JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MONGOLIA
MINISTRY OF INFRASTRUCTURE (MOI)
THE 4TH THERMAL POWER PLANT(TES4)
PROJECT IMPLEMENTING UNIT (PIU)

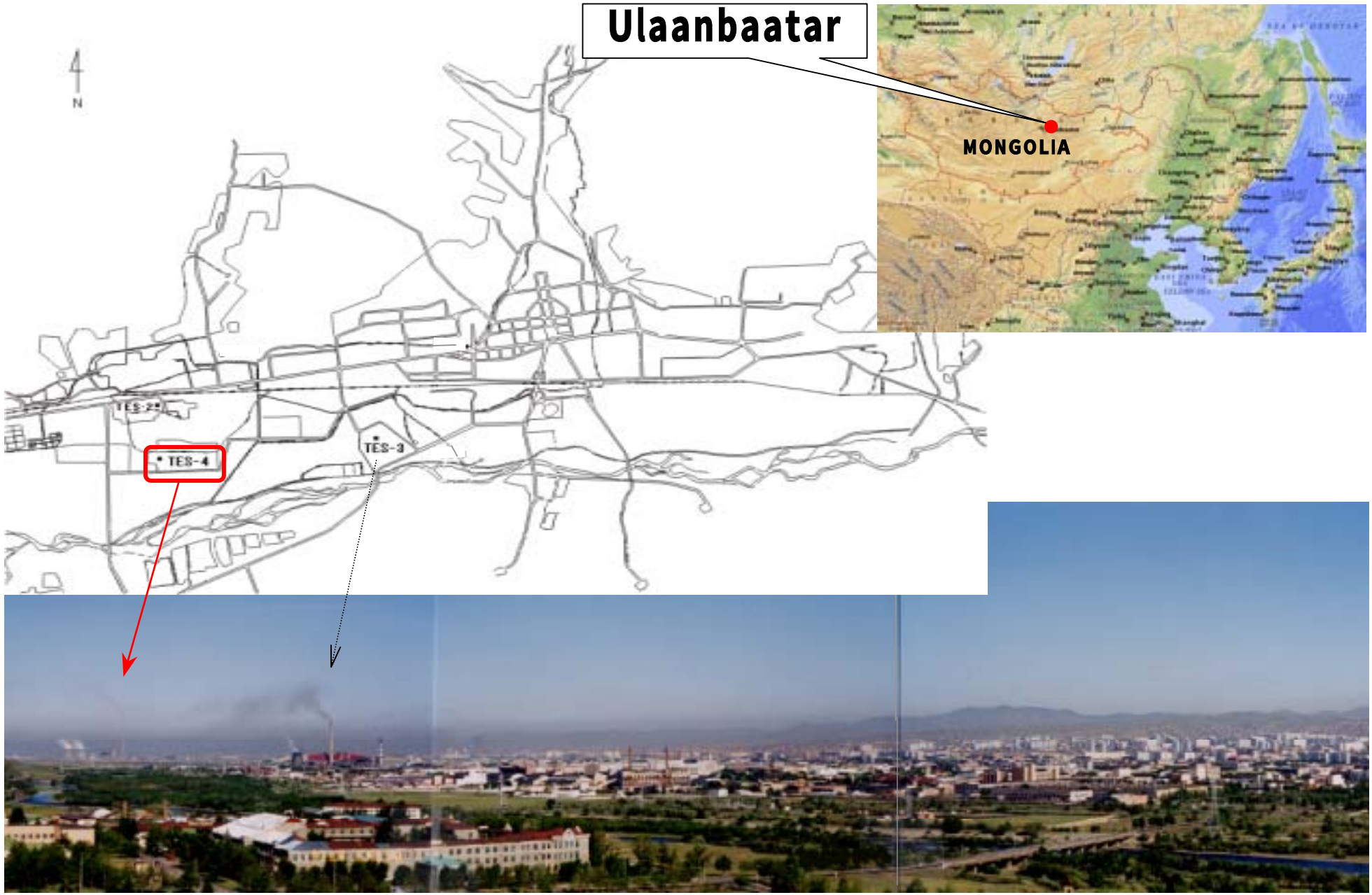
JICA DEVELOPMENT STUDY SUPPORTING THE REHABILITATION PROJECT OF THE 4TH THERMAL POWER PLANT IN ULAANBAATAR MONGOLIA

FINAL REPORT

SUMMARY

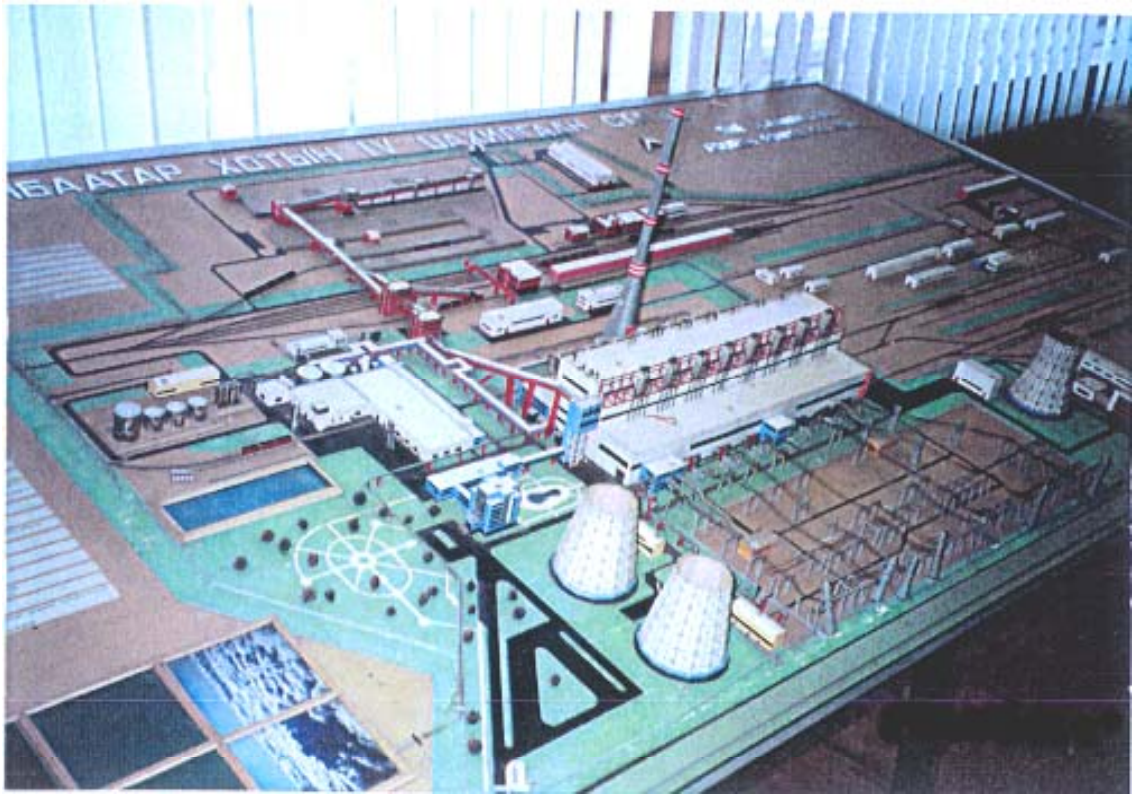
SEPTEMBER 2002

ELECTRIC POWER DEVELOPMENT CO., LTD.



LOCATION MAP

Power Station General View



Power Station Model

Boiler Control Panel (Rehabilitated)

Boiler Control Panel (Existing)

Mill (Rehabilitated)

Generator & Exciter (Existing)

No.3 Ash Pond (Existing)

No.4 Ash Pond (Under Construction)

CONTENTS

Abbreviation

ACGHI	:	American Conference of Governmental Industrial Hygienists
ADB	:	the Asian Development Bank
B/C	:	Benefit par cost
CCR	:	Center control room
CES	:	Central Energy System
COMECON	:	Council for Mutual Economic Assistance
CRT	:	Character display
D/D	:	Detail Design
EA	:	Energy Authority
ECCR	:	Electric center control room
EDO	:	Electric Distribution Office
EES	:	East Energy System
EIA	:	Environmental impact assessment
EIRR	:	Economic Internal Rate of Return
ERA	:	Energy Regulatory Authority
ESP	:	Electrostatic Precipitator
ETC	:	Energy Training Center
FBC	:	Fluidized-Bed Combustion
FC	:	Foreign Currency
FDF	:	Forced Draft Fan
FIRR	:	Financial Internal Rate of Return
FL	:	Floor Level
FRP	:	Fiber Reinforced Plastic
GCB	:	Gas circuit breaker
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
GTZ	:	German Technical Cooperation
HDO	:	Heat Distribution Office
HOB	:	Heat only boiler
IARC	:	International Agency for Research on Cancer
IAS	:	International Accounting Standards
IDF	:	Induced Draft Fan
IEE	:	Initial Environmental Impact Evaluation
IMF	:	International Monetary Fund
IRR	:	Internal Rate of Return

JBIC	:	Japan Bank for International Cooperation
JICA	:	Japan International Cooperation Agency
JISHA	:	Japan Institution of Safety and Health Association
J-Power	:	Electric Power Development Co., Ltd.
LAN	:	Local Area Network
LC	:	Local Currency
MBB	:	Make before break
MEGM	:	Ministry of Energy Geology and Minerals
M/M	:	Minutes of meeting
MOID	:	Ministry of infrastructure Development
NDF	:	Nordic Development Fund
NEDO	:	New Energy and Industrial Technology Development Organization
NOx	:	Nitrogen Oxides
PGF	:	Primary Gas Fan
O&M	:	Operation and maintenance
OCB	:	Oil circuit breaker
OCR	:	Over-current relay
OECF	:	Overseas Economic Cooperation Fund
PDCA	:	Plan-Do-Check-Action
PIU	:	Project Implementing Unit
QC	:	Quality Control
ROE	:	Return on equity
ROA	:	Return on assets
SAPROF	:	Special Assistance for Project Formation
SATU	:	Name of Environmental Assessment & consulting company
SIDA	:	Swedish International Development Cooperation Agency
SOE	:	State Owned Enterprise
SOx	:	Sulfur Oxides
SPM	:	Suspended Particulate Matter
S/W	:	Scope of Works
TES2	:	Ulaanbaatar Thermal Power Plant No.2
TES3	:	Ulaanbaatar Thermal Power Plant No.3
TES4	:	Ulaanbaatar Thermal Power Plant No.4
TV	:	Television
VCB	:	Vacuum circuit breaker
WES	:	West Energy System
ZD	:	Zero Defect

UNITS

Prefixes

μ	:	Micro- = 10^{-6}
m	:	Milli- = 10^{-3}
c	:	Centi- = 10^{-2}
d	:	Deci- = 10^{-1}
da	:	Deca- = 10
h	:	Hecto- = 10^{2}
k	:	Kilo- = 10^{3}
M	:	Mega- = 10^{6}
G	:	Giga- = 10^{9}
T	:	Tera- = 10^{12}

Unit of Length

mm	:	Millimeter
cm	:	Centimeter
m	:	Meter

Units of Area

cm^2	:	Square centimeter
m^2	:	Square meter
km^2	:	Square kilometer

Units of Volume

m^3	:	Cubic meter
l	:	Liter
kl	:	Kiloliter

Units of Mass

g	:	Gram
kg	:	Kilogram
t	:	Ton (metric)

Units of Density

kg/m^3	:	Kilogram per cubic meter
mg/kg	:	Milligram per kilogram
ppm	:	Parts per million
mg/m^3N	:	Milligram per normal cubic meter
$\mu g/m^3N$	:	Microgram per normal cubic meter
$\mu g/m^3$	:	Microgram per cubic meter
mg/l	:	Milligram per liter

Units of Pressure

t/m^2	:	Ton per square meter
kg/cm^2	:	Kilogram per square centimeter (gauge)
mmHg	:	Millimeter of mercury
mmAq	:	Millimeter of aqueous
hPa	:	Hecto Pascal

Units of Energy

kcal	:	Kilocalories
kWh	:	Kilowatt-hour
MWh	:	Megawatt-hour
GWh	:	Gigawatt-hour
kW/ m^2	:	Kilowatt per square meter

Units of Heating Value

cal/kg	:	Calories per kilogram
kcal/kg	:	Kilocalorie per kilogram
kJ/kg	:	Kilojule per kilogram

Units of Temperature

°C	:	Degree Celsius or Centigrade
°K	:	Degree Kelvin

Units of Electricity

W	:	Watt
MW	:	Megawatt
A	:	Ampere
kA	:	Kiloampere
V	:	Volt
kV	:	Kilovolt
kVA	:	Kilovolt ampere
MVA	:	Megavolt ampere
MVar	:	Megavar (mega volt-ampere-reactive)
kHz	:	Kilohertz

Units of Time

s	:	Second
min	:	Minute
h	:	Hour
d	:	Day
w	:	Week
y	:	Year

Units of Flow Rate

t/h	:	Ton per hour
t/d	:	Ton per day
t/y	:	Ton per year
m^3/s	:	Cubic meter per second
m^3/min	:	Cubic meter per minute
m^3/h	:	Cubic meter per hour
m^3/d	:	Cubic meter per day
m^3N/s	:	Cubic meter per second at normal condition
m^3N/h	:	Cubic meter per hour at normal condition

Units of Conductivity

μS/cm	:	MiscroSiemens per centimeter

Units of Sound Power Level

dB(A)	:	Deci-bell (A-weighted)

Units of Currency

US$	:	US Dollar
Yen	:	Japanese Yen
Tug	:	Mongolian tugrug (9.07Tug＝1Yen：2001/10)
MTug	:	Million tugrug
GTug	:	Billion tugrug

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OVERALL EVALUATION AND RECOMMENDATIONS

OVERALL EVALUATION AND RECOMMENDATIONS

I. General

This study was conducted based on site surveys and data collected on Ulaanbaatar Thermal Power Plant No.4 (TES4), and a maintenance and rehabilitation plan was prepared from an overall perspective of power plant management considering not only rehabilitation plans for equipment and facilities, but also plans for personnel training and financial management to assure financial discipline.

By implementing the recommendations in this plan, TES4 will be able to strengthen its financial base and administration of plant management, thus contributing to the long-term stable supply of good quality power and heat to combat the forecasted increase in power and heat demand.

From the above perspective, it will be necessary to consider the following during the implementation of the recommendations:

- It will be indispensable to obtain the understanding of the Mongolian government and to promote the reform of the energy sector, as well as to obtain the understanding of the heads and staff of each section of TES4, and to properly implement the recommendations in order for TES4 to positively materialize the recommendations mentioned in this report.

- Once corporatized, TES4 must procure funds on its own; however, the provision of financial aid from Japan and other foreign countries will be necessary to secure the foreign currency needed for equipment and other procurement considering the current severe situation of the international balance of payments of Mongolia, while TES4 retains funds of local currency adequately.

- With respect to organizational reform and personnel training, the provision of software support such as technical and intellectual support will be indispensable because the improvement of operation and management skills will contribute to raising the efficiency not only for TES4, but also for all plants in Mongolia.

Based on the above considerations, an overall evaluation and recommendations are described in the following.

II. Evaluation and Recommendations

(1) Maintenance and Rehabilitation Plans

Selection of the equipment requiring rehabilitation was made and an execution plan was prepared together with cost estimate and annual fund requirements. The effects of the rehabilitation were determined and an economic and financial evaluation was made. As a result, it was concluded that the rehabilitation plan was worthy of implementation. The result of the evaluation and the recommendations are shown below:

1) Selection of Rehabilitation Equipment

The selection of equipment to be rehabilitated was made by the importance and degree of degradation of the equipment and was ranked in 3 categories (A: Rehabilitation from which a large effect is expected, B: Rehabilitation for decrepit equipment, C: Repair works considered by TES4). Particular attention was paid to the point that, on account of the 40-year service life of TES4 up to 2025, ash ponds No. 5 and 6 with a capacity of 10 years each will be necessary, and that it will be necessary to rehabilitate 80 MW turbines, which fail frequently, in order to respond to the future increase in demand. It will also be necessary to conduct environmental measures to meet the environmental regulations and other life extension measures.

2) The Rehabilitation Improvement Effect

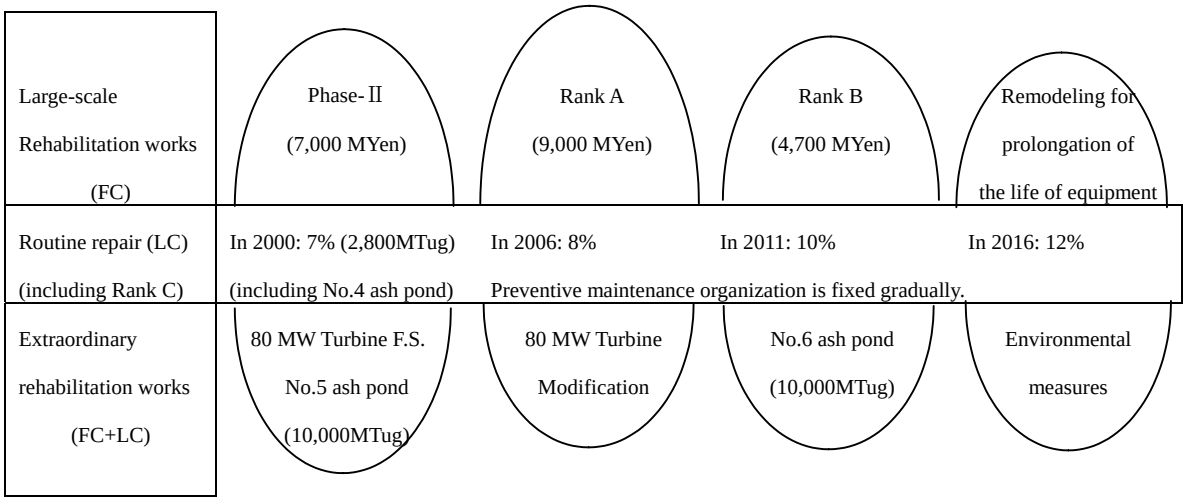
The expected effects of the above rehabilitations are shown in the table below. This table reveals that positive implementation of each item will have significant effects, leading to a strengthened financial base of TES4.

The Rehabilitation Improvement Effect for the Equipment (Rank A)

Rehabilitation Improvement Item	*Rehabilitation Improvement Effect (MTug/year)*
(1) Reduction of Auxiliary Power Ratio	693.6
(2) Recovery of Condenser Vacuum	170.3
(3) Saving Heavy Oil Consumption	164.3
(4) Increase in Power Availability	10,749.4
Total	11,777.6

3) Future Maintenance and Rehabilitation Plan

The future maintenance and rehabilitation plan is shown below.



4) Economic and Financial Evaluation

An economic and financial evaluation was made on the A-ranked rehabilitation plan based on the rehabilitation improvement effect and the future maintenance and rehabilitation plan. The result is shown below:

- The economic evaluation resulted in B/C=3.21, showing viability of the rehabilitation plan, although EIRR could not be calculated.
- The financial evaluation resulted in FIRR=3.83% and B/C=0.69, revealing that the plan was not favorable from the standpoint of corporate profitability, but this conclusion was due to TES4's low level of tariff, so that a raise in tariff would be necessary.

5) Funding Plan

As for the funding plan, the following 7 cases were established with different loans and other conditions.

Case 1: With the same conditions as Phase-II Yen credit

Case 2: No borrowing except for the arranged Phase-II Yen credit (It should be noted that this case is not realistic as the foreign currency portion must be borrowed from abroad because of Mongolia's shortage of foreign reserves)

Case 3: Interest rate for foreign currency is 30% (average rate for short-term lending in 2000 according to the statistics of the Bank of Mongolia) and the remaining conditions are unchanged from Case 1.

Case 4: Modifying Case 3 by changing the foreign interest rate to 10%, an allowable rate to make the cash flow for each year positive.

Case 5: More realistic loan conditions for foreign currency with a 5-year repayment period and (grace for construction time) and 30% interest rate.

Case 6: Modifying Case 5 by changing the foreign interest rate to 5.5%, an allowable rate to make the cash flow for each year positive.

Case 7: Modifying Case 5 by changing the sales prices to: power 33.35/kWh and heat 6,900/Gcal, the minimum level to make the cash flow for each year positive and to avoid capital deficiency.

Cases 1, 3 and 4 assume a 20-year repayment period, but are not possible without soft conditions such as those provided by yen credit with an interest rate as low as 1%. Case 2 is a case where all the funding requirements can be met by its own fund, but in reality, foreign currency is necessary, so that this case is not possible either.

Of the above 7 cases, Case 5 is the case the most likely to be faced by a corporation that may possibly be privatized in future. As seen in Case 6, even if an unrealistically low interest rate is applied, capital deficiency occurs and the case becomes impossible, which leads to the belief that a price hike is necessary as in Case 7.

To that effect, the first thing to do is to make accounting treatment appropriate, implement asset revaluation and normalize the depreciation period in order to prepare financial statements more properly reflecting the actual financial situation. The next thing concerns loan conditions; as there has been no long-term lending in the financial market in Mongolia and loan conditions are unclear, improvement of the financial market is essential, while TES4 must make borrowing conditions clear through negotiations for each loan and prepare funding plans considering the size and timing of the price hike and whether to procure local fund requirements by its own fund.

(2) Organizational Reform

TES4 was corporatized in September 2001, and managing the plant as an independent profit-making enterprise and strengthening management bases and vitality are required, so TES4 should reconsider its organization with particular attention paid to its autonomy. It will be necessary to streamline the organization and to delegate the powers to lower levels, discontinuing the system of decision-making only by the top level so as to create a change of mind-set in the lower organizations. Moreover, it will be necessary to create new departments for safety and

health and for quality control to strengthen the awareness of accident prevention and the stable supply of power and heat.

With regards to plant maintenance, it will be necessary to concentrate repair functions in the Repair Department by transferring repair functions scattered in different sections of the operation to that department, thus making clear the Repair Department's responsibility for equipment failure and promoting quality improvement of maintenance work. The main recommendations are shown below:

- Streamline and make clear the line and staff organization and the chain of command
- Delegate powers to lower levels and share the information within each section (make different departments and sections thoroughly relate to each other)
- Create a Safety and Health Department and Quality Control Department

(3) Administration of the Plant Equipment

1) Administration of the Operation

Trips and failure of equipment due to wrong operation by the operators in TES4 have occurred frequently – out of 202 shutdowns in 2000, some 24% of the shutdowns was due to wrong operation by the operators. Hence, countermeasures will be essential and the points to be improved are shown below:

- Understanding of plant observation items, alarm values and limiting values, and preparation of the relevant measuring instruments
- Strict implementation of inspection patrol and understanding of check points of equipment
- Preparation of operation manual and schematic diagrams of the plant
- Improvement of the method for taking over the next shift and means of in-house communication
- Improvement in keeping the operation logs: log sheet, chart, long-term deterioration record and monthly efficiency report
- Supervising states of switchgear strictly for maintenance and improvement of coping with accidents; utilization of training simulator and preparation of operation procedure in case of accidents.

2) Administration of the Maintenance

Given that the repair groups have been repeating similar failures, which leads to a decrease in confiability and an increase in maintenance cost, it will be necessary to take the following countermeasures as shown below:

- Improvement in maintenance administration organization: daily repair work, major overhaul and middle overhaul
- Understanding of plant conditions: history record of maintenance, inspection results and analysis of causes of failure
- Preparation of a maintenance plan based on permanent countermeasures and remaining life assessment
- Preparation of repair manual and improvement in repair skills: preparation of a manual and feedback on repair works
- Preparation of replacement parts and materials and maintenance of repair and testing tools
- Improvement of workplace environment

3) Administration of the Engineering

Management items closely related to the power plant operation, as shown below, are scattered in different sections, which does not allow for efficient management. The administration of the engineering improves the plant efficiency, protects the environment and maintains the plant. Therefore, it will be necessary to review the current organization. Specifically, administration management should be concentrated in a department, absorbing the Engineering Department and Research Department, and particular emphasis should be placed on efficiency management. The relevant departments should cooperate to detect the causes for efficiency decreases and to conduct countermeasures. The items of centralized management are shown below:

- Plant efficiency control
- Coal quality control
- Plant water quality control
- Boiler combustion control
- Plant performance test

4) Administration of the Fuel

It is important to positively make purchase plans, inventory control and administration of receiving and dispatching facilities.

5) Administration of the Inventory

Inventory control is to quantitatively control purchases and stocks such as spare parts in order to assure the procurement of spare parts as planned in terms of quantity and quality, and to store them in such as way as not to deteriorate their functions. It is necessary to

conduct control as planned and without waste in close coordination with the maintenance plans.

6) Administration of Safety and Health

A poor working environment will not only cause industrial accident and occupational disease but also adversely affect of repair work result. The table below shows that there were over 112 industrial accidents in 2000. It is necessary to improve the current working environment. To that effect, it will be necessary to create a department of safety and health control under direct control of the president and to implement the following items in order to improve occupational safety and health.

Number of Industrial Accidents and Return to Work in 2000

(Unit: Case)

Number of Industrial Accidents (number of medical certificates)	*Return to work*		*Situation of recipients of compensation*		
	Change of job	*Return to the original job*	*Continuing to work*	*Retired*	*Dismissed*
112	17	35	10	12	38

- Improvement of work place environmental administration organization
- Thorough instruction for improvement of the work place environment (illumination, dust and noise)
- Accident occurrence and measures for reducing industrial accidents to zero
- Patrol for safety and fire prevention and display of points of danger (hazard display)
- Safety instructions for repair work, display of work place, and proper arrangement and order of work place
- Safety education (participation in an external seminar and practice of safety education in-house)
- Workers' health check

(4) Environmental Conservation

The required items of environmental conservation for TES4 are, firstly, the addition of ash disposal ponds and, secondly, the installation of sirens for safety valves. Moreover, utilizing ash and reducing SO_X in flue gas is expected to be required in future, so it will be necessary to prepare for the necessary funds as planned. Shown below are the evaluations and recommendations regarding environmental conservation:

1) TES4 Flue Gas

Measurements made in 1998 show that the density of soot discharged from each unit (converted in 6% O_2) varies widely, ranging between 463 - 735 ppm for SO_2 and 142 - 475 ppm for NO_2.

The dust density (converted in 6% O_2) ranges from 190 to 942 mg/m^3N in 1998 - 2000.

2) Calculated diffusion of soot

Soot diffusion was calculated by a simple method, revealing that the landing point of maximum density reached a distance of more than 30 km both at an average wind speed of 1.9 m/s and at a maximum wind speed 9.0 m/s in the winter of 2000 (stability of atmosphere: more than 90%), which leads to the supposition that air pollutants had little influence on the city.

3) Noise

Under normal operation of the plant, the noise levels measured in the premises of the plant and the vicinity were below the standard value of 85 dB (A) with little influence on the surrounding environment. However, sometimes when the safety valves discharged steam, the level of acoustic pressure of the safety valves reached about 150 dB (A), exceeding the standard and also beyond the standard level of 85 dB (A) in the vicinity of the power plant. Therefore, it will be necessary to equip noise-eliminating measures such as a silencer.

4) Waste water treatment

All of the waste water of the power plant except domestic waste water is collected in a slurry pit to be utilized for the transport of ash to the ash disposal pond. The current system has no wastewater treatment but wastewater is not discharged out of the system, so it can be considered to have no influence on the surrounding environment.

5) Problems regarding operation of the ash pond

No.3 Ash Pond, which has been used since 1995, is almost full and it will be difficult to meet the demand from 2002. No.4 Ash Pond, which is now under construction, is of an emergent nature (at some 2 year’s of capacity), so that it will be necessary to construct another ash disposal pond with a larger capacity for a stable power supply at the earliest time possible.

Relatively strong winds in spring may affect the surrounding environment with flying ash from No.3 Ash Pond. It will be necessary to conduct partial soil cover, periodic water spray and other measures.

(5) Personnel Training

Even if an excellent organization and management system is established, no growth of an enterprise can be expected without the right human resources. Personnel training within a company is to provide the necessary expertise and personnel training based on the corporate philosophy, business goals and business strategy. It will be necessary to make clear the purpose of a particular personnel training, how the personnel training will be reflected in daily work and to establish a training curriculum with understanding and awareness at organizational and individual levels.

A performance appraisal system including management by objective and a suggestion encouragement system should be periodically reviewed to avoid the mannerism and demerit system. It is vital for each member of staff to conduct a circle of plan, do, check and action consciously. Shown below are the items to be improved:

- Promotion of on-the-job training
- Personnel training of operation and maintenance as well as efficiency management
- Establishment of corporate philosophy
- Elicitation of common problems
- Thorough implementation of management by objective and review of the performance appraisal system
- Promotion of the suggestion encouragement system

(6) Financial Management

It will be necessary to change management policy from production-first to profit attaining principles as planned with more profit awareness. The responsibilities for budget making and execution should be made clear in each department and it will be necessary to establish such a system so as to be able to respond flexibly to factors of budgetary change and review cost, the distinction between direct and indirect sections and the production cost calculation for power and heat in order to determine a more accurate production cost.

Fund management will be one of the most important issues of management. Although it is not clear how the issue of receivables and payables will be solved, it will be necessary to prepare funding plans for working funds and capital funds for the future self-management of funds and to establish a system of fund management as a corporation able to conduct fund monitoring and timely measures in order not to fall short of funds.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background of Study

Mongolia, with an area of approximately 1.56 million km^2 (about 4 times the area of Japan) is located in the eastern part of Central Asia. The country is a landlocked country surrounded by the Russian border in the north and Chinese border in the south. It has a continental climate, with an annual average temperature of 1°C below zero. During the coldest season (from December to January), the outdoor temperature often drops down to 40°C below zero. The annual rainfall is about 200 - 400 mm and the rainy season is from June to September.

The population of Mongolia is about 2.4 million. And 0.8 million people live in Ulaanbaatar (about 30% of all population), which is the capital city of Mongolia.

The total capacity of all the power generating facilities in Mongolia is about 830 MW. The electric power supply in this country is fed by three major electrical power systems, namely the Central Energy System (CES), the Eastern Energy System (EES) and the Western Energy System (WES).The power generation capacity of the CES, which has the largest consumption area (Ulaanbaatar City), is currently about 790 MW. TES4 in this study belongs to CES and supplies about 63% of the electrical power demand in CES and about 64% of the total thermal energy demand in Ulaanbaatar City.

However, this power plant was made in former Soviet Union and designed to operate by the indirect combustion system. Because of the frequent occurrence of accidents, the availability of TES4 has been very inferior and this has resulted in frequent electrical power failures as well as the low temperature of hot water for room heating purposes.

In addition to the above project, the counter measure for ashes processing system blockage, the countermeasure for wear-proof coal pulverizer system, and rehabilitation of the hot water supply system has been implemented through two grant aid programs started from 1992.

To cope with this situation and upon the request of the Government of Mongolia, the Japanese Government has started the Phase-I project (for a combustion system conversion of boiler No.1 in 4 out of a total of 8 boilers, improvement-renewal of the control equipment and the supply of boiler tubes) in TES4 under a loan assistance program, which began in 1996.

In May 1998, the Mongolian Government requested loans from the former OECF (the current Japan Bank for International Cooperation, or JBIC) for the conversion of the combustion method of the boilers (No.5 to No.8 boiler), rehabilitation of the control units (No.5 to No.8 boiler), replacement of

the generator excitation systems (No.1 to No.4 Generator), replacement of boiler tubes, etc. as Phase-II of the Rehabilitation Project of the power plant.

This study based on above-mentioned request was implemented, and signed on July 2 1999 (M/M) and signed on September 6 1999 (S/W).

1.2 Purpose of Study

This study aimed at the implementation of the following works for Phase-II of the Rehabilitation Project of the 4th Thermal Power Plant in Ulaanbaatar, Mongolia. By the study implemented from last year, the purpose of the study has been completed as scheduled.

- Collection, sorting and review of the available material information, and literature
- Plant survey of the existing facilities
- Determination and verification of the specifications of the equipment to be rehabilitated in Phase-II and cost estimation to be incurred on the project
- Preparation of the bidding documents
- Preparation of maintenance and rehabilitation plans for the existing whole plant

In accordance with the Agreement confirmed between Mongolia and JBIC, technical specification of the equipment to be rehabilitated in Phase-II and cost estimation were studied. The bidding documents and cost estimation report were duly completed and submitted to Mongolia in September 2001. Accordingly, this report has been made with the focus on maintenance and rehabilitation plans for the whole power plant.

1.3 Scope of Study

This study was implemented in accordance with the Scope of Work (S/W), which was signed on September 6, 1999 and the scope of the study was as follows. Please note that the data used in this report are those collected until October 2001.

(1) Preparation of maintenance and rehabilitation plan

For the preparation of the plan, not only existing data, information, literatures and documents, but also outline of the design, drawings, supervision planning, construction schedule and executing organization etc. for all facilities and equipment to be rehabilitated were reviewed, examined and investigated.

The plan consisted of the planning of personnel education, training and also financial aspects, in addition to the planning of the facilities to be rehabilitated.

In addition to the above, the plan was designed to cover environmental protection such as air pollution, waste water penetration, ash disposal ponds and so forth.

(2) Cost estimation

The cost estimation for the plan including foreign and local currencies was studied and the annual planning of funds for the plan was examined.

(3) Economic and financial analysis

In relation to the maintenance and rehabilitation plan, the economic internal rate of return (EIRR), financial internal rate of return (FIRR) and sensible analysis were conducted. Based on the above analysis, future financial aspects (profit and loss, asset and balance sheet) were proceeded by consideration of the operation and maintenance.

(4) Assessment for the plan and recommendation

By assessing the plan and extracting problems, recommendations need to be made for the issues to be improved in the future such as the pollution caused by dust (especially), protection against pollution and utilizing waste water etc.

(5) Seminar of technology transfer

A seminar based on the plan needs to be held in Mongolia and the technology transfer to the counterpart should be strictly executed.

CHAPER 2

ECONOMIC SITUATION OF MONGOLIA

CHAPTER 2 ECONOMIC SITUATION OF MONGOLIA

2.1 Political and Economic Background

After the collapse of the Soviet Union and COMECON in 1990, Mongolia transformed from single-party dominance to multi-party democratic government and is on its way to a market economy from a centrally-planned economy. To that effect, liberalization policies have been pushed forward such as the liberalization of prices, international trade and foreign exchange rates, and the privatization and reform of economic sectors.

Western countries, in response to the democratization of Mongolia in 1992, and as if to fill the void left by Soviet withdrawal, have been extending assistance to the country through aid organizations such as IMF, the World Bank, the Asian Development Bank and bilateral channels. That assistance helped bail the country out of the economic crisis at the beginning of the 1990s and the country is now attaining a certain level of macroeconomic stability; however, the country is still faced with a pile of problems as it tackles self-sustainable economic development through a market economy.

2.2 Economic Situation

2.2.1 Economic Structure

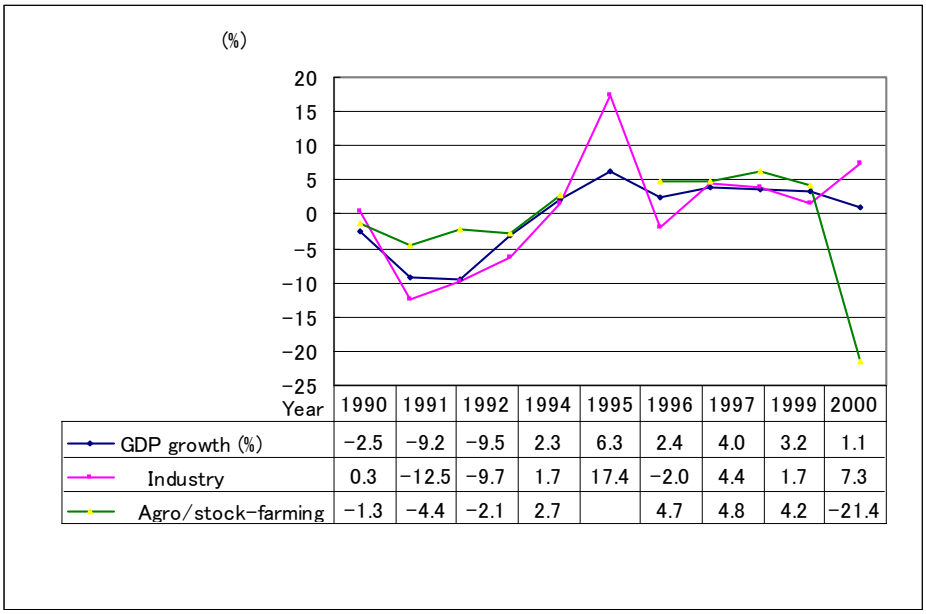
The area of Mongolia is 1,564,000 km^2 and the population is 2,408,000, as of the end of 2000 with a density of slightly over 1.5 person/ km^2. About 57% of the population, 1,377,000 people, live in urban areas and rural villages, and the remaining live a nomadic life. In Ulaanbaatar, the capital of the country, there are 787,000 people, more than 30% of the total population, which shows over-concentration in a particular city. This situation has led to considerable economic problems in maintaining its function as the country's capital, building the infrastructure and sustaining modern life consumption. It is said that over 35% of the population are below the poverty line, which is another important problem.

As for the industrial structure viewed from the GDP with 34% in agriculture and stock farming and 23% in commerce, which represent, combined together, nearly 60% compared to 14% in mining and manufacturing. In terms of industrial output including power, heat and water supply, coal mining accounts for 6% providing mainly fuel for power and heat production and is one of the important industries. Electricity and heat account for 16%, showing its importance to the life and industrial infrastructure of the Mongolian economy.

2.2.2 Transition of Economic Situation

The economic size of Mongolia is 1,045 billion Tug in terms of GDP as of the end of 2000 (preliminary estimate), equivalent to some 100 billion yen. The magnitude of international trade is US$ 502 million in exports and US$ 632 million in imports, evidencing the country's heavy dependence on international trade.

Economic movement of Mongolia from 1990 through 2000 as shown in Fig. 2.2-1 by key economic indices reveals that GDP decreased considerably from 1990 through 1993, the period for the beginning of democratization, and 1994 saw a recovery, which has continued since then in both the sectors of industry, and agriculture and stock farming. It should be noted that the large decrease in agriculture and stock farming in 2000 was due to snow damage causing the death of as much as 3.5 million head of livestock.

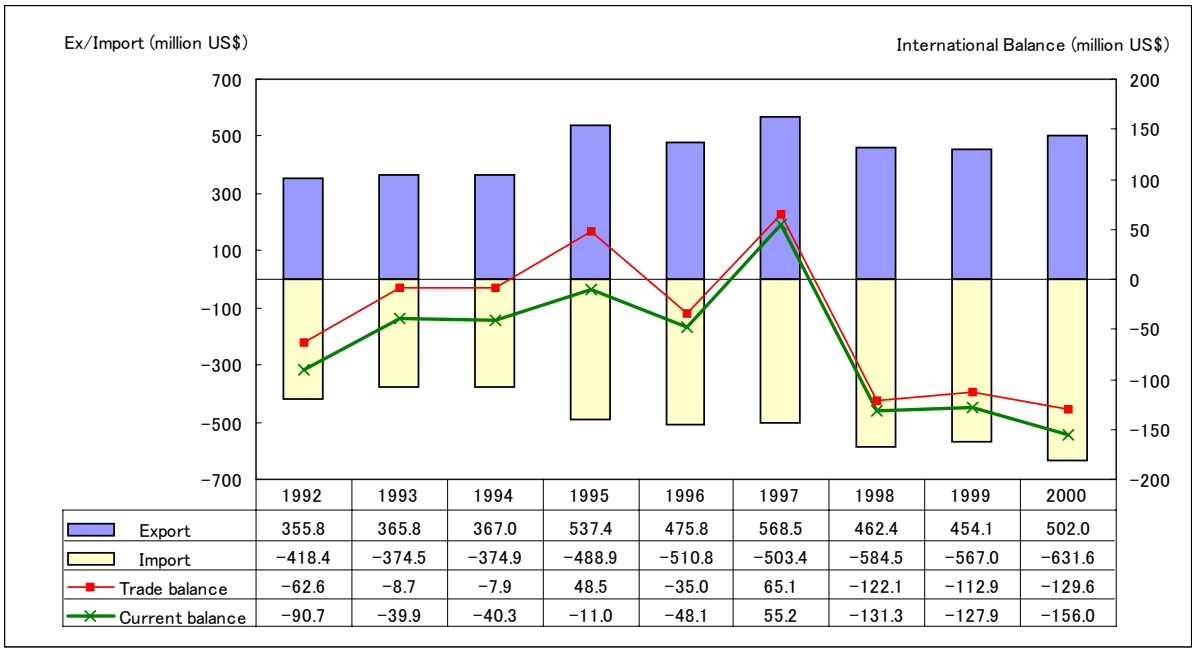


Year	1990	1991	1992	1994	1995	1996	1997	1999	2000
GDP growth (%)	-2.5	-9.2	-9.5	2.3	6.3	2.4	4.0	3.2	1.1
Industry	0.3	-12.5	-9.7	1.7	17.4	-2.0	4.4	1.7	7.3
Agro/stock-farming	-1.3	-4.4	-2.1	2.7		4.7	4.8	4.2	-21.4

Fig. 2.2-1 Real GDP Growth Rate

(Source : Ministry of Finance and Economy)

Fig. 2.2-2 shows the balance of international payments, illustrating a chronic deficit in trade and current balances (excluding the official transfer balance). Equilibrium on the balance of payments is attained by influx from financial assistance and overseas borrowing through international aid organizations and donor countries. That situation has increased the external debt burden year by year.



	1992	1993	1994	1995	1996	1997	1998	1999	2000
Export	355.8	365.8	367.0	537.4	475.8	568.5	462.4	454.1	502.0
Import	-418.4	-374.5	-374.9	-488.9	-510.8	-503.4	-584.5	-567.0	-631.6
Trade balance	-62.6	-8.7	-7.9	48.5	-35.0	65.1	-122.1	-112.9	-129.6
Current balance	-90.7	-39.9	-40.3	-11.0	-48.1	55.2	-131.3	-127.9	-156.0

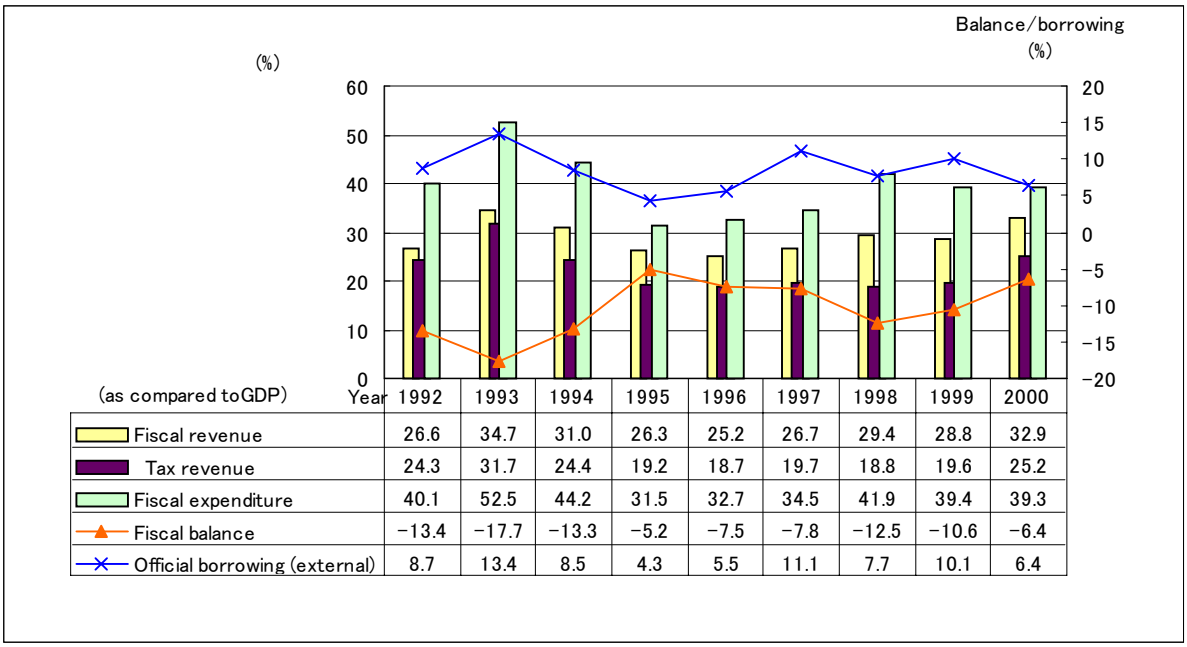
Fig. 2.2-2 Balance of International Payments (excl. official transfer balance)

(Source : Ministry of Finance and Economy)

The economic overview from 1990 as shown above has revealed that the country's economy has stabilized in terms of GDP and inflation, while the country's trade structure with chronic deficit and vulnerability to international prices of prime trade items remain large destabilizing factors. Recent macroeconomic stability has been attained mainly by support from the international community and a pile of problems still remains on the road to self-supporting development.

Fiscal conditions of the Mongolian government, as shown in Fig. 2.2-3, reveal that government spending accounts for about 40% of GDP as of the end of 2000, having a considerable weight with the country's economy. Government spending has been curbed but tax revenues have not been able to cover the spending so the fiscal deficit has been made up mainly with government borrowing from abroad.

One of key targets in economic management by the government has been to curb inflation and stabilize the exchange rate of the Tug, so that a policy of money and fiscal restraint has been adopted. This tightening policy took effect by holding down inflation but caused the issue of arrears in government organizations with business enterprises, which has led to a debt cycle among business enterprises.



(as compared toGDP) Year	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fiscal revenue	26.6	34.7	31.0	26.3	25.2	26.7	29.4	28.8	32.9
Tax revenue	24.3	31.7	24.4	19.2	18.7	19.7	18.8	19.6	25.2
Fiscal expenditure	40.1	52.5	44.2	31.5	32.7	34.5	41.9	39.4	39.3
Fiscal balance	−13.4	−17.7	−13.3	−5.2	−7.5	−7.8	−12.5	−10.6	−6.4
Official borrowing (external)	8.7	13.4	8.5	4.3	5.5	11.1	7.7	10.1	6.4

Fig. 2.2-3　External Debt Burden

(Source：Ministry of Finance and Economy)