argo handling equipment		
Reach stacker (2 sets)	78,080	
35-ton truck crane	18,880	
Forklift / conveyor	9,526	
Auxiliary equipment	17,351	
Subtotal	123,837	
Signal and telecommunication	294,436	1,716
Power supply equipment	177,283	497
Total	1,191,650	311,471
Grand total	1,503,121	

(2) Comparison of the investment costs

Plan 1 and plan 2 necessitate the same amounts of investment for signal, telecommunication, power supply equipment and fork-lift / conveyor for the transshipment work of cargo in wagons. Plan 1 needs more funds for the crane foundation and less for the platform pavement. As a result, there is only a small difference of the cost for civil structure and architecture work between the two Plans. On the other hand, the cost of cargo handling equipment in Plan 1 is more than twice the cost in Plan 2. Consequently, the cost of Plan 1 is about 10 percent larger than the cost of Plan 2. From the viewpoint of the investment costs,

therefore, Plan 2 is more advantageous than Plan 1.

11-6 Economic and financial analyses

(1) Economic analysis

The economic analysis in Chapter 10 indicates that the EIRR of Plan 2, 26.28 %, is far larger than that of Plan 1, 8.88 %. This means that Plan 2 has larger benefit from the viewpoint of national economy.

(2) Financial analysis

The economic analysis in Chapter 10 suggests that Plan 2 is more advantageous. To study if the project is viable from the financial viewpoint, therefore, we made financial analysis on Plan 2 assuming several cases of different conditions. See 10-2 for the detail.

11-7 Overall evaluation

Through the above discussions, it has been proved as a conclusion that the cargo transshipment facilities using reach stackers as the main cargo handling equipment in Plan 2 is more advantageous in various aspects, particularly when the financial burden on Mongolian Railway is taken into account. Thus, this report adopts the cargo transshipment improvement plan based on the use of reach stackers.

CHAPTER 12 DETERMINATION OF OPTIONAL URGENT PROJECT

12-1 Basic Policy

Based on the following preconditions, an urgent project was prepared by selecting part of the facilities and layout envisaged for the year 2000.

(1) The project must realize facilities to transship cargos

arriving by Chinese freight trains to Mongolian freight trains at Zamyn-uud station.

(2) The transshipment facilities must handle containers on gondola cars and flat cars as well as foodstuff, fertilizer and other cargos of different packing styles loaded on wagons.

(3) The project does not cover the transshipment facilities for construction materials, fluorite and other cargos transported in gondola cars. However, these cargos can be dealt with by the container handling facilities.

(4) To minimize the expenditure, the project does not include items that are not urgently required for the transshipment work. For this reason, facilities for car washing and locomotive maintenance and other auxiliary equipment will be considered in the whole layout for the year 2000.

(5) Not only in the urgent project but also in the whole plan for the year 2000, the track layout and related facilities must be designed to facilitate linkage with the petroleum transshipment site which will be constructed and operated by another entity (Mongol Petroleum Import Corporation).

(6) For the budgetary reason, the project cannot necessarily cope with the whole transshipment demands forecast at the time of its completion.

(7) The project must be completed with as small an initial investment as possible

12-2 Plan of Urgent Project

The urgent project was determined as follows according to the basic policy given in 12-1 by selecting part of the whole plan for the year 2000. The project consists of the following facilities and equipment.

(1) Track

1) 1,435 mm gauge track

Departure and arrival track : 3 (existing tracks)

Sorting track : 3 (1 existing, 2 to be

constructed

Draw-out track	: 1 (to be constructed)
Cargo transshipment track	: 2 (1 each for wagon and gondola car/container car

2) 1,520 mm gauge track

Departure and arrival track	: 6 (existing tracks to be extended
Sorting track	: 3 (1 existing, 2 to be constructed
Draw-out track	: 2 (existing, 1 track to extended)
Cargo transshipment track	: 2 (1 each for wagon and gondola car/container car

(2) Civil structure

Construction work of embankment and track bed for the above tracks, cargo transshipment platforms (for cargos in wagon and containers) and roads

(3) Building

Cargo handling office	150 m^2 x 2 floors
Cargo storage house	300 m^2
Residential house	4,050 m^2 (for family use)
Garage (for reach stacker)	210 m^2

(4) Cargo handling equipment

Four 1.5-ton forklifts and four belt conveyors will be used for cargos in wagon, and a reach stacker for containers.

(5) Signal and telecommunication equipment

To improve the efficiency of shunting, maintenance, inspection and other work in the yard, fixed and portable radio communication equipment and talk-back equipment will be introduced for communications between ground crews. If the budget allows, a digital telephone exchange will preferably be

introduced to replace the existing exchange which often fails to connect intended subscribers.

(6) Power equipment

The team planned to install lighting equipment with mercury floodlamps to maintain an average illumination density of 10 lux on the low platform, 100 lux with lamps fixed at the ceiling of the house on the high platform, and one lux for the storage and locomotive turn-out tracks, with necessary transformers and power supply cables. The existing power generating plant can supply power for the lighting equipment, if the existing 630 Kw generator now defective is repaired.

12-3 Alternative Urgent Projects

The urgent project includes construction of tracks, civil work and an access road to the transshipment site as the minimum requirements that are indispensable to implement any scale of cargo transshipment work. However, various combinations are conceivable in terms of machine type and quantity, for the cargo handling equipment within the extent of the whole plan for the year 2000. The choice solely depends on the funds to be invested. This report proposes, therefore, a combination of equipment that can be procured with the least amount of costs.

Figure 12-3-1 in the report shows the overall layout of the facilities and equipment drawn in the urgent project plan. Figure 12-3-2 shows the layout of the transshipment facilities.

CHAPTER 13 EVALUATION OF EFFECTS ON THE ENVIRONMENT

The site where the facilities are to be constructed under this project is located sufficiently distant from and leeward of the residential area. Therefore, the residents will not be affected by noise, vibration or dust during and after the construction of the cargo transshipment facilities. Contamination by exhausts, oil leak and other wastes from the

maintenance and washing facilities will be prevented, if appropriate measures are taken against the detrimental factors involved in the project. The measures include installation of sedimentation basin, water purification facilities and pits to prevent drain of oil and oil-contaminated water. Wastes shall be recycled as much as possible. Those that cannot be reused shall be treated so that they do not damage the environment and shall be disposed for reclamation.

CHAPTER 14 TECHNOLOGY TRANSFER

During the study, the team made efforts to transfer relevant technologies to Mongolian counterparts through the explanation of reports, data collection, hearings, discussions and on other occasions. In implementing the project before and after commissioning the cargo transshipment facilities, the aid providers are required to transfer technologies related to the equipment and facilities adopted in the project so that Mongolia acquires advanced technologies and subsequently the knowledge and capabilities for self-subsistence.

During the construction period, Mongolian people will be able to experience the management practices in the West, including the methods of managing the construction work, quality control, process control and industrial relations, through the group work of local consultants, construction companies and Western consultants

CHAPTER 15 COMPREHENSIVE EVALUATION AND PROPOSAL

The economic analysis has proved that EIRR is as high as 26.28 % when the short term cargo transshipment improvement plan is implemented and that Mongolia will gain benefits for the national economy from the implementation of the project. The financial analysis also suggests that the project will yield

profits to Mongolian Railway.

After the cargo transshipment facilities are commissioned, cargo transshipping work can be done by Mongolia according to the international rule, thereby making Mongolia stand at an equal footing with China. Commissioning the cargo transshipment facilities in Mongolia will also eliminate the freight cars now stagnating at Erenhot in China, to smoothen the rotation of freight cars leased from Russia and save the rental charges Mongolia is now paying to Russia in foreign exchange. The construction work and operation of the cargo transshipment facilities at Zamyn-uud will create employment opportunities and contribute to a reduction of unemployment in Mongolia.

The new petroleum transshipment facilities planned by Petroleum Import Corporation seem to be indispensable in the future, when the increasing demand is taken into consideration. Therefore, it is appropriate to promote the plan as it is scheduled.

Shunting locomotives (1,435 mm and 1,520 mm gauges) must be procured in time for commissioning the cargo transshipment facilities at Zamyn-uud station.

It is preferable for Mongolian Railway to have facilities for overhaul of locomotives. In case Chinese gauge locomotives are introduced to Zamyn-uud station in the future, a policy should be established regarding how and where their maintenance should be implemented.

In parallel with the construction work, it is required to improve all the cargo handling stations in Mongolia. In particular, the cargo handling facilities at Ulaanbaatar station should be strengthened on a priority basis.

Eventually, the implementation of the project will lead to the development of industries, improvement of living standards, vitalization of national economy, and enhancement of Mongolia's position in the international society. Thus, it is recommended to urgently promote the project with assistance including grant aid from developed countries.