CHAPTER 5

MAINTENANCE AND REHABILITATION PLAN

CHAPTER 5 MAINTENANCE AND REHABILITATION PLAN

5.1 Selection of Rehabilitation Equipment

Based on the hearing from the members of the power plant and result of site survey, we selected the equipment for rehabilitation and classified it into the following three ranks according to the current status.

The selected equipment for rehabilitation is shown in Table 5.1-1.

- Rank A： Selected is turbine equipment that has not yet been rehabilitated, and equipment that has recently had an accident or failure and equipment of which large rehabilitation effects can be expected. Rehabilitation of this equipment is planned to be carried out from 2006 to 2010 after the rehabilitation project (Phase-II) has been completed.

- Rank B： Selected is equipment of which failure rate increases by superannuation, and rehabilitation is needed by 2010. This equipment for rehabilitation is planned to be carried out in the rehabilitation work from 2011 to 2015 after carrying out the rehabilitation work of Rank A.

- Rank C： Equipment for rehabilitation by the power plant is considered as Rank C. The improvement has been made gradually for repair of structure equipment such as replacement of damaged windowpanes, leaking powerhouse roof repair, and lighting equipment etc. for improvement of the work place environment. These are considered as equipment that the repair can be planned by the power plant.

Table 5.1-1 Equipment to be Rehabilitated

（*：Equipment contributed to the improvement in the condenser vacuum.）

(1) Boiler Equipment	Rank
Repair work for leakage from ESP	B
Installation of sootblowers	B
Replacement of boiler tubes (high press portion)	C
Replacement of screw conveyor	C
Repair work for steam and water leakages	C
Repair work for sand expansion at economizer	C
Gas duct expansion replacing work	C

(2) Turbine Equipment	Rank
Replacement of auxiliary steam temp and press reducing control valves for plant start-up	A
Replacement of auxiliary steam temp and press reducing control valves for normal conditions	B
Replacement of auxiliary press reducing valve	C
* Replacement of feedwater pumps and motors	A
* Replacement of condenser pumps and motors	A
* Replacement of expansion joint of condenser and extraction pipes	A
* Replacement of valves for vacuum equipment	A
* Replacement of ejectors	A
* Replacement of HP/LP feed water heaters	A
* Turbine No.1, 5, 6 (each 80MW) modification	C
* Installation of mechanical filters at cooling tower outlet	A
* Repair work for cooling tower (Study of alternate equipment)	C
* Condenser tube cleaning devices (Study of pipe cleaning equipment)	C
* Replacement of circulating water pumps	C
Repair work for steam and water leakages	C

(3) Control and Instrumentation Equipment	Rank
Replacement of turbine and auxiliary transmitters	A
* Optimize condenser hotwell level control equipment	A
Replacement of No.1 to No.6 TG supervisory instruments	A
Replacement of No.1 to No.6 LP HTR level transmitters and controllers	A
* Replacement of turbine control and instrumentation	A
Installation of No.5 to No.8 chemical dosing equipment supplied on Phase-I	C
Automate No. 2 evaporator equipment operation	C

(4) Electrical Equipment	Rank
Replacement of 6kV electric motors for FDF and IDF (No.1B to No.8B) including appropriate interlock system	A
Replacement of H.V. (6.6 kV) switchgears (OCB type) to GCB or VCB type Switchgears	A
Replacement of L.V. (0.4 kV) switchgears	A

Replacement of generator protection system	A
Replacement of 10.5 kV switchgears (OCB type) for generators to VCB type switchgears	A
Replacement of 220 kV / 110 kV switchgears (OCB type) to GCB or VCB type switchgears only for generator transformer	A
Rehabilitation of various motors	C
Improvement based on cause analysis of burned motors	C

(5) Fuel Handling Equipment	Rank
Installation of coal amount measurement for coal conveyers	A
Adoption of coal analyzer	A
Installation of TV monitoring system for fire, leak and safety for conveyer No.3 and No.4 lines	A
Replacement of firefighting system	A
Replacement of wet dust collector	B
Replacement of bulldozer	B
Supply of spare parts for coal crushers	C
Replacement of steam heating system at coal handling area	C

(6) Chemical Equipment	Rank
Installation of dissolved oxygen monitoring system for condenser	A
Installation of automatic control and supervisory instruments for water treatment equipment	A
Installation of spot cooler at water sampling room	A
Substitute chemicals for ammonia and hydrazine (Introduction)	C
Chemical lining and coating of tubes and tanks (Introduction)	C
Replacement of ventilation devices in water treatment and analysis rooms	C

(7) Other Facilities	Rank
Repair of window glasses	C
Repair of rain water leak in the power house roof	C
Repair of lighting equipment	C

5.2 The Rehabilitation Improvement Effect

Among the equipment selected for rehabilitation in this report, the rehabilitation improvement effect expected after rehabilitation work implementation of the equipment considered as Rank A is estimated as Table 5.2-1.

Table 5.2-1 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 fuel consumption	164.3
(4) Increase of the plant availability	10,749.4
Total	11,777.6

5.2.1 Reduction of Auxiliary Power Ratio

Through the loans (phase-I) from the Japanese government from 1996 - 1999, coal combustion equipment of boiler No.1 - boiler No. 4 was converted to the direct combustion system. The auxiliary power ratio is reduced by rehabilitation of equipment, such as MILL and PGF. The changes in the auxiliary power ratio from 1995 - 2000 are shown in Fig. 5.2-1.

Through the loans from the Japanese government scheduled for 2001 - 2005 (Phase-II), the same rehabilitation as that of Phase-I is due to be implemented for boiler No. 5 - boiler No. 8. Reduction with the same auxiliary power ratio is expected.

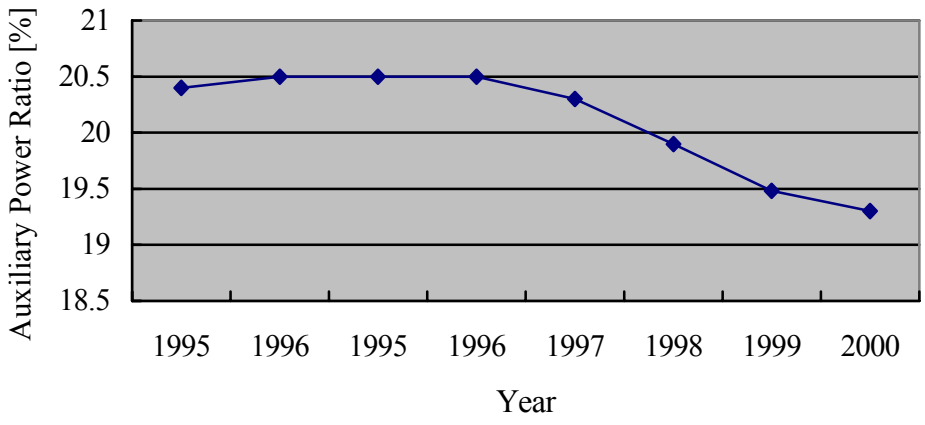

Fig. 5.2-1 The Changes in the Auxiliary Power Ratio

In addition to above-mentioned improvement effect, a big reduction in the auxiliary power ratio is expected by inverterization of feed water pump motor No. 1 - No. 8. Now, the feed pump is operated by fixed rotation irrespective of the boiler load. The feed water control valve adjusts water flow.

When the average load is per the year 2000 base, the amount of auxiliary power consumption will be reduced by 35.1GWh. Since the electric energy selling unit price of TES4 in 2000 year is 19.76 Tug/kWh, the rehabilitation improvement effect is:

$$35.1\text{GWh} \times 19.76\ \text{Tug/kWh} = 693.6\ \text{MTug}$$

5.2.2 Recovery of Condenser Vacuum

The condenser vacuum has gradually deteriorated every year since 1993. In TES4, the recovery of the condenser vacuum is one of the most important items of the annual action plan, and a workgroup centering on the Engineering Department including the Operation Department and the turbine section has been formed, so cause investigation and measures are being implemented. However neither cause investigation nor its measure are sufficient. The changes of the condenser vacuum over the past 11 years in TES4 are shown in Fig.5.2-2.

Major causes of condenser vacuum decline are that since planning and implementation of the necessary repairs have not been fully conducted, the suction portion of the air leak has increased by the superannuated equipment. And also, there is clogging of the condenser tube inlet by foreign substances, and a shortage of the cooling water flow resulting from non-collecting of the bearing cooling water.

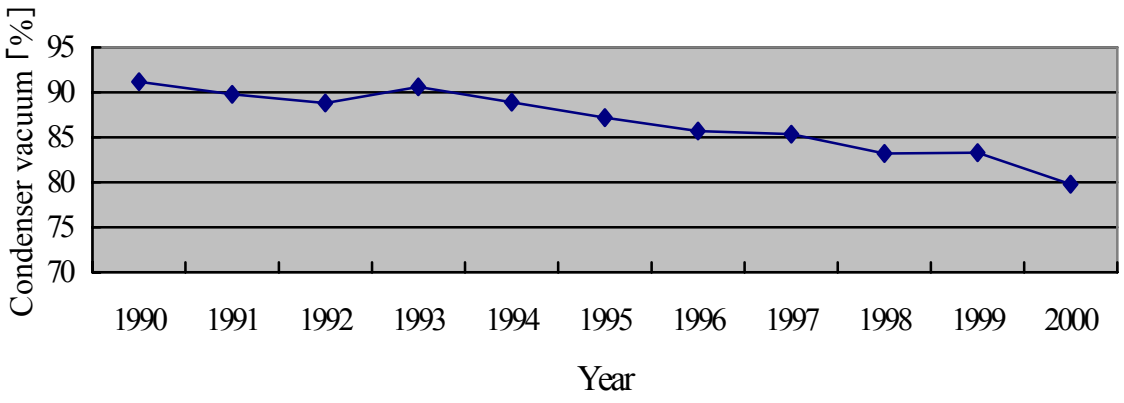

Fig. 5.2-2 The Changes of the Condenser Vacuum

By replacing and repairing Rank A equipment, the recovery of the condenser vacuum can be expected to produce a design value (92%:650 mmHg).

Consequently, a reduction in the amount of annual fuel losses of 11,885 tons can be aimed at by improvement of condenser vacuum.

Since the fuel unit price of Baganuur coal in the year 2000 is 7,000 Tug/t and 3,420 kcal/kg, the amount of annual coal losses becomes:

$$7{,}000 \text{ Tug/t} \times 11{,}885\text{t} \times 7{,}000 \text{ kcal/kg} \div 3{,}420 \text{ kcal/kg} = 170.3 \text{ MTug}$$

5.2.3 Saving Heavy Oil Fuel Consumption

Through the loans (Phase-I) from the Japanese government from 1996 - 1999, pulverized coal combustion equipment from No. 1 boiler - No. 4 boiler was converted to the direct combustion system. As a result, the amount of heavy oil consumption has been cut sharply through fewer failures of the pulverized coal combustion equipment. It is also considered that as the number of boiler start-ups decreased, this factor led to drastic reduction in the amount of heavy oil consumption by decrease in the number of times of critical failure. The changes of the amount of heavy oil consumption and purchasing cost in 1997 - 2000 are shown in Fig.5.2-3.

The number of boiler shutdowns per cause of each failure in year 2000 is shown in Table 5.2-3. The number of shutdowns by failure of turbine equipment and electric equipment is 23 times and 54 times, respectively.

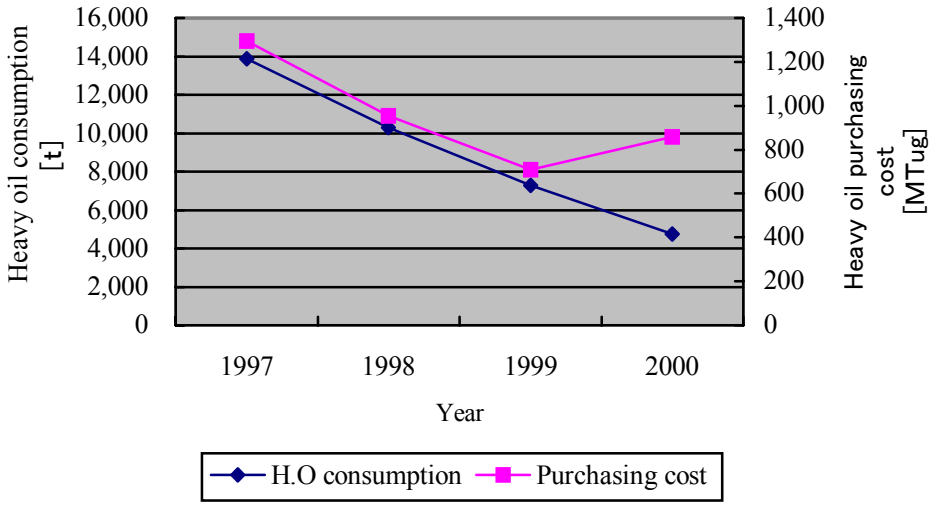

Fig. 5.2-3 The Changes of the Amount of Heavy Oil Consumption and Purchasing Cost

Table 5.2-2 The Number of Boiler Shutdown according to Failure Cause in Year 2000

Equipment	*Boiler*	*Turbine*	*C & I*	*Electric*	*Fuel*	*Maintenance*
2000 year	131	23	6	54	2	1

The equipment for rehabilitation selected in this report has, mainly, turbine and electric equipment. By rehabilitating equipment of Rank A, each annual failure number of cases presupposes that it decreases to ten percent or 2 times and 5 times. Consequently,

15 t × (21+49) =1,050 [t] reduction amount of heavy oil consumption is expected.

The heavy oil unit price in year 2000 is 156,494 Tug/t. When heavy oil purchase unit price is constant, reduction in the amount of heavy oil consumption becomes:

1,050 t × 156,494 Tug/t =164.3 MTug

5.2.4 Increase of the Plant Availability

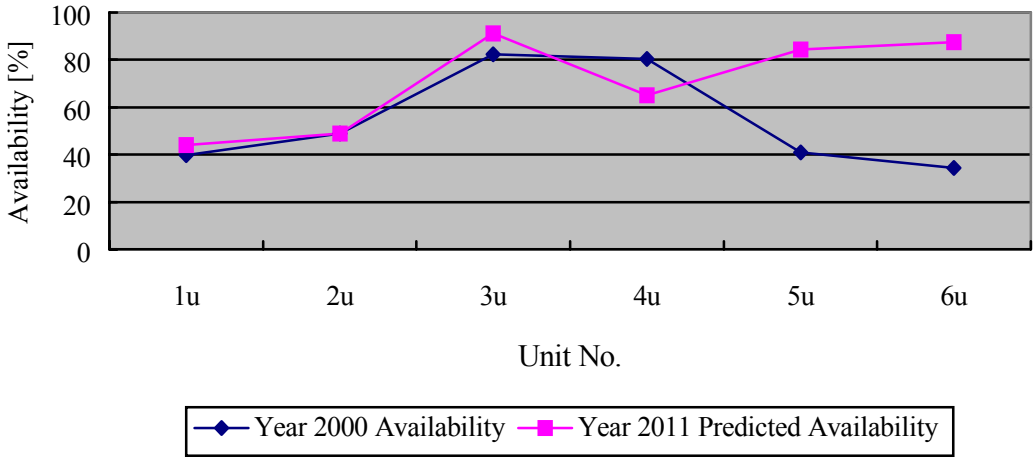

Fig. 5.2-4 The Changes of Availability of Each Turbine/Generator

Since large decrease in failure repair hour is expected, availability (operation time base) of turbine/generator No.3, 5 and 6, which are not scheduled for a major or middle overhaul, increases to 80% or more, and an average of about 70% becomes possible. Additionally, electric energy production increases in 744 GWh. Since electric energy sales in year 2000 (a portion of which is deducted as auxiliary power) are 1,526 GWh, the amount of TES4 annual electric energy sales increases to 2,270 GWh in 2011 after rehabilitation of Rank A equipment.

Since the capability of annual electric energy sales after Phase-II rehabilitation becomes 1,726 GWh, the amount of increase in selling electric energy by rehabilitation effect of Rank A equipment is:

744 GWh－(1,726 GWh－1,526GWh) =544 GWh.

If the electric energy selling unit price considers the year 2000 as a base, since it is 19.76 Tug/kWh, the increase in the sales income by increase of turbine/generator availability becomes:

19.76 Tug/kWh × 544 GWh=10,749.4 MTug.

(2) The increase in the Amount of Selling Heat Supply

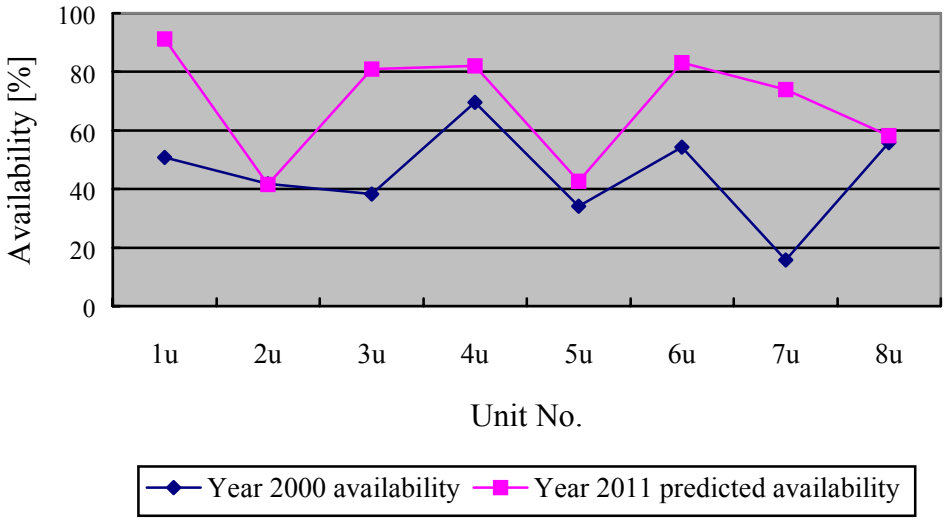

Fig. 5.2-5 The Changes of Availability of Each Boiler

Since a large decrease in failure repair hour is expected, availability (operation time base) of boiler No.1,3,4 and 6, which are not scheduled for a major or middle overhaul, increases to 80% or more, and an average of about 70% becomes possible. Additionally, steam production increases to 7,756 kt. Even if the increased part of the electric energy production is deducted from the increased steam production, the increased portion in the market capability of annual heat supply becomes 2,475 Tcal.

Boiler availability depends on the growth of heat demand. In order to relate the increase in the boiler availability with the increase in heat sales income, the growth in the heating demand must surpass the forecasted heating growth.

Since the market capability of the annual heat supply after Phase-II rehabilitation becomes 6,100 Tcal, the rehabilitation effect of the Rank A equipment will appear in 2018 and beyond.

5.3 Future Maintenance and Rehabilitation Plan

If the life of plant is considered to be 40 years and the continuation of operation to last until 2025, it is necessary to extend the ash ponds of the 5th and the 6th within ten years. Furthermore, in preparation for the increase in demand, it is necessary to arrange a fund necessary for the rehabilitation of 80 MW turbines that cause a lot of failure, future environmental measuring equipment corresponding to environmental regulation and other prolongation-of-life activities, etc. A future repair plan is shown in Fig. 5.3-1.

As these are large-scale rehabilitation works that require foreign financial support, it is necessary to carry out following:

- First, to implement the rehabilitation work (Phase-II) of the 4th power plant scheduled for 2001 to 2005
- Second, to implement the rehabilitation work of the equipment selected as Rank A from 2006 to 2010, which is expected to have a high repair effect
- Third, to implement the rehabilitation work of the equipment selected as Rank B from 2011 to 2015, which is expected to be too old for operation

In parallel to the above mentioned rehabilitation works, it is necessary for TES4 to increase the cost of routine maintenance and repairs from about 7% of the present production cost to 10 - 15% as in Japan. This increased cost covers rehabilitation of the equipment selected as Rank C, which is carried out by TES4 and also proper repair work such as maintenance of equipment and tools as planned.

Because a large amount of money is required to carry out turbine modification for future increasing of demand and ash pond expansion for future continues plant operation, and subsequently, because TES4 is unable to cover its own repair and maintenance costs, supplemental funding is required for extraordinary rehabilitation works to be financed by foreign support.

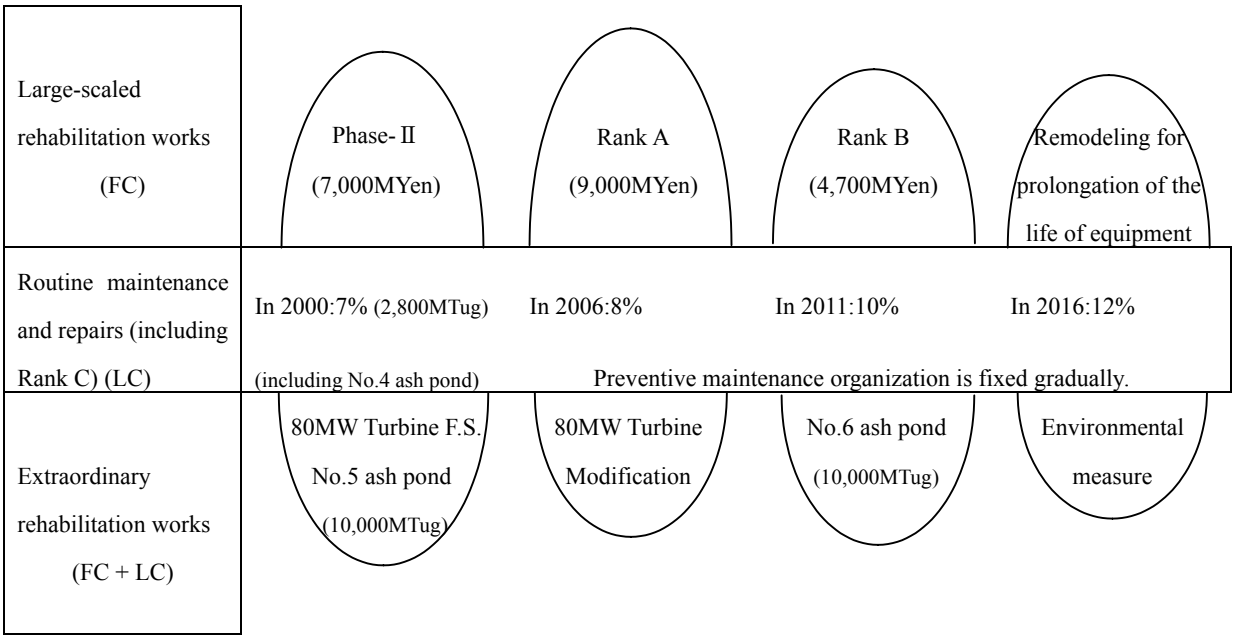

Fig. 5.3-1 Future Maintenance and Rehabilitation Plan

Among the equipment for rehabilitation selected in this report, the cost estimation of rehabilitation work for total cost of Rank A equipment is about 9,000 million Yen, and total cost of Rank B equipment is about 4,700 million Yen.

5.4 Economic and Financial Evaluation

An economic and financial evaluation was made of A-ranked plan of rehabilitation based on the rehabilitation effects and its plan mentioned in the previous sections 5.2 and 5.3.

5.4.1 Economic Evaluation

(1) Assumptions

The cost-benefit analysis by alternative method was adopted as the evaluation method with a discount rate of 9%, proximate to 8.6%, weighted average rate of interest of the bonds issued in 2000 by Bank of Mongolia, government bond equivalence.

The evaluation covers the period of 20 years from 2006, the first year of the rehabilitation plan, through 2025, about 40 years (service life of a thermal power plant adopted in a long-term plan of Mongolia) after the completion of the first unit of TES4. The evaluation considers the following rehabilitation effects.

Table 5.4-1 Annual Effects of Rehabilitations

Effects	*Year*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
1 Reduction of Auxiliary Power	GWh	NA	NA	8.8	17.6	26.3	35.1	35.1	35.1	35.1	35.1
2 Vacuum Increase & Coal Saving	Coal/ton	NA	NA	6300	12600	18900	25200	25200	25200	25200	25200
3 Heavy Oil Saving	Oil/ton	NA	NA	262.5	525	787.5	1050	1050	1050	1050	1050
4 Increase Power Production	GWh	NA	NA	136	136	408	544	544	544	544	544

Effects	*Year*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*
1 Reduction of Auxiliary Power	GWh	35.1	35.1	35.1	35.1	35.1	35.1	35.1	35.1	35.1	35.1
2 Vacuum Increase & Coal Saving	Coal/ton	25200	25200	25200	25200	25200	25200	25200	25200	25200	25200
3 Heavy Oil Saving	Oil/ton	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050
4 Increase Power Production	GWh	544	544	544	544	544	544	544	544	544	544

1) Benefit Setting

A coal-fired power plant with an equivalent capacity to the increase in plant factor was adopted as the alternative, so that the installed capacity was assumed at 100MW. That installed capacity was calculated considering the installed capacity of 62MW calculated by dividing the increase in power production of 544GWh/year by 8,760 hours and 10% of station use and 70% of plant factor.

The construction cost of the above alternative power plant and its cost of maintenance and operation were adopted as benefit. The construction cost was assumed at 150 thousand Yen/kW and 12 billion Yen in total (equivalent to 109 billion Tug. at the exchange rate of October 2001) and the construction period was assumed to be 3 years. The maintenance and operation cost was assumed at 4% of the construction cost.

2) Cost Setting

The cost was assumed to comprise the investment amount of the rehabilitation plan and 2% of the investment amount as maintenance and operation cost. The assumed cost considered the following effects of rehabilitation: the decrease in coal consumption due to vacuum improvement and decrease in heavy oil consumption due to decrease in the number of start and stop resulting from the decrease in the number of forced outage.

The unit prices for fuel were taken from the data for 2001 of TES4: 8,708 Tug/ton, weighted average of 8,050 Tug/ton for Baganuur coal and 5,405 Tug/ton for Shivee-Ovoo coal at the ratio of 7:3 of actual consumption plus 20% as transportation cost.

(2) Evaluation

EIRR was not possible to calculate and B(alternative power plant)/C(rehabilitation) was 3.21. It follows that the rehabilitation plan is viable from the standpoint of the national economy of Mongolia. In order to ascertain the robustness of the above viability, sensibility analysis was made with the investment amount of the plan, that of the alternative, the fuel cost, the unit price of import from Russia and the exchange rate of Tug to the dollar as parameters. In any case B/C did not go below 2. Furthermore, even in the combined case of 20% increase in the investment amount of the plan, 20% decrease in investment amount of the alternative, 4 US$/MWh drop of the unit price of import from Russia, and devaluation of Tug to the dollar to 1,900 Tug/US$, B/C was 2.16, showing sufficient economics of the plan.

5.4.2 Financial Evaluation

(1) Assumptions

The cost-benefit analysis was adopted as the evaluation method with the increase in sales and decrease in expenses due to the rehabilitation plan as benefit and the investment amount and maintenance and operation cost as cost. The evaluation criteria and discount rate should originally be the capital cost of a company. However, appropriate capital cost cannot be calculated partly because TES4 has so far been state-owned and partly because the country's financial and capital market is immature. Therefore, 9% was assumed, proximate to 8.6%, weighted average rate of interest of Bank of Mongolia bonds as in the economic evaluation.

The evaluation covers the same period as in the economic evaluation, for 20 years from 2006 through 2025. The financial evaluation considered the same effects of rehabilitation as in the economic evaluation.

The assumptions for cost and benefit are given below.

1) Benefit Setting

The benefit was assumed to be the sales of power and heat. The unit price was assumed to be the wholesale prices for TES4: 22.23 Tug/kWh for power and 3,450.1 Tug/Gcal for heat. The sales volume was assumed to be the increase in sales volume due to increase in plant factor brought by the rehabilitation plan. The rehabilitation would also reduce the power station use so that the corresponding increase in power sales volume was added to the sales volume. As for heat, the increase in production capacity would be latent until 2018 because of suppressed demand of Ulaanbaatar.

2) Cost Setting

The variable cost for 2001 was calculated by multiplying the variable cost from the actual of 2000 by 15%, increase of coal price in 2001. The variable cost for 2000 was calculated for power by dividing some 11.9 billion Tug of fuel cost by some 1,500 GWh of sales volume, resulting in 7.8 Tug/kWh and for heat by dividing some 7.1 billion Tug of fuel cost by some 2,500 Tcal of sales volume, resulting in 2.804 Tug/Gcal. Then, multiplying the above unit prices for 2000 by the price increase rate of coal resulted in 8.97 Tug/kWh for power and 3,225 Tug/Gcal for heat to be used as 2001 variable cost.

The assumed cost also considered the decrease in coal consumption due to vacuum improvement and the decrease in heavy oil consumption due to decrease in the number of stops and starts brought by decrease in the number of forced outages. Additional cost for maintenance and operation was assumed at 2% of the investment amount for the newly installed facilities in the rehabilitation plan.

(2) Evaluation

FIRR was 3.83%, well below 8% of the rate of the Bank of Mongolia bonds. B/C was 0.69. Those evaluation criteria show that the plan should be discarded from the standpoint of an enterprise. Nevertheless, the economic evaluation justifies the plan as worth implementing. This result suggests that the unfavorable financial evaluation was due to low level of the wholesale prices and that some raise in the wholesale prices should be made.

Sensitivity analysis was made on the above evaluation with the investment amount of the rehabilitation plan, the fuel prices, and the wholesale prices for power and heat as parameters. In order to achieve 9% of FIRR to allow the adoption of the plan, the parameters must be independently as follows: 26% reduction in the investment amount, 52% drop of fuel prices and raise in the wholesale prices to 27.4 Tug/kWh for power and 11,250 Tug/Gcal for heat. In a combined case of raise in the wholesale prices for power and heat, considering that heat actually recovers half the cost so that heat price is increased 2 times, 9% of FIRR can be achieved with 25 Tug/kWh for power and 7,000 Tug/Gcal for heat.

5.4.3 Funding Plan

TES4 will need maintenance and rehabilitation funds to continue its operations up to 2025 including not only Rank A rehabilitation plan discussed in the previous section but also Rank B rehabilitation necessary for age deterioration, Rank C routine maintenance, turbine replacement of Units 1, 5 and 6, and addition of ash ponds.

(1) Funding Plan

1) Loan conditions for Phase-II were taken as basis: yen credit 85% (interest 1.11%, repayment period 20 years, grace 7 years) and local funding 15% (interest 35%, repayment period 5 years, grace for construction time)

2) Interest during construction was assumed to be paid by own fund.

3) Interest rate for local funding was assumed at 35% because the prime rate was 2-3%/month although there was no long-term commercial lending beyond 1 year according to a hearing from the Bank of Mongolia at the time of the survey.

4) The following 7 cases were established with different loan 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 because the foreign currency portion must be borrowed from abroad because of shortage of Mongolian foreign reserves)

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

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

Case 5: More realistic loan conditions for foreign currency with 5 years 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%, allowable rate to make cashflow for each year positive

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

(2) Overall Evaluation

Cases 1, 3 and 4 assume 20 years repayment but are not possible without soft conditions as provided by yen credit with as a low interest rate as 1%. There is uncertainty about whether yen credit will be provided in future and in the case of future privatization there is no possibility of Case 1. In Case 2, 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 most likely to be faced by a corporation facing future privatization. As seen in Case 6, even if an unrealistically low interest rate is applied, capital deficiency occurs and the case becomes impossible, which indicates 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 depreciation period in order to prepare financial statements more properly reflecting the actual financial situation. The next is loan conditions; as there has been no long-term lending in Mongolian financial markets 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 a price hike and whether to procure a local fund requirement by its own fund.

CHAPTER 6

POWER PLANT OPERATION AND MANAGEMENT PLAN

CHAPTER 6 POWER PLANT OPERATION AND MANAGEMENT PLAN

TES 4 has been incorporated as an independent company since September 2001 and is accordingly required to manage the company as a profit-making enterprise.

In this chapter, necessary reformations and improvements not only in the plant operation but also in the whole management are proposed for TES4 to break from the convention, pointing out the present conditions to be reformed and improved.

6.1 Organization

6.1.1 Review of the Organization

(1) The Points at issue with the Provisional Organization

The provisional organization chart which was proposed by TES4 and approved by the government, does not differ substantially from the organization under which TES4 has operated so far as a state-owned power plant.

Consequently, the organization of TES4 should be reviewed in due consideration of its originality as an independent corporation on the transferring the Corporation.

The following points at issue are drawn to our attention on the Provisional Organization.

1) The basic functions (line) and the administrative functions (staff) are not clearly structured.

2) There line of command is unclear.

There are no clear- cut lines of the roles and functions between the second Vice President and the Finance Manager.

3) The following two departments should be established in the administrative function.

(a) Safety and Health control Department

(b) Quality Control Department

(2) Proposal for an Improved Organization

We propose the attached organizational chart for reference (Refer to Fig. 6.1-1) that takes the above points into consideration.

1) The Finance and Procurement Departments should come under the direct control of the second Vice President. The Personnel Section, Welfare Section (Canteen, Hospital, Stock Farm), the General Affairs Section, and the Marketing Section should come under the supervision of the General Affairs Department and the second Vice President should exercise direct jurisdiction over them.

2) The Corporate Planning Department should vigorously support the operation of the power plant as the Presidential staff department with reinforcement of its personnel.

3) A new Safety and health Control Department should be established as the Presidential staff department. It should rigorously implement safety and Health control at the work place.

4) In order to enhance the quality of the Operation and Maintenance Departments, a new Quality Control Department should be established as the first Vice Presidential staff to upgrade the quality of repair work and eradicate operating errors and also to reform the workforce's awareness of TES4.

5) The repair group that are arranged in each operation section should be brought together in the Repair Department for unified maintenance of TES4.

6) Each operation section that has transferred their repair group should be exclusively responsible for the administration of the operation of their respective equipment. The Operation Department should concentrate its effort on managing all operation sections to integrate and coordinate them for upgrading safety and steady operation of equipment, thus obtaining high efficiency for saving costs with exclusive responsibility.

6.1.2 Job Assignment and Responsibility

(1) Improvements in Job Assignment

The basic work rules of each operation section as the job assignment are very specific in content, the functions of each section and the mutual relations between each section are not defined.

In this context, we propose the following suggestions when the job assignment specifications are prepared.

1) Apart from the existing basic work rules, new job assignment specifications should be established and the mutual relations between each department defined.

Its content should be limited to some general expressions for solving the borderline problems

voluntarily by employees of the related departments and sections that are not specifically included in any job assignments. Demarcation disputes between departments or sections will be eliminated using such expressions.

2) Each department and section has to review the existing basic work rules based on these new job assignment specifications and make them more concrete for use as the work rules and regulations in each department and section.

3) The work agreements between each department or section and the power plant should be abandoned and yearly plans for each department or section should be established with clearly defined numerical targets. These plans and targets have to be linked to the annual targets set beforehand by the top management, namely, an objectives management system should be developed in the company and all departments or sections must totally commit themselves to achieve the targets in cooperation with top management.

4) The present system excessively concentrates decision-making powers on the top management, which has a very heavy burden of responsibility.

   Since the top management is not fully knowledgeable about every field in the company, it is essential to move a little more away from the top-down approach to a bottom-up approach. Powers and authority should be delegated to the managers of subordinate organization as well as responsibility and accountability.

The top management should share more of the powers and authority with the department managers and give them specific responsibilities at the same time, so that the top management may be free from mundane duties and can concentrate on their proper functions.

The job assignment specification and basic rules make it clear “who should take responsibility for executing the work functions.”

Even if the specifications and rules define the transfer of power or authority, it does not mean that each department will act in the best manner in accordance with objectives of the company.

Consequently, it is essential for the top management to create a regular reporting system, whereby they receive precise information of the site at all times from each manager. Reviewing these reports, the top managers have to give appropriate orders or instructions to the managers. The top management cannot escape its responsibility for the decisions made by each department manager even if they have transferred or delegated power or authority to subordinates.

Fig.6.1-1

6.2 Administration of the Plant Equipment

This chapter indicates the status and improvement plan for administration of plant equipment, such as operation administration, maintenance administration, engineering administration, inventory administration, fuel administration, and safety and health administration.

TES4 strives for maintenance, rehabilitation, efficient operation of the plant equipment, prevention of an accident before it happens and continuous stable supply of electric power, adopting the improvement plan.

6.2.1 Administration of the Operation

(1) Improvement in observation techniques of the operator

The current Status of TES4	*Improvement Plan*
(Observation item) • Since many indicators and recorders for turbine equipment and boiler No.5 to No.8 have failure parts and are difficult to observe, CRT were introduced for observation several years before aiming at intensive observation by CRT. • The control devices for boiler No.1 to No.4 have been replaced and enabled monitoring at indicators, recorders, CRT, alarm windows, etc.	• Probe the main process data, that cannot be observed and repair the faulty measuring instrument immediately. • Operators should grasp the amount of change of process data based on the difference in load band and coal characteristics. • Operators should check the recorded process data, and should act promptly when abnormalities are found.
(Patrol) • Each operation group follows a regular patrol route. • The auscultation stick (to check soundness of a rotating machine) is not used. • The environment of the field (especially boiler building) is quite dark even in daytime. • Number of flashlights is insufficient. • Patrol tools are insufficient.	• Operators should not patrol vaguely, but patrol acknowledging checkpoints of the equipment. • Patrol check items should be reviewed considering the past frequency of abnormalities. • Perform the device for finding abnormalities. For example, marking the normal value on a local gauge.

(2) Preparation and maintenance of operation support manuals

Current Status of TES4	*Improvement Plan*
(Operation manual) • The operation group of each section is keeping the operation manual. • The operation group of each section prepared the operation manual in collaboration with the Engineering Department or the Research and Planning Department, and recognition of the Repair Department and the Operation Department has been obtained.	• The Operation Department should keep all operation manuals and make required amendments. • For improvement of operation manuals in use, operators who actually use the operation manual should take the lead, forming the working group.
(Keeping place of operation support manuals) • The operation group of each section is managing the operation support manuals in each section chief room. • Duplication of the required part is made at every work.	• Operation support manuals should be kept in the bookshelf in CCR and ECCR so that operators who actually operate can peruse at any time.
(Other operation support manuals) • The supplier's documents that are supplied by the manufacturer are important, in which not only the operation and maintenance method but also many drawings are included. The operation and maintenance manual should be developed based on these supplier's documents. However, in TES4 some drawings have already been lost and some remodeled parts are not yet reflected in the drawing.	• The operation and maintenance manual should be completed. And one complete set should be kept in the Operation Department and another in the Repair Department.

(3) Improvement of the method for taking over the next shift and means of in-house communication

Current Status of TES4	*Improvement Plan*
(Taking over to the next shift) • The operator of each section is taking over individually to the next shift respectively. • The shift engineer of the Operation Department has taken over the fault matter of the whole plant to the next shift collectively.	• The operator, who received taking over, holds a meeting at first and has in common with information. • Operators should strive for grasp a working order immediately after taking over.
（The means of in-house communication） • The Operation Department has put up the daily working order in front of service building 1FL elevator. • Information is exchanged at the engineer meeting of all engineer participation on the 2nd Wednesdays every month.	• The participant at a meeting should strive for making the atmosphere, which can perform free opinion exchange. • Build the communication-of-information system by a station LAN so that grasp of the working order may always be possible in the office of plant.

(4) Improvement in keeping the operation logs.

Current Status of TES4	*Improvement Plan*
(Log sheet) • Since the operation log of the past, such as a log sheet, is kept in the data room after checking by the Operation Department, the past operation log cannot be referred to in CCR.	• Keep log sheets in a binder where the engineer of the Operation Department can be perused at any time.
(Long-term deterioration record) • Although the operator is recording main process data on the log for every hour, it is useless as a long-term deterioration record.	• When abnormalities are acknowledged in the plant, and going back and investigating the time when the signs of abnormalities occurred, long-term deterioration records are greatly consulted.
(Monthly efficiency report) • The calculation group of the Operation Department is computing the efficiency parameter based on the data that the operators recorded every day. (Manual calculation) • Once every month, the calculation group describes the results of computation and his comments in a monthly efficiency report, and this is reported to the Operation Department manager.	• The efficiency calculation should be executed by the computer to save computation . • The monthly efficiency report should also be kept in CCR so that operators can be perused it and to raise the consciousness to efficient operation of the plant.

(5) Improvement in administration of repair work by the operator

Current Status of TES4	*Improvement Plan*
(Work procedure) • The repair engineer who belongs to the Operation Department does repair work. • When repair work cannot be performed by the repair engineer (repair which requires part exchange, or it takes a long time), the maintenance plan is discussed and determined in the technical communication meeting.	• The Repair Department should perform all repair work. (The Operation Department should not perform any repair work.) • During complicated times such as Major Overhauls involving many contractors and a great deal of construction work, the Repair Department assembles all contractors before commencement of the work, and checks notes on the contents of construction, the construction time schedule, and safety procedures.
(Supervising states of switchgear, valves and dampers in a ledger) • Except for the Chemical Section, no section is supervising states of valves and dampers in a ledger. • Since supervising states of switchgear is not carried out at all, many electric shocks have occurred.	• Since it leads that supervising states of switch gear, valves and dampers in a ledger is inadequate to serious accidents, such as electric shock, when work becomes complicated, define the "switchgear procedure" and "valves and dampers procedure", and strictly supervise the maintenance.

(6) Coping with accidents

Current Status of TES4	*Improvement Plan*
(Preparation of operation procedures in case of accidents) • Operation procedure at the time of accidents is not provided.	• Although accidents are of infinite variety and it is impossible to prescribe a detailed operation procedure uniformly, operation procedures for typical accidents should be made.
(Training of operators) • Operators are trained using a plant simulator to a minimum extent in order to learn the adequate judgment and the operation procedure at the time of accidents.	• The operators should be trained to be skillful in equipment operation, and well versed in the function and principle of equipment, and have sufficient skill to react to many kinds of accidents.

6.2.2 Administration of the Maintenance

(1) Improvement in Administration of the Maintenance Organization

Current Status of TES4	*Improvement Plan*
(Daily repair works) • There is a repair group in the Boiler Section, the Turbine Section, the Electric Section, the Instrumentation Section, the Chemical Section, and the Fuel Section, respectively. Most daily repair work is done by these repair groups.	• The Repair Department should manage and perform all repair work including daily repair work.
(Major overhaul) • Repair is often postponed due to financial deficit or late arrival of repair parts. It has led to degradation of equipment and decline in availability of the power plant.	• Time scheduling of the major overhaul should be well arranged including connection between repair work and material procurement. (Cautions are especially required for other repair work at the same site.)
(Middle overhaul) • In addition to the major overhaul and daily repair work, repair which cannot be carried out unless stopping operation of a unit is carried out as a middle overhaul biyearly. • Overhaul of the auxiliary machines except for turbine auxiliaries are executed by the repair group engineer of each section under the supervision of the Repair Department like the major overhaul.	• Time scheduling of the middle overhaul should be well arranged including connection between repair work and material procurement. (Cautions are especially required for other repair work at the same site.) • Secure the cost of construction required for the major overhaul so that the overhaul can be carried out as planned.

(2) Planning and implementation of repair work

Current Status of TES4	*Improvement Plan*
(Planning of repair work) • Each operation section that takes charge of the daily repair work omits required sufficient repair just because he gives top priority to continuation of operation. Consequently, the life of equipment is shortened or it has become a failure factor of other equipment. (Temporary repairs are carried out instead of permanent repairs.)	• There are two kind of repair work: one is a temporary repair which is performed immediately after the accident and the other is a permanent repair which is a countermeasure aiming at recurrence prevention after investigating the cause of accidents. Even the daily repair work should consider recurrence. • A preventive maintenance is to consider remaining life assessment.
• Analysis of the cause of the failure and repair work for the damaged equipment is inadequate, and the same failure occurs repeatedly.	• In making the repair plan, the results of the past repair work should be considered to avoid repeating the same failure.

(3) Preparation of repair manual and improvement in repair skills

Current Status of TES4	*Improvement Plan*
(Preparation of repair manual) • When new equipment is installed, the repair manual is arranged based on supplier's equipment instruction manual. • Generally, there are many old drawings and there are many parts that do not match the present status due to equipment reconstruction etc.	• In assembly and disassembly work, dimension control is essential for the performance of the equipment. Dimensions and clearances to be kept and measuring methods should be indicated in the maintenance manual. • In the arrangement of the maintenance manuals, improvement in repair skills of a repair engineer is also expected.
(Improvement in repair skills) • Accidents that damage other equipment have occurred by a part or a tool left behind inside equipment.	• The repair engineer should witness and check the check items indicated in the maintenance manual after the worker completed the assembly work.

(4) Observance of a repair manuals and the judgment for repair work results

Current Status of TES4	*Improvement Plan*
(Observance of repair manuals) • Many maintenance manuals exist, but instructions in the manual are neglected in the actual repair work.	• A repair master and a worker should observe the instructions indicated in the repair manual.
(Judgment of a repair work result) • The evaluation of quality of the major and middle overhaul is made by the Inspection and Research Department.	• A repair master should make an inspection record before assembly of the equipment.

Current Status of TES4	*Improvement Plan*
• At the end of the major and middle overhaul, an inspection record that recognizes the completion of the overhaul is issued after technical deliberations of the Repair Department. Then the Operation Department can re-start the plant.	• A repair engineer should carry out history management (a photograph etc. is included) also including the repair result. • The Quality Control Department should be newly established and carry out QC (Quality Control). (Refer to 6.1.1 "Review of an organization.")

(5) Preparation of replacement parts and materials, and maintenance of repair and testing tools

Current Status of TES4	*Improvement Plan*
(Preparation of replacement parts and materials) • In daily repair works, shortage of parts and consumables required for repair is one of the reasons why sufficient repair is not carried out.	• Chronic shortage of spare parts and consumables should be dissolved preparing a sufficient budget.
(Maintenance of repair and testing tools) • Required repair tools, such as a spanner and an oscilloscope, and testing tools are insufficient. • Although there are lathes, milling machines, etc., in the machine shop, all machines are old and maintenance for the machines is not sufficient.	• Chronic shortage of repair and testing tools should be dissolved preparing a sufficient budget. (Refer to 6.2.5 "administration of the inventory.") • Damaged workshop machines, such as an electric furnace should be repaired as soon as possible.

(6) Improvement of workplace environment

Current Status of TES4	*Improvement Plan*
(Proper arrangement and order) • Arrangement of tools and power cables for work is inadequate. • The display of a working space, an opening, etc. is not provided.	• At the end of a daily work, the quantity of tool should be used to check for prevention of loss of tools. • The display of a working space, an opening, etc. is effective for prevention of an industrial accident.
(Cleaning) • The usual cleaning is not sufficient and local panels and electric terminal boxes are covered with dust.	• Plant cleaning should be performed periodically by composing a cleaning staff and deciding the cleaning range and frequency.

6.2.3 Administration of the Engineering

(1) Restructuring of the Organization for the Engineering

Current Status of TES4	*Improvement Plan*
(Administration of the organization) • The supervision item closely related on operation of the plant is distributing in each section, and is not supervised efficiently.	• The Engineering Department and the Inspection and Research Department should be combined as one organization, and administration of the engineering related closely should be managed as the unitary control by the Operation Administration Section of the Engineering Department.

(2) Improvement in Supervision Items

Current Status of TES4	*Improvement Plan*
(Plant efficiency control) • The Operation Department kept the plant efficiency calculating it manually.	• The "efficiency control manual" that defines the basic efficiency control of the plant should be arranged to perform work smoothly and rationally. For improvement of the plant efficiency, all members concerned should serve work together.
(The quality control of coal) • Analysis of coal characteristics is done at the time of coal receipt and discharge (every 24 hours) and the analyzed data is reported to the Operation Department, but it is used only for efficiency calculation and is hardly utilized for combustion control.	• The analyzed coal data should be reported to the Operation Department, and should be utilized for combustion control operation. It is also useful when requiring coal quality of a coalmine. • Price adjusting article with the difference of moisture and calorie should be specified in contracts with coalmines.
(**The quality control of plant water**) • The investigation for cause of water quality deterioration and the countermeasure against it are inadequate.	• Plant water quality should always be controlled. When water quality deteriorates, proper countermeasure should be taken promptly after investigation of the cause.
(**Boiler combustion control**) • The Boiler Operation Section performs daily operation control among boiler combustion control. • The engineer in charge who checks a boiler combustion state with various parameters is in the Engineering Department.	• Operators should observe the boiler parameters, such as boiler metal temperature, spray water flow, and unburned carbon quantity. • A TV camera that supervises flue gas should be installed for monitoring in CCR, and it is utilized for combustion control or early correspondence of the abnormalities of EP.

6.2.4 Administration of the Fuel

Current Status of TES4	*Improvement Plan*
(Fuel procurement plan) • The procurement plan for coal is determined with concurrence of three companies, i.e. the power plant, coalmine and railroad. From the power plant, the vice president, the fuel section chief, and the railroad engineer participate in the meeting of the three companies.	• Stored quantity of coal should be planned strictly based on the operation plan of the power plant and the capability of the coal handling system.
(Administration of the fuel storage) • The fuel section checks the quality of coal (calorie, ash, and water content) at the time of coal acceptance, and reports it to the Operation Department. • Coal pile in the coal storage yard is pressed since it is lignite that is easy to burn out. However, press was not enough and smoke was seen emitting since the fuel cost for a bulldozer was expensive. (Temperature observation of stored coal is not carried out.)	• For execution of coal quality control, the latest coal analysis equipment should be introduced. It may be useful for improvement in analysis work. • Press of coal pile should be performed satisfactorily by the bulldozer in order to prevent spontaneous combustion.

6.2.5 Administration of the Inventory

Current Status of TES4	*Improvement Plan*
Retaining quantity of spare parts） • There is a plant warehouse that the Procurement Department manages, and spare-parts warehouses that each section manages.	• In retaining the quantity of spare parts and consumables, preparation and maintenance of a ledger for the stored goods is essential.
（Inventory management） • The tag system for the spare parts warehouse has been introduced through a grant aid from Japan and arrangement of the order of the goods in the plant warehouse is carried out comparatively carefully.	• Recognize the purpose of inventory management and put ledger management into practice. • Look over appropriate quantity according to the character of each spare part again, and the quantity of each spare part should be held.
(Procurement of spare parts) • When spare parts are needed, the manager of the Repair Department makes a request to the manager of the Procurement Department. • The Procurement Department examines whether the part should be procured from a domestic or overseas supplier, and performs the procedure required for purchase.	• The procurement procedures for spare parts necessary for daily repair work should be simplified. • In order to secure parts procurement, the following procedures are useful: a) Expansion of supply sources b) Establishment of procurement agency c) Accommodation of spare parts between TES4 and the other plants

6.2.6 Administration of Safety and Health

(1) Improvement of the work place environment and its administration organization.

Current Status of TES4	*Improvement Plan*
(Work place environmental administration organization.) • Based on 6th article of the occupational health and safety regulation, measurement of the illumination in the work place coarse particulate, and noise is carried out, when the measured data exceeds the limitation value, the Inspection and Research Department warns the section responsible in written form to improve the work place environment.	• A Safety and Health Control Department should be established under direct control of the president and shall carry out measures and instruction for improvement in the work place environment to the department responsible. • Work environment in CCR, ECCR, and in the service building shall also be investigated periodically as well as the powerhouse.
(Illumination in the work place) • The illumination in many areas of the boiler and turbine equipment is less than the limited value, and we are striving for improvement of lighting equipment.	• The deficiency of illumination in the powerhouse, obstacles left in the work place such as damaged machines, materials for repair, etc, broken steps and catwalks cause industrial accidents. These improper conditions should be improved immediately.
(The situation of a coarse particulate) • The equipment that generates severe coal dust are the coal discharging conveyer, tippler, crusher, mill, etc. • As a measure against a coarse particulate of a coal-discharging conveyer, a wet type dust collector is installed in the crusher house, and there is a spray of water and steam to the throat of the changeover chute.	• Although it is difficult to completely suppress coal dust generation in areas where coal is handled, dust elimination measures, such as the introduction or improvement of a ventilator in the area where the concentration of coarse particulate exceeds the limited value, should be introduced.
(The noise situation) • The work places where the noise exceeds the limit value of 85dB(A) are the circumference of the boiler, the mill, the turbine, some coal conveyers, and the mechanical workshop, etc.	• When doing repair work in work places where the noise level is higher than the limit value, workers shall wear protective implements, such as earplugs, to prevent themselves from developing hearing impairment.

(2) Accident occurrence and measures for reducing industrial accidents to zero

Current Status of TES4	*Improvement Plan*
(Accident occurrence) • 72 accidents have occurred in the power plant in the past six years (1995 - 2000). • The most common types of accidents are due to electric shock or are accidents during machine operation. Burn and fall accidents rank second.	• The Safety and Health Control Department should be established under direct control of the president and shall carry out all measures and instruction for improvement in the work place environment to each section.

Current Status of TES4	*Improvement Plan*
• In 1998 and afterwards, in the power plant, measures such as labor protection, safety, and the construction of a special health improvement plan have been implemented, and the number of accidents is decreasing.	• The measure aiming for zero industrial accidents is strengthened under the instruction of the above-mentioned organization.

(3) Real state of occupational disease and a plan for its improvement.

Current Status of TES4	*Improvement Plan*
（Situation of disease） • The numbers of occupational disease were decreasing at one stage but are recently increasing again. • The most common disease is pneumoconiosis.	• In order to prevent pneumoconiosis, while putting the measure against a coarse particulate into practice and aiming at an improvement in work place environment, use of a protective dust mask is enforced.

(4) Measures for Workers' Safety and Health

Current Status of TES4	*Improvement Plan*
（Safety Patrol） • The safety patrol investigates inside the plant twice a day. • Small issues regarding abnormalities acknowledged during the patrol are reported to the manager of the Inspection and Research Department and each section. In the case of a big issue, an improvement notice is sent to the section. In this case, if the abnormality is not yet resolved, work is not permitted to continue.	• The Safety and Health Control Department should be established under the direct control of the president. This will give authority to the patrol. (Hazardous work shall not be permitted under any circumstances.) • In addition to the issuance of the improvement notice, who shall resolve the issue and by when it should be resolved should be clarified immediately after the patrol.
(Fire prevention patrol) • One engineer specializing in fire prevention and 17 firemen (3 groups, 4 shifts) are nominated. They patrol every two hours and report any abnormalities acknowledged in their patrol at the technical communication meeting.	• The fire-fighting team shall not only report patrol results, but shall carry out improvement instructions, including equipment reconstruction.
(Hazard display) • Even if hazards (destruction of handrails and catwalks, steam leak parts) are recognized, sufficient exchange and repair are impossible due to a financial deficit.	• Even if immediate repair is difficult, it is necessary to take some measure, such as installing a hazard sign. • Caution signs (caution items) should be provided where serious accidents have occurred to prevent similar accident.

Current Status of TES4	*Improvement Plan*
(Safety instructions for repair work) • Before commencement of repair work, although a check of work tools and work procedures is carried out, a check of safety notes for the work is not performed.	• Before commencement of repair work, the repair engineer in charge shall draw up "safe work procedures" that indicate work procedures, safety measures, and names of workers responsible for each work segment, and it should be subject to the approval of a safety person in charge.
（Practice of safety education in-house） • 4th-6th class workers have taken examinations once a year under the supervision of the Inspection and Research Department. The chief engineer of each section, the chief of the Operation Department, and the chief of the Inspection and Research Department carry out the examination together. Technical questions and safety questions are included in the examination questions. The examination is carried out using the personal computer of the Inspection and Research Department. • Questions in the examination are set from the "Technical operation rules" and "Safety rules for equipment operation" that the Ministry of Infrastructure created. • The examination committee of each section carries out examinations for workers of classed lower than 4th. Technical questions and safety questions are included in the examination questions.	• In order to eliminate industrial accidents, safety education of workers is important. Training which heightens the creative thought in regard to actual hazards should be carried out utilizing past examples of accidents in the power plant, and not simply by checking the degree of comprehension of safety rules on equipment operation by examination. • There have been situations that have almost but not quite resulted in accident. Most workers have had this kind of experience. Discussion of this kind of experience between workers should help to prevent future accidents.
（Workers' health check） • The results of the in-plant clinic medical examination are indicated.	• Attention should be paid especially to the health of a shift worker. • A counselor for health should be employed in the power plant. • The causes of various diseases in employees should be investigated and preventive measures should be put into practice.

6.3 Environmental Protection

6.3.1 Environmental Situation

(1) Weather Status in 2000

Annual average temperature was -0.7°C and seasonal average was 3.1°C in spring, 18.5°C in summer, -2.8°C in autumn and -21.5°C in winter, respectively.

The wind direction that appeared the more frequently throughout a year was north-northwest (7.8%) and south (7.9%). As for winter season, the most numerous wind direction was south 9.1%.

As for wind velocity, annual average was 3.3m/s and appearance frequency of more than 6.0m/s was 15.1% but the proportion of Calm was very much with 47.4% through a year.

In winter when air quality deteriorated with pollutants, the grounding inversion layer occurred frequently with strong atmospheric stability over Ulaanbaatar City.

Table 6.3-1 Weather Status recorded by Tahilt Meteorological Observatory

	Average temperature (° C)	*Average wind velocity (m/s)*	*Calm (%)*	*Most numerous of wind direction*	*Atmospheric Stability (%)*
Spring	3.1	4.0	30.9	NNW	45.6
Summer	18.5	4.0	34.6	NNW	42.6
Autumn	-2.8	2.2	50.0	S, NNW	74.9
Winter	-21.5	1.9	74.5	S	91.4
Annual	-0.7	3.3	47.4	NNW, S	--

(2) Ambient Air Quality

1) Comparison with Ambient Air Qualities such as the World Bank Standard

Mongolian air quality standard is revised in 1997 and the value of each item is set up by the measuring method. Daily average values are 30μg/m^3 for SO_2, 40μg/m^3 for NO_2 and 150μg/m^3 for dust as severe value. The values of SO_2, NO_2 are set up more severely than the environment standard value of the World Bank and Japan.

Table 6.3-2 Comparison of the Environmental Standards for Air Quality

	SO_2 $\mu g/m^3$			NO_2 $\mu g/m^3$			Dust (SPM) $\mu g/m^3$		
	Hourly Value	Daily Ave.	Annual Ave.	Hourly Value	Daily Ave.	Annual Ave.	Hourly Value	Daily Ave.	Annual Ave.
World Bank		150	80		150	100		150 (TSP 230)	50 (TSP 80)
Mongolia	*1	*1		*2	*2		*3	*3	
	A 500	A 30		A 85	A 40		A 500	A 150	
	B 500	B 70		B 150	B 60		B 500	B 200	
Japan	290 (0.1 ppm)	110 (0.04 ppm)			82~120 (0.04~0.06 ppm)		200	100	

**1 A: Russian method 30, B: Ultraviolet fluorescence method 70 (No.1monitoring station),*
**2 A: Russian method 40, B: Chemiluminescent method 60 (No.1monitoring station)*
**3 A: HVA method 150 (No.1station) B: Russian method (Weight conc. method) 200*
(Note) Mongolian hourly value means the maximum of one time measurement, and a standard follows the value by the measuring method.

2) Air Quality in 2000

The air pollution substance has being measured at four monitoring stations in Ulaanbaatar City. According to air monitoring data in 2000, SO_2 value was high in winter and exceeded the standard only a day. Although there is no obvious fluctuation of NO_2 values for each station through a year, the value of the No.2 station was a little higher than the other stations and exceeded the standard 109 days.

Dust value measured only at the No.1 monitoring station exceeded the standard 16 days in a whole year.

6.3.2 Environmental Conservation by TES4

(1) Status on the Exhaust Gas

As a exhaust gas countermeasure, only a stack with a height of 250m considering the dispersion effect and ESP with a removal efficiency of 90% or more is adopted at TES4. According to measurement results of 1998, SO_2 and NO_2 concentrations (values revised by 6% O_2) ware within the range of 463 to 735ppm and 142 to 475ppm respectively, since there was obvious fluctuation of emission value from each unit. Dust concentration based on 6% O_2 was within the range of 190 to 942 mg/m^3N, according to the measurement result from 1998 to 2000.

The emission standard for the exhaust gas of the power plant does not exist at present in Mongolia.

(2) Prediction Result by simple Dispersion Calculation

In the winter when air quality deteriorates remarkably, there are many cases the exhaust gas from a stack usually flutters horizontally without diffusion in the air, since the atmospheric stability is strong (by the grounding temperature inversion).

As a simple calculation result of short-term dispersion by average wind velocity 1.9m/s and the maximum wind velocity 9.0 m/s which appeared in 2000 December (atmospheric stability: more than 90%), the maximum ground level concentration point is about 30 km or more. Therefore, environmental impact by emissions is considered to be very small in the city.

(3) Noise

Since the sound pressure level under usual stable operation of TES4 is in the range of the standard value of 85 dB(A) at power station and surrounding area, noise impact to the periphery is considered to be very small. When a safety valve releases the steam, the sound source level is approx.150 dB(A) and sound pressure level at the periphery exceeds the standard value. Due to reduce the environmental impact, TES4 has to take the necessary measures such as installing a silencer to the sound source.

(4) Waste Water

All the wastewater excepting drainage from TES4 is fed to the slurry pit and reused for ash transportation to the ash pond. Although this system has no wastewater treatment facility, it is conceivable that there is no influence on the periphery, unless the wastewater is discharged outside.

(5) Management Problem of Ash Pond

The 3rd ash pond being reclaimed with coal ashes since 1995 is almost full now and the reclamation will become difficult in 2002 and beyond.

TES4 is constructing the 4th ash pond now, but it has a small scale capacity for urgent reclamation for about 2 years. Therefore, to maintain stable operation of the power station, an optimum ash pond for long term reclamation has to be constructed possibly at early stage.

Table 6.3-3 Calculation Result of Ash Disposing Quantity in the 3rd Ash Pond

(Unit : 1,000t)

Year	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Baganuur coal consumption	1,806.8	2,072.1	1,958.6	1,982.3	1,787.4	1,792.2
Shivee-ovoo coal consumption	161.7	17.2	20.4	62.7	288.1	398.2
Total	1,968.5	2,089.3	1,979.0	2,045.0	2,075.5	2,190.4
Ave. Ash Content *1	12%	12%	12%	12%	12%	12%
Ash quantity	236.2	250.7	237.5	245.4	249.1	262.8
Ash volume 1,000m^3 *2	277.9	294.9	279.4	288.7	293.0	309.2
Ash disposal total volume	1,743,100 m^3 (Approx.90% of Ash pond capacity of 1,961,000 m^3)					

**1: Value considering ESP efficiency *2: Revised by specific gravity 0.85*

The ash scattering occurs from the 3rd ash pond by comparatively strong wind in spring and sometimes impacts on the periphery. In order to mitigate ash scattering problem, certain measures have to be taken, such as covering with soil, periodical sprinkling with pond water, etc.

6.3.3 Recommendation for Environmental Conservation of TES4

(1) Ash Pond Installation for Long Term Ash Reclamation

- TES4 has been constructing a new ash pond since 2001, but it has a small scale capacity for urgent reclamation for 2 years. Therefore, to maintain stable operation of the plant hereafter, an optimum ash pond with reclamation possible on a scale of 5 to 10 years has to be constructed.
- In considering a same capacity as 3rd ash pond for reclamation period 6 years, the construction cost is estimated at about 1.15 billions yen.
- As for this construction proposal TES4 is requesting the support of Japan earnestly.

(2) Silencer Installation as Measure against Noise

- As reduction measure against the noise level caused by steam discharge from safety valve into the air, installation of silencer is necessary. Since the sound level in surrounding area exceeds standard value 85dB(A) at the time of steam discharging, it is desirable to install it possibly at early stage.
- As TES4 has eight boilers, detailed investigation on the installation place and number of silencer, etc. is necessary.
- Installation cost of a silencer is estimated at 7 million yen in Japan.