CHAPTER 3

SITUATION OF POWER AND HEAT SECTOR OF MONGOLIA

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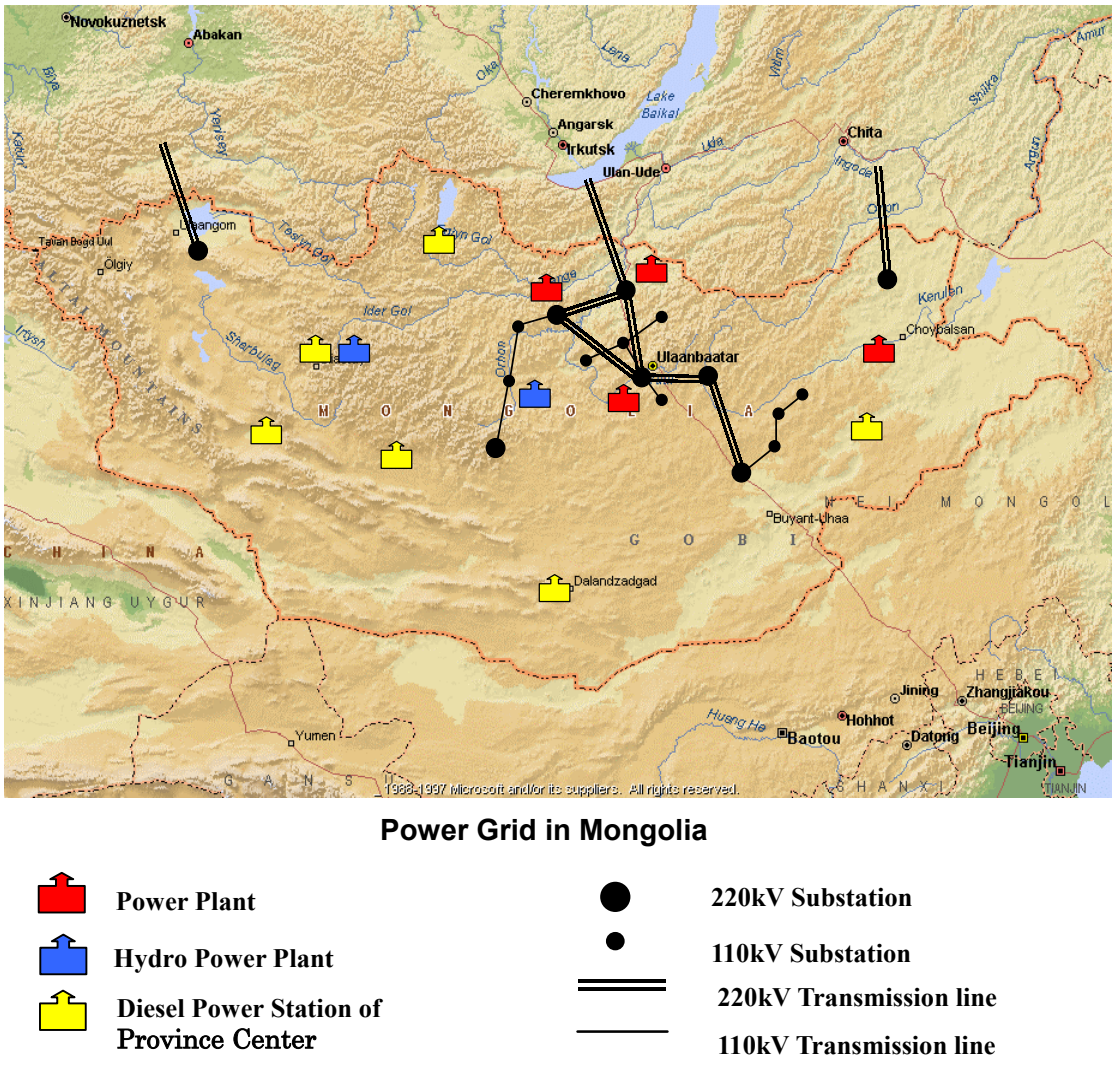
3.1 Sector Structure and Reform

3.1.1 Sector Structure

The power and heat sector of Mongolia is currently (at the time of survey, October 2000) operated by state-owned enterprises under the supervision of the Ministry of Infrastructure. There are three main power grids: the CES linking Ulaanbaatar the capital of Mongolia, Darkhan an iron-making city, Erdenet a copper-mining city and Baganuur a coal-mining city; the EES centered in Choibalsan; and the WES with constant supply from Russia. In all of these systems, state-owned enterprises are engaged in the power and heat supply business. Rural areas, which are not connected to these systems, have publicly-operated diesel power stations in Aimags and Soums. The three power grids mentioned above are not interconnected.



Power Grid in Mongolia

Power Plant

Hydro Power Plant

Diesel Power Station of Province Center

220kV Substation

110kV Substation

220kV Transmission line

110kV Transmission line

Fig. 3.1-1 Power Grid in Mongolia

In the CES, the largest power grid, there are Thermal Power Plant No.2 (21.5 MW), Thermal Power Plant No.3 (148 MW) and Thermal Power Plant No.4 (540 MW) in Ulaanbaatar, supplying power and heat. There is the Darkhan Power Plant (48 MW) in Darkhan, and the Erdenet Power Plant (28.8 MW) in Erdenet. The total installed capacity of the CES is 786.3 MW.

The EES has the Choibalsan Power Plant (36 MW), while the WES is supplied with electricity from Russia, keeping diesel power on standby for emergency. The total installed capacity of Mongolia is 828.3 MW including the Dalandzadgad Power Plant (6 MW) commissioned in 2000 in the southern Gobi region.

3.1.2 Sector Reform

In April 2001, the government of Mongolia enacted the New Energy Law in order to realize a radical reform based on market-economy principles. Thus, the EA was disbanded and the foundation for energy sector reform was laid based on a market economy. Nevertheless, the EA would remain in existence with a limited function and would take charge of the recovery of accumulated receivables and payables of energy sales according to the "Privatization Guidelines for 2001-2004."

The above Privatization Guidelines are intended to conduct the sector reform in two stages: the first stage will reform the sector in such a fashion as to commercialize the current system of management and production in line with market principles. To that effect, the following measures are to be taken:

1) Separate the regulatory function from the EA and delegate it to an independent regulatory organization according to the New Energy Law;
2) Reform the business units of energy production and distribution into commercial corporations;
3) Separate and privatize the repair and maintenance sections from the generation and transmission corporations; and,
4) Reorganize the EA into an organization in charge of the recovery of receivables and payables.

In August 2001, the following state-owned enterprises were corporatized by a decree according to the above guidelines. As of the time of survey, however, those corporations remained wholly owned by the government.

- Generation: TES2, TES3, TES4, Erdenet Power Plant, Darkhan Power Plant, Dalandzadgad Power Plant
- Heat Production: Baganuur HOB (heat only boiler) Nalaikha HOB

- Transmission: Central Transmission Co., Eastern Transmission Co. and Western Transmission Co.
- Distribution: Ulaanbaatar EDO, Erdenet/Bulgan EDO, Darkhan/Selenge EDO, Baganuur/ Southeastern EDO
- Heat supply: Ulaanbaatar HDO and Darkhan HDO
- Dispatch: National Dispatching Center

3.2 Power Supply and Demand

Table 3.2-1 shows the historical change of power supply and demand of the Central Grid which TES4 supplies.

Table 3.2-1 Historical Change of Supply and Demand of Central Grid (Unit : GWh)

	1990	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Power production (generation end)	3,348	2,722	2,612	2,481	2,523	2,628	2,614	2,720	2,574	2,740	2,871
Auxiliary power	534	626	525	552	562	598	579	608	532	628	640
Auxiliary power ratio (%)	16%	23%	20%	22%	22%	23%	22%	22%	21%	23%	22%
Power production (sending end)	2,841	2,096	2,087	1,929	1,961	2,030	2,035	2,112	2,042	2,112	2,231
Power import	228	84	99	198	215	381	383	376	356	195	184
Power export	76	33	68	53	60	28	69	42	60	59	25
Power supply (sending end)	2,966	2,147	2,118	2,074	2,116	2,383	2,349	2,446	2,337	2,248	2,390
Transmission loss	323	340	287	289	262	598	413	507	823	549	
Transmission loss (%)	11%	16%	14%	14%	12%	25%	18%	21%	35%	24%	
Power sales	2,643	1,807	1,831	1,785	1,854	1,785	1,936	1,939	1,514	1,699	
Power sales (growth rate)		-31.6%	1.3%	-2.5%	3.9%	-3.7%	8.5%	0.2%	-21.9%	12.2%	
Maximum demand	530	524	481	468	464	477	488	506	512	499	526
Maximum demand (growth rate)	-10.2%	-1.1%	-8.2%	-2.7%	-0.9%	2.8%	2.3%	3.7%	1.2%	-2.5%	5.4%

(Source : MOI 'Capacity Building in Energy Planning')

In 2000, power generation (at the sending end) amounted to 2,231 GWh against 2.841 GWh in 1990, when market-oriented economic reform began, showing a recovery of only 80%. This well illustrates that the economic collapse due to the loss of Soviet support and the withdrawal of Soviet troops, who used to be large consumers of energy in socialist times, had a huge impact on the energy sector. Station loss and transmission/distribution loss continued to be large, which is considered to be due to aging of the facilities and other technical causes, and partly due to insufficient billing and theft, particularly with respect to transmission/distribution loss.

Fig. 3.2-1 shows the power supply composition on a kWh basis. TES4 meets 63% of the total demand as of 2000, evidencing its importance. Import from Russia accounts for 8%.

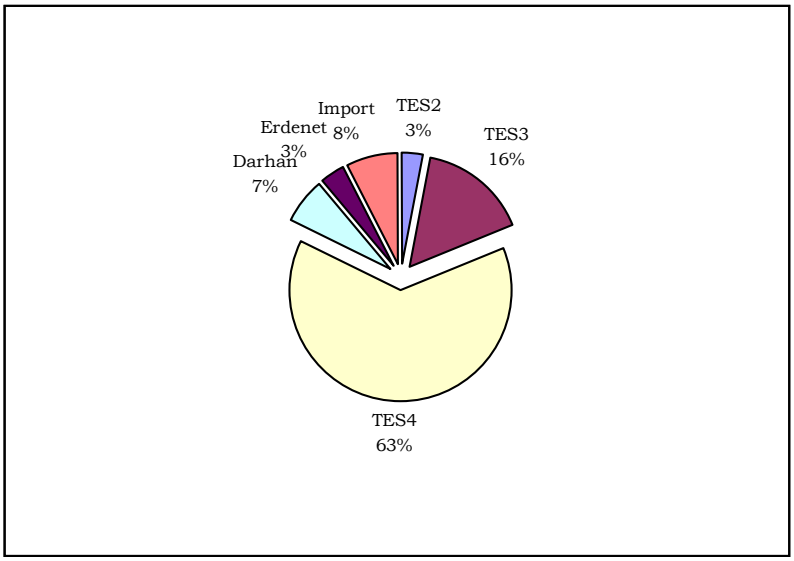


Fig. 3.2-1 Power Supply Composition of CES（as of 2000）

(Source: TES4)

3.3 Heat Supply and Demand

In major cities, heat is supplied by power and heat cogeneration facilities, and heat only boilers. Ulaanbaatar is supplied by TES2, TES3 and TES4.

Fig. 3.3-1 shows the heat supply composition as of 2000 (hot water and heat combined); TES4 accounts for 64%, playing an important role in the heat sector as well.

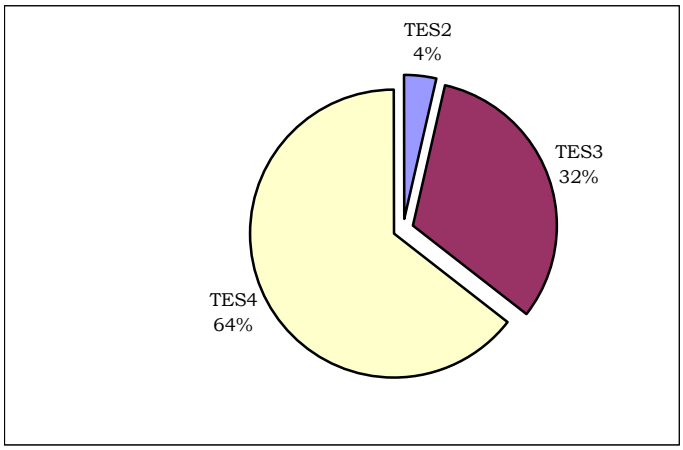


Fig. 3.3-1 Heat Supply Composition in Ulaanbaatar

(Source：TES4)

3.4 Power and Heat Tariff

3.4.1 Tariff Level Movement

For about 30 years, between 1960 and 1990, energy prices including heat were charged at nominal levels such as 0.35 Tug/kWh for residential use and 0.18 Tug/kWh for industrial use. Table 3.4-1 and Fig. 3.4-1 show the movement of energy prices from 1991 onward.

Table 3.4-1 Energy Price Movement (nominal term)

	unit	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Coal	Tug/ton	88	208	1,925	2,688	2,688	3,346	5,991	7,220	7,191	8,338
Oil	Tug/ton	1,260	6,560	47,240	58,459	67,500	77,876	94,796	98,000	111,575	123,000
Elec.	Tug/MWh	382	983	8,466	15,000	15,000	16,520	33.480	38,000	38,000	45,000
Heat	Tug/Gcal	87	175	577	1,232	1,232	1,475	2,739	2,880	2,880	5,000

(Source: ADB and ERA)

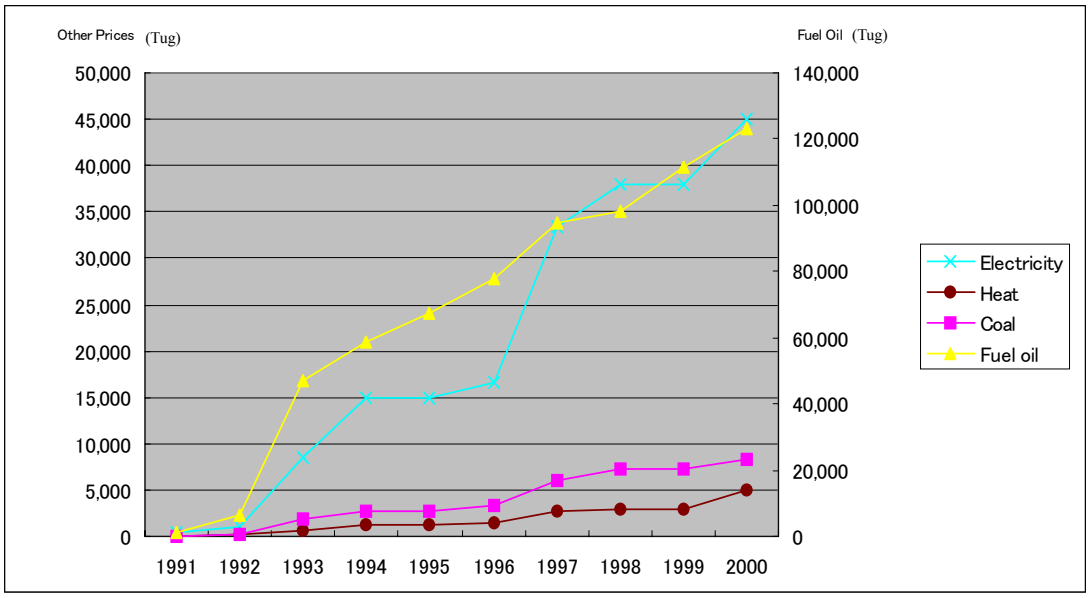


Fig. 3.4-1 Energy Price Movement (nominal term)

3.4.2 Tariff Setting Mechanism

The power plants have so far been places of operation of the EA or its production units, so that the tariff for those power plants were prices for internal transaction rather than wholesale price and were determined as such taking into account consumer prices (retail prices), the production cost of the power plants and other expenses such as those for rural electrification.

That situation has not encouraged management efficiency of the power plants and did not allow the accumulation of retained earnings necessary for future maintenance and expansion of their facilities.

Table 3.4-2 shows the wholesale price and production cost of each power plant. The average retail price was 45 Tug/kWh for power and 5000 Tug/Gcal.

Table 3.4-2 Wholesale Price and Production Cost of Power Plants

	Power (Tug/kWh)		*Heat* (Tug/Gcal)	
	Wholesale price	*Production cost*	*Wholesale price*	*Production cost*
TES2	28.40	22.98	2603.6	5936.7
TES3	31.76	25.36	3058.6	5065.0
TES4	19.76	16.02	2603.6	5041.6
Darkhan	28.05	20.01	1393.8	4073.3
Erdenet	38.62	31.80	3253.9	4461.2

(Source: TES4)

In September, 1997, an automatic tariff adjustment mechanism was introduced, in which the power plants were supposed to apply for tariff revision to the EA (currently the ERA) quarterly according to a decree issued by the Ministry of Infrastructure; however, tariff revision has seldom been made based on that mechanism. The price-setting formula of the adjustment mechanism considers factors such as increases in prices of coal and heavy oil, and changes of consumer prices and exchange rates of the Tug.

The ERA is currently studying a new tariff-setting method to apply from 2002 instead of the automatic tariff adjustment mechanism. This new method is named the “Interim Method” and is considered to be a step toward market mechanism with a view to a change from policy price to cost recovery. By this method, cost recovery and fair return are expected to be achieved. The new method determines the production cost based on the past three-year records and adopts the rate-basis method for return, which determines the return by multiplying the value of employed assets by the average rate of interest (profit) according to the capital structure.

3.4.3 Sales Collection Mechanism

In October 2000, the above settlement method was modified, keeping the direct payment from EDO/HDO to the power plants, in such a way that the whole amount of the cash collected by EDO/HDO would go first to the power plants, which would then return to EDO/HDO their portion including expenses. As for the Erdenet area, the through-EA method remained and, in addition to arrears by the Erdenet copper mines, the fact that the EA was paying sales tax on the energy sector

from the collected amount left only a small amount being paid to TES4. No fundamental solution has so far been provided for the problems of receivables.

Another issue, that of debt cycle, as seen in the Baganuur area, was caused by nonpayment by the coal mines because of the nonpayment for coal purchases by TES4, which was being solved by set-off between coal sales and power sales. There were also arrears of power and heat sales in the government-related organizations including schools and hospitals and this problem was being dealt with by set-off with payable tax based on quarterly consultations between the sector's companies, the Ministry of Finance and Economy and the tax authorities considering the government lack of funds.

The accumulated amount of receivables and payables is enormous and this debt cycle issue involves not only power and heat companies, but also the EA, government-related organizations, coal mines and copper mines and other nonpayment companies, prevailing in the economy of Mongolia. For this reason, it is not possible for the debt cycle issue to be solved by individual companies and it will take more time to solve. To address the debt cycle issue, in September 2001, discussions were made between the Ministries of Finance and Economy and of Infrastructure, the State Property Committee and 18 energy-related companies, but no conclusion was reached. The frequently modified method of the collection of the sales amount is also deeply rooted in the debt cycle issue and it is necessary to establish a transparent method based on a market economy. Although no new collection method was made clear at the time of survey, a study was being conducted on a collection method in line with the sales transaction between the newly corporatized entities of the energy sector, where each power plant sells power to a transmission company, which in turn sells power to each EDO.

CHAPTER 4

SITUATION AND ISSUES OF ULAANBAATAR THERMAL POWER PLANT NO.4 (TES4)

CHAPTER 4 SITUATION AND ISSUES OF ULAANBAATAR THERMAL POWER PLANT NO.4 (TES4)

4.1 Business Performance

4.1.1 Sales and Production

TES4 has the whole of the area covered by the Central Energy System as its area of services and sells power to each EDO (energy distribution office) through the transmission company of CES. TES4 supplies 4 EDO's: Ulaanbaatar EDO, Erdenet/Bulgan EDO, Darkhan/Selenge EDO and Baganuur/Southeast EDO. As for heat, TES4 covers Ulaanbaatar only, supplying Ulaanbaatar HDO (heat distribution office) with hot water and heat and directly supplying factories in its surroundings with process steam although in a limited amount. Table 4.1-1 shows the sales and production for the past 4 years.

Table 4.1-1 TES4 Sales and Production

	Unit	*1997*	*1998*	*1999*	*2000*
Power Production	GWh	1,736.0	1,732.0	1,825.0	1,910.0
Auxiliary power	GWh	351.6	344.7	355.7	367.7
Auxiliary power ratio (%)	%	20.2	19.9	19.5	19.3
Power Sales	GWh	1,384.8	1,386.8	1,469.7	1,525.6
Heat Sales	T cal	2,097.3	2,195.6	2,307.1	2,523.1
Revenues	Million Tug	33,282.0	39,492.0	33,757.0	36,534.0
Power Revenues	Million Tug	29,711.0	34,172.0	28,129.0	29,745.0
Heat Revenues	Million Tug	3,570.0	5,320.0	5,628.0	6,789.0
Power Unit Price	Tug/kWh	21.5	24.6	19.1	19.5
Heat Unit Price	Tug/Gcal	1,702.4	2,42.0	2,439.5	2,690.8
Production Cost	Million Tug	24,712.0	31,885.0	33,839.0	38,357.0
Power Cost	Million Tug	15,861.0	20,469.0	21,563.0	25,465.0
Heat Cost	Million Tug	8,852.0	11,417.0	12,276.0	12,892.0
Power Unit Cost	Tug/kWh	11.45	14.76	14.67	16.69
Heat Unit Cost	Tug/Gcal	4,220.66	5,199.95	5,320.97	5,109.59
Fuel					
Coal					
Consumption	ton	1,979,052.0	2,050,940.0	2,075,552.0	2,109,369.0
Amount	Million Tug	9,627.0	12,639.0	13,516.0	15,221.0
Heavy Oil					
Consumption	ton	13,897.0	10,300.0	7,280.0	4,739.0
Amount	Million Tug	1,296.0	955.0	708.0	860.0
Coal Calorie					
Baganuur	kcal/kg	3,330.0	3,344.0	3,401.0	3,420.0
Shivee-Ovoo	kcal/kg	2,790.0	2,870.0	3,081.0	3,020.0
Employee	person	1,701	1,732	1,388	1,392
Salaries	Million Tug	1,631.0	1,998.0	1769.0	2,423.0
S&GA expenses	Million Tug		135.0	107.0	156.0
Repair	Million Tug	967.0	1,050.0	2,229.0	2,772.0
Profit	Million Tug	8,569.0	7,606.0	-82.0	-1,823.0

(Source : TES 4)

4.1.2 Financial Issues

TES4 shows low profitability and efficiency and continues to suffer from difficult finance. This situation is considered to be due to the following financial issues:

(1) TES4's cost calculation shows that power was profitable with the current price level but heat did not recover its cost, leading to the lack of cost recovery as a whole. TES4 made an application for price revision every year to the EA, who did not determine the price considering the application, which did not allow TES4 to recover the cost.

Cost allocation between power and heat is made as follows but should be revised:

Fixed cost: Allocation was determined in 1996 to make the ratio 7 for power to 3 for heat by the following method and since then, this allocation has been followed. (6:4 before 1996)

Each facility was determined to belong to power or heat and calculation was made based on the book value of the facilities.

- Turbine and generators = power 100%
- Boiler (including mill) = heat 100%
- Other facilities = power and heat 50% each
- (Other facilities belong to different departments/sections such as transportation, control, chemical, factory, administration and fuel)
- Fixed cost such as depreciation is allocated according to the above ratio.

Variable cost: fuel (coal and heavy oil) is allocated by multiplying the fuel requirement per unit of power and heat (called "normative") by the production volume of power and heat. That normative is determined by actual measurements.

The distinction between the production cost and general and administrative expenses has been made as follows and should be revised.

The general and administrative expenses comprise the personnel cost of 32 people of management staff designated by the Ministry of Infrastructure, business trips, telecommunications, fuel, consumables and so forth. The fuel expenses are only those related to company cars for the General Manager, Chief Engineer and Deputy General Manager. Other expenses than the above are included in the production cost.

(2) The retained earnings required for future replacement of the facilities are insufficient. This is because the cost calculation so far adopted does not consider the required depreciation for replacement and does not reflect the true production cost. Therefore, it is necessary that asset revaluation should be made and depreciation period set back to 30 years, the previously adopted one, from 10 years, the currently adopted one, so that production cost calculation may reflect the appropriate depreciation and that a price revision may be made based on such production cost.

(3) The accumulated amount of receivables and payables is enormous. The related-companies are practically playing the role of a bank. There is a concern that how this issue will be solved in the future may considerably affect the finance of TES4.

The outstanding amount of receivables and payables is shown in Table 4.1-2 and Table 4.1-3

Table 4.1-2 TES4 Outstanding Receivables of TES4 by Debtor

(Unit: million Tug.)

	1997	*1998*	*1999*	*2000*
Energy Authority	13,058.5	32,699.6	24,903.0	17,472.3
Ulaanbaatar HDO				2,550.0
Ulaanbaatar EDO				124.2
Darhan EDO				1,142.5
Baganuur EDO				1,535.4
Erdenet EDO				13,753.2
Total	13,058.5	32,699.6	24,903.0	36,577.6

(Source: TES4)

Table 4.1-3 Outstanding Payables of TES4

(Unit: million Tug.)

	1997	*1998*	*1999*	*2000*
Baganuur Coal Mine	666.2	2,999.5	7,360.9	11,474.7
Shivee-Ovoo Coal Mine	43.9	286.1	1,247.3	2,774.2
Railway	-20.3	450.2	916.8	18.1
Total	689.8	3,735.8	9,525	14,267

(Source: TES4)

Inter-company settlement is made through a bank account for settlement but the bill system has not been developed and the bank rate of interest is high. This situation has given the account of receivables and payables the function of a bank as mentioned before, and such a function provides de facto interest-free lending and borrowing. At the same time, the law of bankruptcy does not

function appropriately and state-owned public utilities do not go bankrupt over a shortage of funds.

In September 2001, discussions were made on the set-off of receivables and payables between the related- companies and the government organizations but no conclusion has been reached.

The EA is supposed to be in charge of the issue of receivables and payables but how to solve the issue has not been made clear.

(4) Routine maintenance funds have so far been suppressed so that sufficient fund supply will be necessary for future maintenance such as measures against aged deterioration.

(5) Another fund will be required for new expenses items such as dividend and corporate tax (maximum rate of 40%) following corporatization.

4.2 Facility Management Situation

4.2.1 General

The equipment of TES4 is former Soviet Union made, No.1 unit began plant operation in 1983 and the whole facility was completed in 1991.

Although engineers of the former Soviet Union mainly took the initiative in performing operation maintenance at the beginning, since being pulled back to the mother country after the Soviet Union collapse in 1990, subsequent operation maintenance has been left to Mongolia, and degradation of the equipment has rapidly begun to cause problems for the stable supply of progress energy by the acquisition difficulty (decline of the Russian manufacturing ability) of obtaining Russian made spare parts and financial deficit for repairs etc.

For this reason, the shutdown time caused by the failure of boiler and/or turbine equipment has increased every year; the mechanical shutdown time went up to 50% of the annual operation time (failure ratio) in 1993, and the situation in which the availability factor was not fulfilled went up to 40%.

In order to alleviate the such situation, JBIC dispatched SAPROF survey team in 1995, and the team determined to carry out the first loan-aid financial support those days to form change of the boiler combustion system, change the type of coal pulverizer, replacement of the boiler control system, and replacement of boiler tubes, for the power plant which was problem most, and enforcement has carried out in the 4th thermal power plant rehabilitation project (Phase-I) from 1996 to 1999.

As a result of this assistance, the utilization factor and combustion efficiency of the power plant has improved gradually, Moreover, the electric power and the heat productive capacity of the power plant with the reduction of auxiliary power, and so forth, have been improved, and the results of the rehabilitation project have been forthcoming.

The production of electricity and the transition of the utilization factor, and the amount of boiler evaporation and the transition of the utilization factor of TES4 from 1990 to 2000 are shown in Fig. 4.2-1.

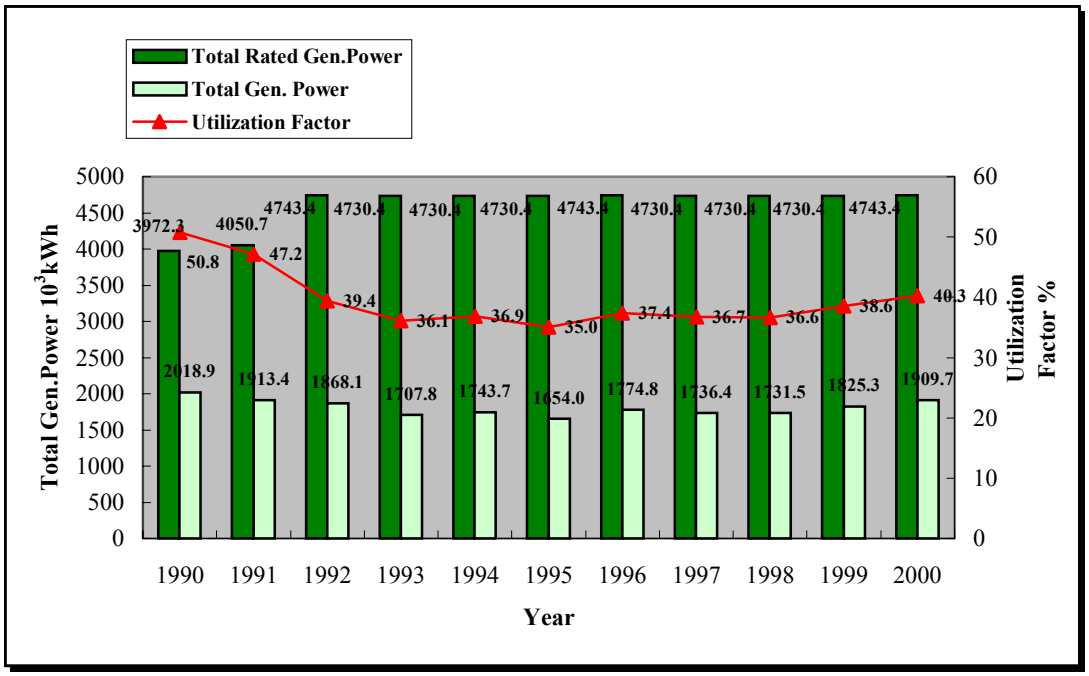


Fig. 4.2-1 Production of Electricity and Transition of Utilization Factor

4.2.2 Evaluation of the Present Situation in TES4 Facility

From the result of the site survey, the personnel training of the power plant engineers and the technology improvement for equipment repair have been achieved on the basis of instruction by the manufacturer supervisors under the guaranty period in the Phase-I project, and the framework and inspection items for the operation and maintenance of the equipment, such as daily inspection, periodic inspection, and repair plan, appear to have been improved.

From now on, it is necessary to aim at the continuation of quality control in operation and maintenance on the basis of the analyzed data, such as the failure factor, availability, boiler efficiency and so forth, for the equipment that was improved after replacement by the Phase-I project.

Also, for existing equipment other than the rehabilitated equipment mentioned above, planned routine work has been carried out by the maintenance group in each operation section, and the periodic inspections, such as the major overhaul once every four years and the middle overhaul once every two years, has also been planned and carried out by repair groups in each operation section and the Engineering Department.

Moreover, the introduction of new technologies, such as lining material, ceiling material and a high-pressure valve for the repair method, has also been projected by the Engineering Department, and there is no problem regarding the planning and technical matters. However, as for the number of times

of failure excluding the rehabilitated equipment, improvement has, in fact, not been found, so that the failure of each piece of equipment mentioned above may be possible.

From the above issues, it is necessary to perform equipment replacement where the equipment part supply is improper, and the daily maintenance of equipment is improper due to its life expiry, as the first issue.

In the second place, it is also necessary to disburse the cost of repair for the maintenance carried out every year. In connection with the above issues, there is no categorical comparison; the composition of the production cost at TES4 in 2000 remained such that maintenance and repairs were 7 % against the personnel cost for repair at 8 %, and if the budget supply in the repair part can be performed as the demand fundamentally planned, reservation of about 14% of maintenance and repair costs will be expected, and the matter will be expected to reduce the ratio of equipment failure as well in Japan.