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 CES as its area of services and sells power to each EDO 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 with hot water and heat and directly supplying factories in its surroundings with process steam although in a limited amount.

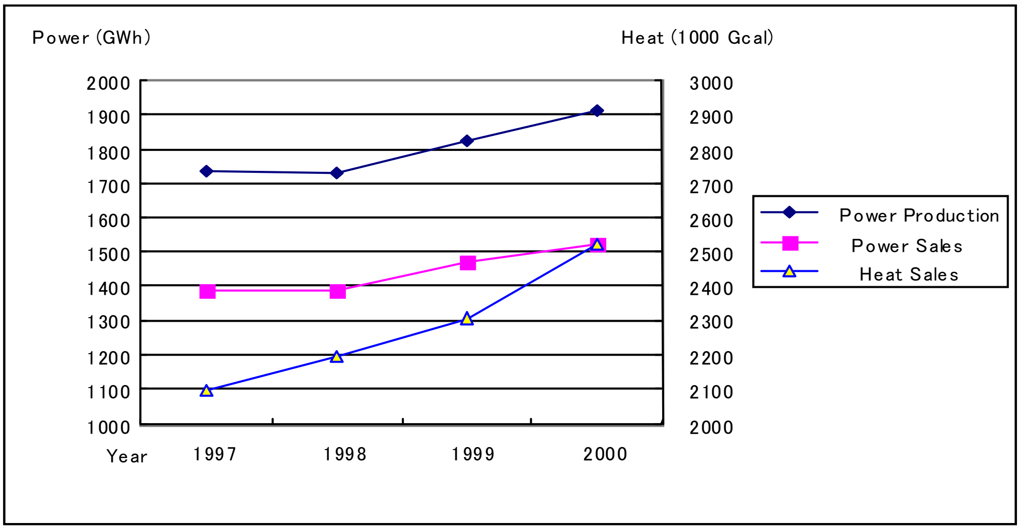
Table 4.1-1 shows the sales and production for the past 4 years.

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

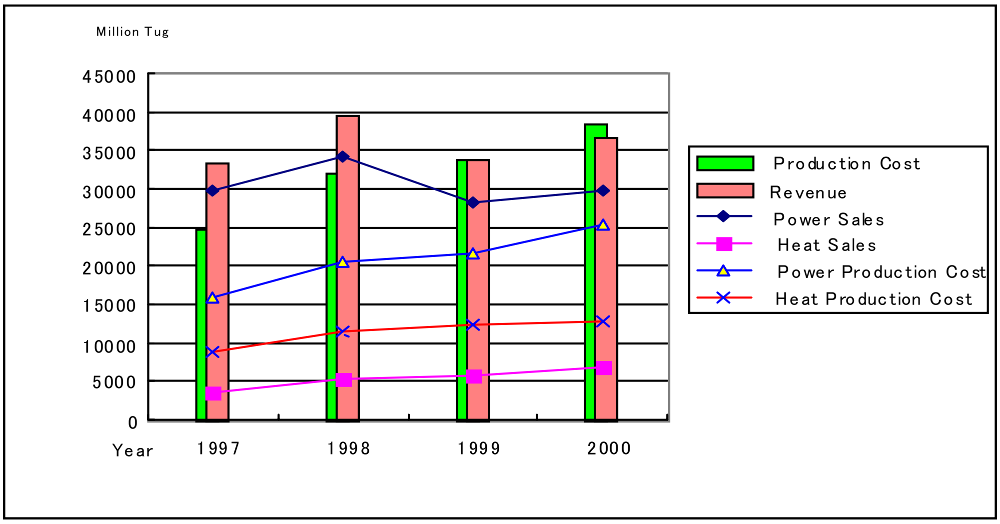
(Source：TES 4)

Movement of the sales and production can be seen from Table 4.1-1.



(Source：TES4)

Fig. 4.1-1 Outstanding Payables of TES4



(Source：TES4)

Fig. 4.1-2 Movement of Revenues and Production Cost

Power production increased at a pace of 2 GWh (1%), 83 GWh (6%) and 56 GWh (4%) with 1997 as a basis and heat at a pace of 98 Gcal (5%), 11.5 Gcal (5%) and 216 Gcal (9%). Meanwhile, power sales showed changes such as 4,461 MTug. (15%), -6,043 MTug. (-18%) and 1,616 MTug. (6%), not proportional to the increase in production, showing large fluctuations.

This is because, as shown in Table 4.1-2 in the next section, the wholesale price for TES4 was lowered by 5.5 Tug/kWh (22%) in 1999 with respect to the previous year. Heat sales increased by 1,750 MTug. (49%), 308 MTug. (6%) and 1,161 MTug. (21%) beyond the rates of increase in production because there was a price raise in 1998 by 44% and in 2000 by 12%.

Production cost increased at a pace of 7,173 MTug. (29%), 1,954 MTug. (6%) and 4,518 MTug. (13%) with 1997 as a basis. Nevertheless, sales did not increase accordingly as seen in the rates of change of 6,210 MTug. (19%), -5,735 MTug. (–15%) and 2,777 MTug. (8%) and could not follow the increase in production cost, bringing a deficit of 1.8 billion Tug. in 2000, equivalent to 5% of the sales.

4.1.2 Sales Price and Production Cost

Table 4.1-2 shows the movement of the wholesale price and fuel cost of TES4 from 1990 to 2001.

Table 4.1-2 Movement of Wholesale Prices and Fuel Prices of TES4 (nominal term)

	unit	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
Power	Tug/kWh	0.14	0.16	0.5	4.0	5.34	5.14	8.05	21.5	24.7	19.28	19.76	22.23
Heat	Tug/Gcal	48.14	87.4	105.3	400.4	532.4	1,000	3,582.1	1,702.4	2,445.2	2,332.6	2,600.6	3,450.1
Baganuur Coal	Tug/ton	46.0	77.5	180.0	1,717.1	2,615.1	2,930.9	3,800.0	4,874.9	6,180.5	7,000.0	7,000.0	8,050.0
Shivee-Ovoo Coal	Tug/ton				1,451.2	1,847.3	2,326.8	2,528.6	3,500.0	4,161.2	4,747.0	4,747.6	5,406.0
Fuel oil	Tug/ton	480.0	830.0	1,260.0	43,900.0	56,700	57,669	80,353	93,251	94,234	97,247	156,494	
Transport.	Tug/ton			40.85	363.0	422.0	492.0	665.0	1,066.0	1,159.0	1,224.6	1,226.0	

（Source：TES4） (The above costs of coal, heavy oil and transportation are actual prices for TES4)

Table 4.1-3 translates the above movement in nominal terms into real terms on a 1991 basis, taking into account the inflation rate and rates of change of the prices, and Fig. 4.1-3 plots the indexed movement.

Table 4.1-3 Movement of Wholesale Prices and Fuel Prices for TES4 (real term)

	unit	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Power	Tug/MWh	160	117.51	33.22	266.82	167.53	181.45	402.18	435.89	309.31	293.26
Heat	Tug/Gcal	87	24.75	33.25	26.6	32.59	80.74	31.85	43.15	37.42	38.64
Baganuur Coal	Tug/ton	78	42.3	142.6	130.67	95.53	85.66	91.19	109.07	112.3	103.89
Fuel oil	Tug/ton	830	296.12	3,645.68	2,833.13	1,879.69	1,811.25	1,744.38	1,662.99	1,560.14	2,322.52

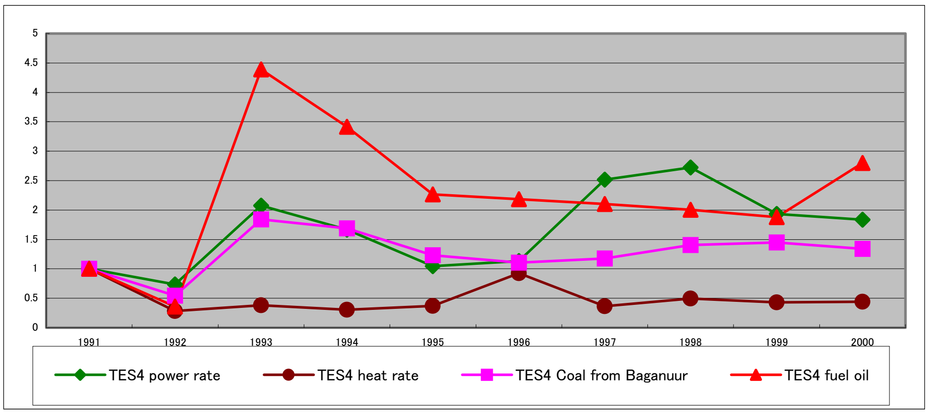


Fig. 4.1-3 Movement of Wholesale Prices and Fuel Prices for TES4 (real term)

In 2000, fuel prices of coal and heavy oil increased by 1.3 times and 2.8 times, respectively with respect to 1991, while the sales price increased by 1.8 times for power but decreased by 0.4 times for heat. This trend is similar to the average energy price at retail as seen in Section 3.4.1 except for the drastic increase in heavy oil.

The above movement as seen in nominal dollar terms, as seen in Table 4.1-4 and Fig. 4.1-4, shows that coal and heavy oil increased by 2.1 times and 4.5 times, respectively and the sales price increased by 3 times for power and 0.7 times for heat.

It can be said that the wholesale price for heat did not reflect the increase in fuel prices. The wholesale price for power can be considered, when compared with import from Russia, to be competitive from the fact that it was about 70% of the import price in 2000.

Table 4.1-4 Movement of Wholesale Prices and Fuel Prices for TES4 (nominal dollar term)

	unit	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Power	US $/MWh	6.2	12.5	10.1	12.9	10.9	11.6	26.4	27.4	18.0	18.0
Import Russia	US $/MWh						41.0	36.0	36.0	33.0	25.0
Heat	US $/Gcal	3.4	2.6	1.0	1.3	2.1	5.2	2.1	2.7	2.2	2.4
Baganuur Coal	US $/ton	3.0	4.5	4.3	6.3	6.2	5.5	6.0	6.9	6.5	6.4
Fuel Oil	US $/ton	32.0	31.5	110.7	136.9	121.8	115.9	114.7	104.5	90.7	142.7

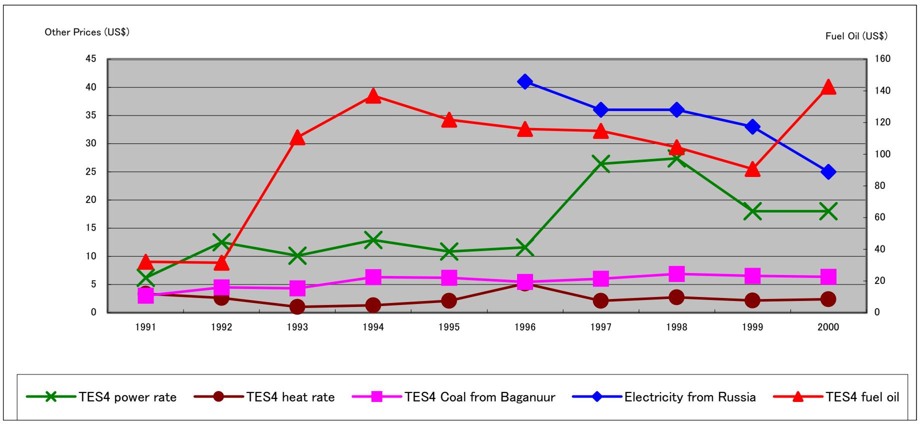
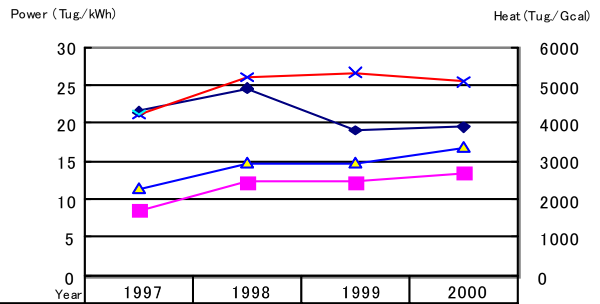


Fig. 4.1-4 Movement of Wholesale Prices and Fuel Prices for TES4 (nominal dollar term)

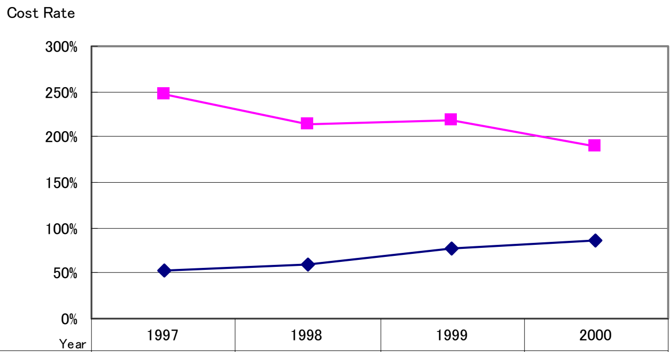
As for the relation of wholesale prices and production cost, Fig. 4.1-5 and Fig. 4.1-6 show a large deficit in heat, recovering less than half the production cost.

This is because the decision power of wholesale prices rests with the EA, who unilaterally notifies the new price for the year (de facto price for internal transaction) to TES4 against the latter's application for price revision in February every year.



Year	1997	1998	1999	2000
Power Unit Price	21.5	24.6	19.1	19.5
Power Unit Cost	11.45	14.76	14.67	16.69
Heat Unit Price	1,702.4	2,423.0	2,439.5	2,690.8
Heat Unit Cost	4,220.66	5,199.95	5,320.97	5,109.59

Fig. 4.1-5 Movement of Average Wholesale Prices and Production Cost（per unit）



Year	1997	1998	1999	2000
Power Cost Rate	53%	60%	77%	86%
Heat Cost Rate	248%	215%	218%	190%

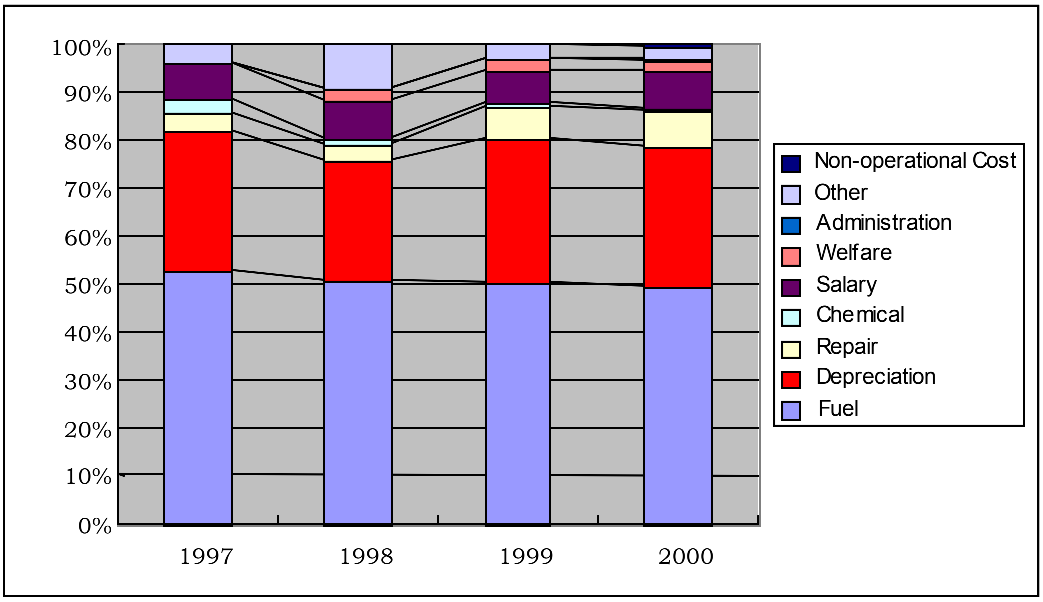
Fig. 4.1-6 Movement of Production Cost Rate

Regarding cost structure, as shown in Fig. 4.1-7, fuel cost accounts for some 50% in 2000, followed by depreciation in 30%, personnel in 8% and repair in 7%. In 1999, the sections of repair, cleaning and motor coiling were spun off to become independent companies and by doing so the personnel was reduced by 350 workers, 20% of the total. Nevertheless, the business plunged into the red, influenced by decrease in price.

When compared with the average cost structure of thermal power plants of Japanese power utilities (as of 1999), fuel cost accounts for 44%, depreciation for 25%, personnel for 5% and repair for 15%, while in Electric Power Development Co. (EPDC) of which the main power plants are coal-fired, fuel cost accounts for 46%, depreciation for 23%, personnel for 4% and repair for 12%.

Although a simple comparison cannot be allowed because of various differences in fuel kind, load factor, price levels and the like, the repair cost for TES4 is small with respect to the degree of aged deterioration and its personnel cost is larger because a 500MW-class thermal plant has as many staff as 1,400. (Incidentally, a coal-fired power plant of similar class of EPDC has some 260 people including those of its affiliated companies)

As for fuel cost as seen in physical terms, coal consumption increased only by 6.6% and heavy oil consumption decreased by 66% in 2000 with respect to 1997, while production increased by 10% for power and 20% for heat.



(Source : TES4)

Fig. 4.1-7 Production Cost Structure

4.1.3 Financial Statements and Financial Performance

Financial statements from 1997, year when International Accounting Standards were introduced in preparing accounting reports and 2000, are shown in Tables 4.1-5, -6 and -7.

Table 4.1-5 Balance Sheet

(Unit: million Tug.)

	1997	1998	1999	2000
A. Asset				
1. Current Asset				
Cash	31	41	36	473
Short-term investment	10	10	10	10
Accounts receivable	13,231	32,927	25,664	37,486
Allowance for doubtful accounts				
Inventory	3,464	3,985	4,335	4,044
Fuel	*403*	*560*	*1,312*	*1,204*
Spare parts & others	*3,061*	*3,425*	*3,023*	*2,839*
Prepaid expenses				
Total Current Assets	***16,735***	***36,963***	***30,045***	***42,012***
2. Non-current Asset				
2.1Tangible asset				
Gross Fixed Assests	105,858	107,594	139,306	142,319
Accumulated Depreciation	-9,352	-22,794	-31,449	-42,735
Construction in process	773	6,452	5,033	4,340
Livestock	36	15	13	3
Total tangible asset	***97,316***	***91,268***	***112,903***	***103,928***
2.2 Intangible asset	0	0	0	0
2.3 Investment and other asset	0	0	0	0
Total Non-current Asset	***97,316***	***91,268***	***112,903***	***103,928***
Total Asset	**114,051**	**128,230**	**142,948**	**145,940**
B. Liabilities and Owners' Equity				
1. Liabilities				
Accounts payable	1,484	5,314	11,997	15,987
Other payable	130	382	168	335
Short-term Loan			50	300
Allowance for short-term liabilities				
Total short-term liabilities	***1,614***	***5,696***	***12,215***	***16,622***
Long-term loan			25,001	25,319
Long-term bond payable				
Other long-term payable	1,016	1,016		
Allowance to long-term liability				
Total long-term liabilities	***1,016***	***1,016***	***25,001***	***25,319***
Total Liabilities	**2,630**	**6,712**	**37,215**	**41,941**
2. Owners' Equity				
a) state	*103,800*	*105,550*	*105,799*	*105,920*
b) private				
c) Treasury stock				
Total equity	***103,800***	***105,550***	***105,799***	***105,920***
Paid in capital				
Revaluation surplus				
Other parts of owner's equity				
Retained earnings (loss)	**7,621**	**15,969**	**-66**	**-1,920**
Current period	7,621	8,348	-66	-1,854
Carried over from previous period		7,621		-66
Total Equity	***111,421***	***121,519***	***105,733***	***104,000***
C. Total Liabilities and Equity	**114,051**	**128,231**	**142,949**	**145,941**

Table 4.1-6 Income Statement

(Unit: million Tug.)

	1997	1998	1999	2000
1. Revenue	**33,282**	**39,650**	**33,757**	**36,534**
1.1 Sales energy	29,711	34,254	28,297	29,745
1.2 Sales heat	3,570	5,320	5,306	6,376
1.3 Other sales		77	154	413
2. Cost of Goods Sold	**24,712**	**30,920**	**32,922**	**37,411**
2.1 Coal	9,627	12,639	13,516	15,221
2.2 Fuel Oil	1,296	955	708	860
2.3 Depreciation	7,222	8,107	10,239	11,320
2.4 Repairs	967	1,050	2,229	2,772
2.5 Personnel Cost	1,951	2,486	2,163	2,966
2.7 Others	3,649	5,683	4,067	4,272
3. Gross Profit	***8,570***	***8,730***	***835***	***-877***
4. General/Administrative/Selling Expenses	**0**	**135**	**107**	**156**
4.1 Salaries and remuneration		79	67	95
4.2 Social insurance		16	13	19
4.3 Repair and maintenance				
4.4 Utility expenses				
4.5 Rent expenses				
4.6 Business travel expenses		7	5	14
4.7 Transportation expenses				
4.8 Material supply expenses				
4.9 Depreciation expenses				
4.10 Advertising expenses				
4.11 Post and communication expenses		31	19	26
4.12 Fuel expenses		1	2	2
4.13 Other expenses				
5. Operating Profit (loss)	***8,570***	***8,595***	***728***	***-1,033***
6. Non-operating Income	**39**	**664**	**19**	**60**
6.1 Interest, penalty income				
6.2 Dividend income				
6.3 Other	39	664	19	60
7. Non-operating Expenses	**988**	**912**	**813**	**881**
7.1 Interest, penalty expenses			4	3
7.2 Welfare	981	830	806	786
7.3 TZBAX				72
7.4 Other	6	82	3	19
8. Profit from Ordinary Activities (loss)	***7,621***	***8,348***	***-66***	***-1,854***
9. Extraordinary Gains				
10. Extraordinary Loss				
11. Income from Associated or Joint Company				
12. Income Before Tax (loss)	***7,621***	***8,348***	***-66***	***-1,854***
13. Income Tax				
14. Net Income for the Period (loss)	***7,621***	***8,348***	***-66***	***-1,854***

(Production cost is based on data provided by Planning Dept. of TES4)

Table 4.1-7 Cash flow Statement

(Unit: million Tug.)

	1997	1998	1999	2000
1. Cash flow from operating activities				
1.1 Net income	7,621	8,348	−66	−1,854
1.2 Adjustments				
a) Depreciation expenses	*5,102*	*13,442*	*8,655*	*11,286*
b) Loss on sale of fixed asset, investment				
c) Gain on sale of fixed asset and investment				
d) Increase in receivable, inventory , prepaid expenses	*−12,441*	*−25,860*		*−11,823*
e) Decrease in receivable, inventory, prepaid expenses			*8,333*	*292*
f) Increase in short-term liabilities, unearned revenue		*4,082*	*6,519*	*4,407*
g) Decrease in short-term liabilities, unearned revenue	*−1,417*			
Net cash flow from operating activities	***−1,136***	***12***	***23,440***	***2,309***
2. Cash flow from investment activities				
2.1 Proceeds from sale of fixed asset				
2.2 Purchase of fixed asset	−381	−1,751	−31,709	−2,311
2.3 Proceeds from investment sold				
2.4 Purchase of investment				
Net cash used by investment activities	***−381***	***−1,751***	***−31,709***	***−2,311***
3. Cash flow from financing activities				
3.1 Bank loan received			25,001	318
3.2 State financing received	1,016			
3.3 Donations received	527	1,750	249	121
3.4 Repayment of loan			−1,016	
3.5 Repayment of current portion of long-term debt				
3.6 Issued stock				
3.7 Stocks repurchased in cash				
3.8 Payment of dividend			−15,968	
Net cash provided by financing	***1,543***	***1,750***	***8,265***	***438***
4. Total Net Cash flow	**26**	**11**	**−4**	**436**
Beginning balance of cash and cash equivalents	5	31	41	36
Ending balance of cash and cash equivalents	**31**	**41**	**37**	**473**

Financial analysis was made based on the above financial statements (Tables 4.1-5,-6 and –7) as shown in Table 4.1-8.

Table 4.1-8 Financial Analysis

	1997	1998	1999	2000
1. Profitability				
(1) Return on Assets	6.7%	6.5%	0.0%	−1.3%
(2) Gross Profit Ratio	25.7%	22.0%	2.5%	−2.4%
(3) Operating Profit Ratio	25.7%	21.7%	2.2%	−2.8%
(4) Net Profit Ratio	22.9%	21.1%	−0.2%	−5.1%
(5) Working Ratio	55.5%	60.0%	69.9%	74.2%
(6) Operating Ratio	77.2%	80.4%	100.2%	105.2%
2. Financial Ratio				
(1) Current Ratio	1037.1%	649.0%	246.0%	252.8%
(2) Quick Ratio	822.4%	579.0%	210.5%	228.4%
(3) Fixed Assets to Equity Ratio	87.3%	75.1%	106.8%	99.9%
(4) Fixed Assets to Long-term Capital Rat	86.6%	74.5%	86.4%	80.4%
(5) Debt Ratio	2.3%	5.2%	26.0%	28.7%
(6) Debt-service Ratio	N/A	N/A	−0.0002	144.6
(7) Self-financing Ratio	−160%	101%	21%	105%
3. Turnover Ratio/Period				
(1) Total Assets	0.29	0.31	0.24	0.25
	41.1 months	38.8 months	50.8 months	47.9 months
(2) Receivables	2.52	1.20	1.32	0.97
	4.8 months	10.0 months	9.1 months	12.3 months
(3) Inventory	7.13	7.76	7.59	9.25
	1.7 months	1.5 months	1.6 months	1.3 months
(4) Fixed Assets	0.34	0.43	0.30	0.35
	35.1 months	27.6 months	40.1 months	34.1 months
(5) Payables	16.66	5.82	2.74	2.34
	0.7 months	2.1 months	4.4 months	5.1 months

It is evident from Table 4.1-8 above that profitability continued to decline for 4 years up to 2000. At the same time, financial stability continued to be sound. However, this is because the financial sector of the country is still underdeveloped and the interest rate is high so that hardly any borrowing has been done except for external borrowing and also because of the accumulated receivables.

As for asset efficiency, the turnover of total assets took 3 to 4 years, showing poor efficiency. The turnover period for receivables was about one year in 2000 for receivables and 5 months for payables, showing a very long turnover period. Such unusually long turnover periods and the gap between the turnover periods of receivables and payables are financially serious issues for TES4, leading to a further increase in payables.

4.1.4 Fund Analysis

A fund analysis was made with the statement of sources and uses of funds shown in Table 4.1-9 and the cash flow statement shown in Table 4.1-7.

Table 4.1-9 Statement of Sources and Uses of Funds

(Unit: million Tug.)

		1998	1999	2000
LONG-TERM FUND	Depreciation	13,442	8,655	11,286
	Capital/Capital Reserve	1,750	249	121
	Retained Earnings	8,348	-16,035	-1,854
	Long-term Borrowings	0	25,001	318
	Long-term Notes	0	0	0
	Long-term Provision	0	0	0
	Other Fixed Debt	0	-1,016	0
	Total of Sources of Long-term Funds	23,540	16,853	9,871
	Tangible Fixed Assets	1,736	31,711	3,013
	Land	0	0	0
	Intangible Fixed Assets	0	0	0
	Construction in Progress & Investments	5,658	-1,421	-703
	Deferred Assets	0	0	0
	Total of Use of Long-term Funds	7,394	30,290	2,311
	Shortage/Overage	16,146	-13,437	7,560
SHORT-TERM FUND	Notes Payable	0	0	0
	Accounts Payable	3,830	6,683	3,991
	Total of Payables	3,830	6,683	3,991
	Short-term Borrowings	0	50	250
	Short-term Provision	0	0	0
	Income Taxes Payable	321	-214	109
	Other Current Liabilities	-70	0	58
	Allowance for Doubtful Accounts	0	0	0
	Discounts on Notes Receivable	0	0	0
	Total of Sources of Short-term Funds	4,082	6,519	4,407
	Cash on Hand	10	-4	436
	Notes Receivable	0	0	0
	Accounts Payable	19,697	-7,264	11,823
	Total of Receivables	19,697	-7,264	11,823
	Securities	0	0	0
	Finished Goods	0	0	0
	Work in Process	0	0	0
	Raw Materials	157	752	-108
	Supplies	364	-402	-184
	Inventories	521	350	-292
	Other Current Assets	0	0	0
	Total of Use of Short-term Funds	20,228	-6,918	11,968
	Shortage/Overage	-16,146	13,437	-7,560

In 1998, long-term funds were procured internally from retained earnings and the remaining funds after use for construction made up for the lack of short-term funds. The short-term funds were mainly procured from payables and filled the fund requirement for payables together with surplus long-term funds.

The cash flow statement shows that the donation in financial activities was applied to asset acquisition so that a small amount of cash flow increase in operating activities became the net cash flow of the year.

In 1999, long-term funds were mainly procured from borrowing to apply for asset acquisition but the lack of required funds was made up by short-term funds. The short-term funds were acquired from payables, which also covered the shortage of long-term funds because of the reduction in receivables.

As for cash flow, operating activities generated 23 billion Tug to be appropriated to asset acquisition, complemented by borrowing. The accumulated retained earnings were taken out by the EA, causing a decrease in cash flow.

In 2000, long-term funds were mainly acquired internally from the retained earnings to be applied for asset acquisition and filling the shortage of short-term funds. The short-term funds were mainly procured from payables to meet the fund requirement for receivables together with the surplus of long-term funds.

As for cash flow, operating activities generated 2.3 billion Tug, all of which were appropriated to asset acquisition so that the net cash flow was narrowly created by borrowing and donation.

4.1.5 Financial Issues

As mentioned in the previous section, 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.

(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 4.1-10 and Table 4.1-11 and the composition by debtor is shown in Fig.4.1-8 and Fig 4.1-9.

Table 4.1-10 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)

In the above table, the outstanding amounts are shown by each EDO/HDO in 2000 because the collection method was modified from through-EA to direct payment from EDO/HDO to TES4.

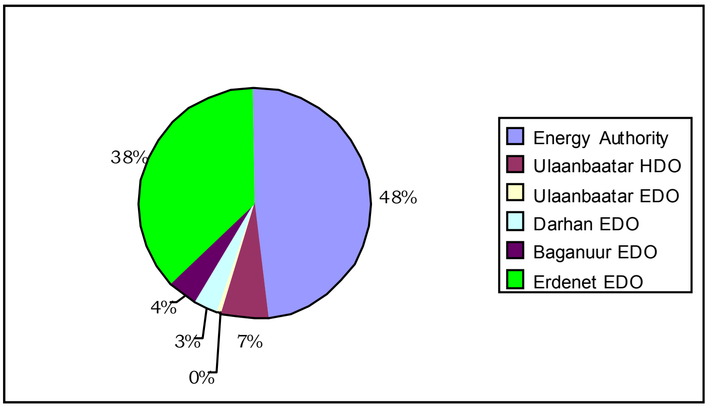


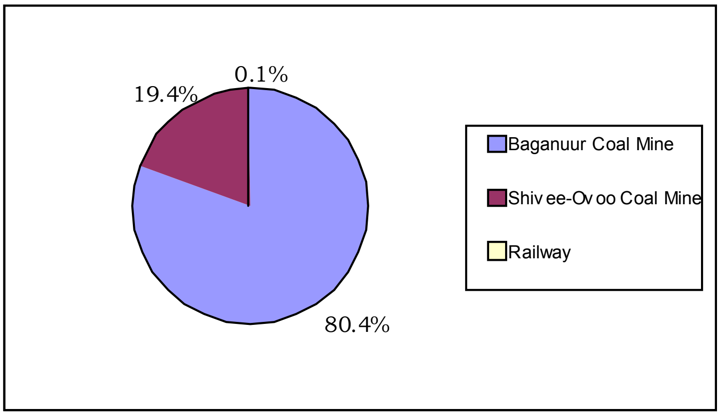
Fig. 4.1-8 Composition of Debtors for Receivables of TES4 (**at the end of 2000**)

Table 4.1-11 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)



(Source: TES4)

Fig. 4.1-9 Composition of Creditors for Payables of TES4 (at the end of 2000)

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%.

Furthermore, the outline of TES4 main equipment is shown in Table 4.2-1.

Table 4.2-1 The Outline of TES4 Main Equipment

Item	*Unit*	*Description*
1. Capacity	MWe	540
2. Boiler		
Number of unit		8
Steam production（each unit）	t/h	420
Boiler outlet pressure	kg/cm^2	140
Boiler outlet temperature	°C	560
3. Turbine-generator		
Number of unit		6
Rated capacity	MWt	80/100
rpm	rpm	3,000
Vacuum（in condenser）	%	92
Type of generator cooling		Air cooling
Voltage	V	6,000
Frequency	Hz	50
4. Auxiliaries		
Coal yard capacity（operation value）	ton	150,000
Chimney height	m	250
Cooling tower dimension (three-set sum total)	m^2	4,200

The contents of the main equipment failure in 1991 are described below.

- Failure of mills (abrasion of power gears, burnout of electric motors)
- Failure of boiler control system
- Spontaneous combustion of the pulverized coal in the indirect combustion system
- Failure of main control valves (difficulty of its switching (open-close function))
- Clogging of the piping in the ash handling system

Against the above situation, the government of Japan determined the first grants-in-aid by JICA in June 1992, and conducted the following repair works in the period of November 1992 to March 1995.

- The measure against the abrasion of the pulverized coal supply system
- The measure against the clogging of the piping in the ash handling system
- Repair of the electric precipitator
- Repair of the boiler chemical dosing pump
- Maintenance of tools, measuring instruments, lighting instruments, cleaning equipment and others

Also, a request for assistance was received from Mongolia in connection with the repair work of hot water supply equipment, and the second grant aid of JICA has been continuously conducted since 1996.

Although the operation condition improved considerably, the number of times of blackout decreased and stability of the CES was improved by the above assistance, problems, such as abrasion of the reduction gear in mills, defects of the boiler automatic control, difficulties in the main steam and feed water valve switching, etc., still occurred frequently in the main portions of equipment, and the situation was far from providing stable operation.

In order to alleviate such a situation, JBIC dispatched a SAPROF survey team in 1995, and the team determined to carry out the Japanese Government loans in those days for changes in the boiler combustion system, changes in the type of coal pulverizer, replacement of the boiler control system and replacement of boiler tubes, for the power plant, which were causing the most problems, and enforcement was carried out in the rehabilitation project of the 4th thermal power plant (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 and Fig.4.2-2.

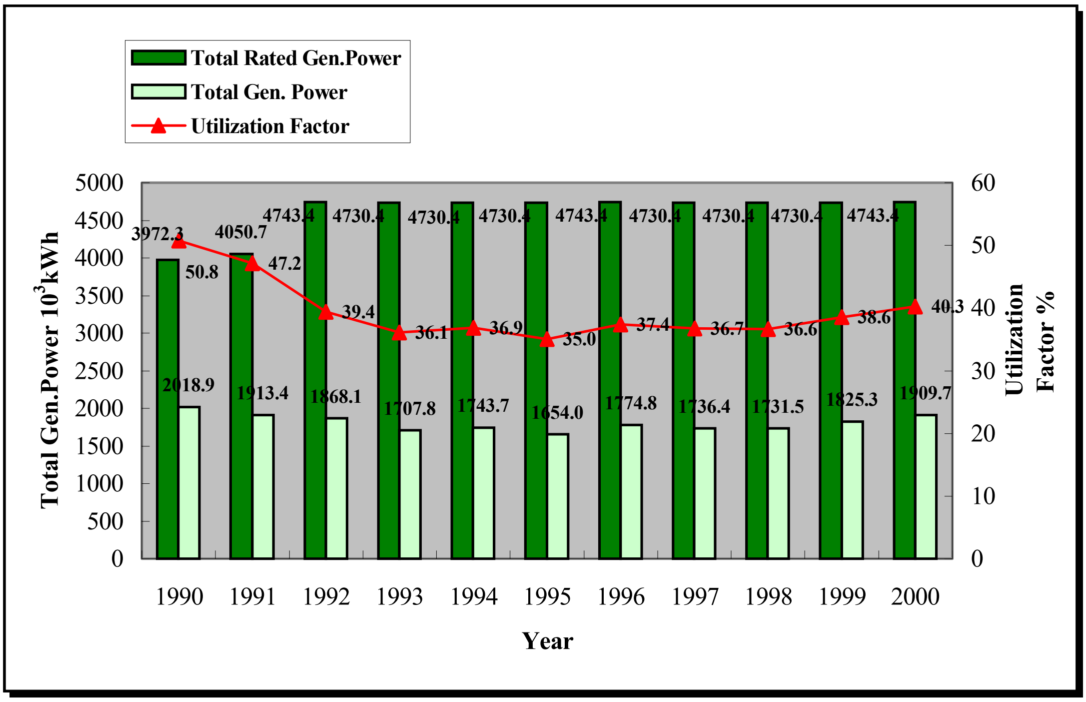


Fig. 4.2-1 Production of Electricity and Transition of Utilization Factor

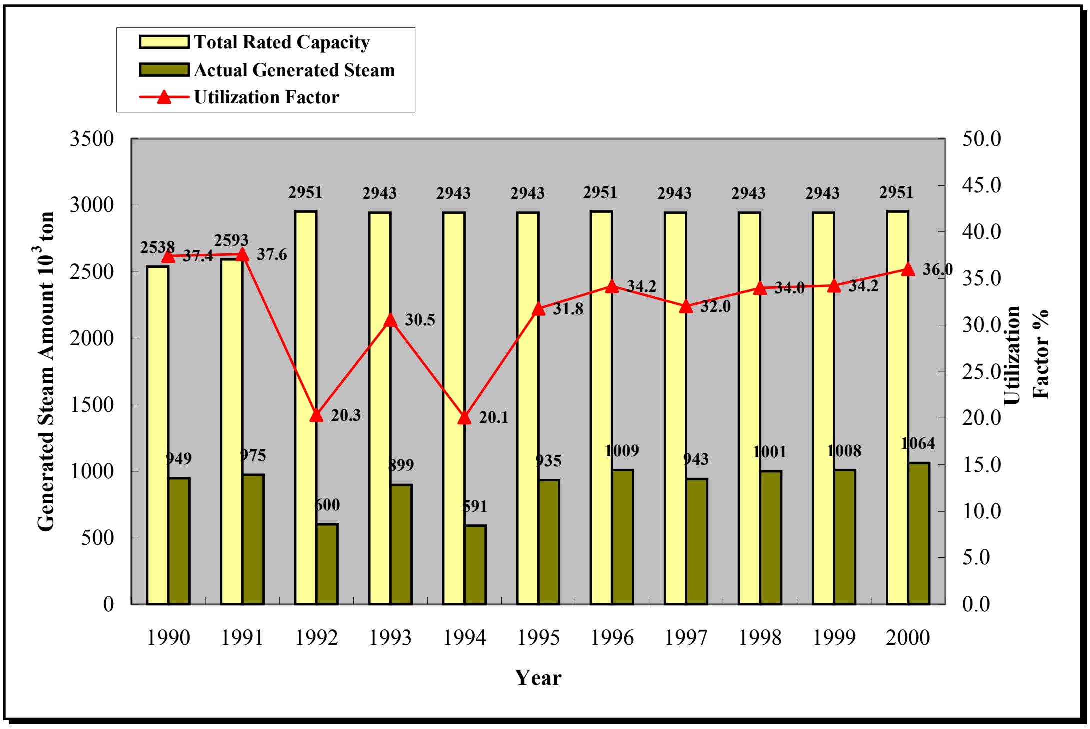


Fig. 4.2-2 The Amount of Boiler Evaporation and Transition of Utilization Factor

4.2.2 Boiler Facilities

The 4th thermal power plant rehabilitation project (Phase-I) performed by the Japanese Government loans mainly carried out the replacement of combustion equipment of No. 1 boiler to No. 4 boiler and all construction ended in September 1999. It has been maintaining satisfactory operation status since then, and in particular, the boiler availability factor has been recovered to about 44%. Furthermore, transition of the availability factor, the ratio of failure and the ratio of reserve are shown in Fig. 4.2-3.

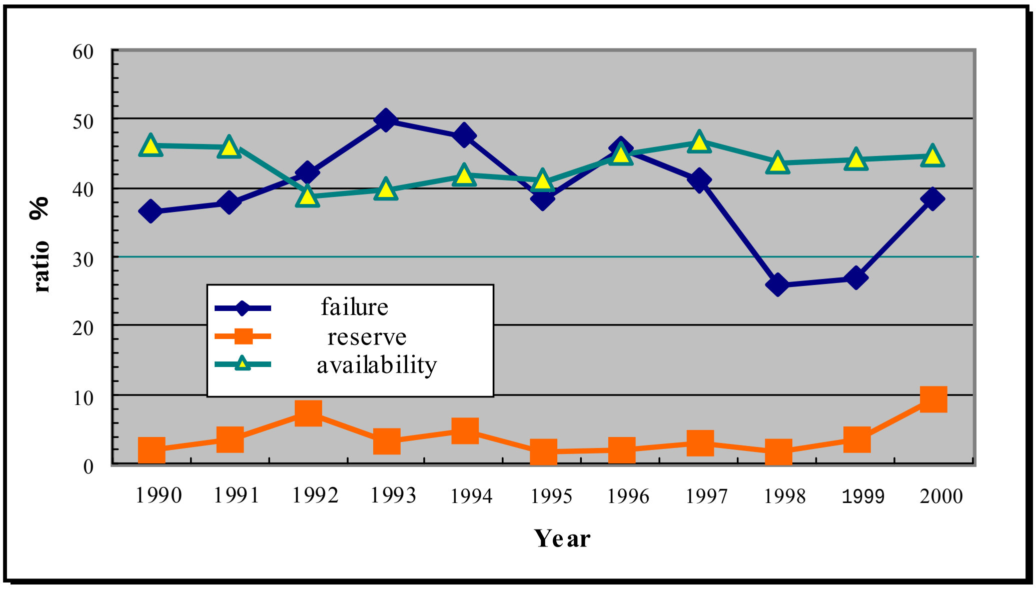


Fig. 4.2-3 Transition of Availability Factor, Ratio of Failure, Ratio of Reserve

The maintenance and repair works including the repair work plans of that boiler equipment, which was rehabilitated by the Phase-I project, have altogether been carried out by TES4. Especially, the maintenance of coal pulverizers and boiler control systems, which are the main equipment of the power plant, has been mainly taken on by the power plant engineers who were educated by supervisors from each manufacturer during erection work and commissioning at the site in the Phase-I project.

As for the coal pulverizers, after replacement was performed, although much more than anticipated abrasion of rollers and fans occurred and pulverized coal leaked from the spring part for the mill-roller pressure devices and pyrite hoppers (extraction part of foreign matter), all of those repair works were conducted by the power plant engineers.

However, if the main trouble factors in No. 1 boiler to No. 4 boiler (already replaced) and No. 5 boiler to No. 8 boiler (not replaced) in 2000 are compared with the repair time base carried out in the Phase-I project, the rate of trouble on the mill system is clearly negligible, only 7% (mill motor failure: 2%, High-vibration of mill: 5%) in No. 1 boiler to No. 4 boiler. Also, as a result of the above, this had led to about one third (1/3) improvement to 24% in No. 5 boiler to No. 8 boiler (mill motor failure: 19%, gearwheel of mill reduction gear failure: 5%). Furthermore, the comparison of the main failure factor of each boiler and the repair time ratio in 2000 are shown in Fig. 4.2-4.

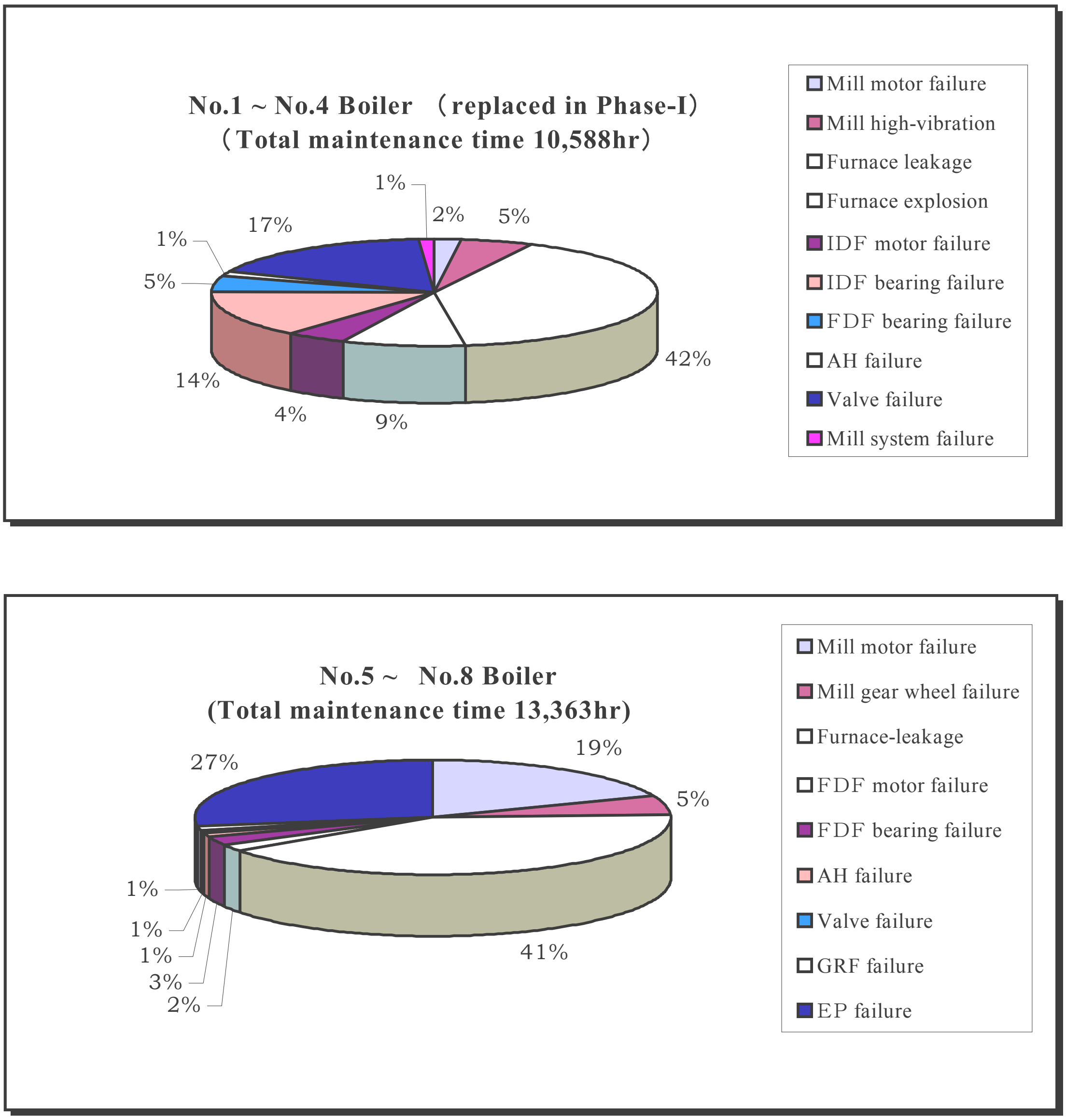


Fig. 4.2-4 The Comparison of Failure Factor of Boiler and Repair Time in 2000

In addition, the trouble in the Mill system of No. 5 boiler to No. 8 boiler occupied 24% (19% + 5%), which ranks second to the trouble in the furnace fire pressure parts, and the above issues will be expected to be improved by the Phase-II project to be implemented from now on.

The trouble of leakage in the furnace fire pressure part through all boilers was over 40%, and was the biggest root cause of trouble in the existing facilities.

The transition of the boiler shutdown time by individual root cause is shown in Fig. 4.2-5. Trouble due to the break-down of furnace pressure parts, failure of the main auxiliary equipment, such as FDF, IDF, and etc., has been increasing since 1998 after repair work started, and it is assumed that there are still some problems remaining in portions of the existing equipment other than those in the replacement range.

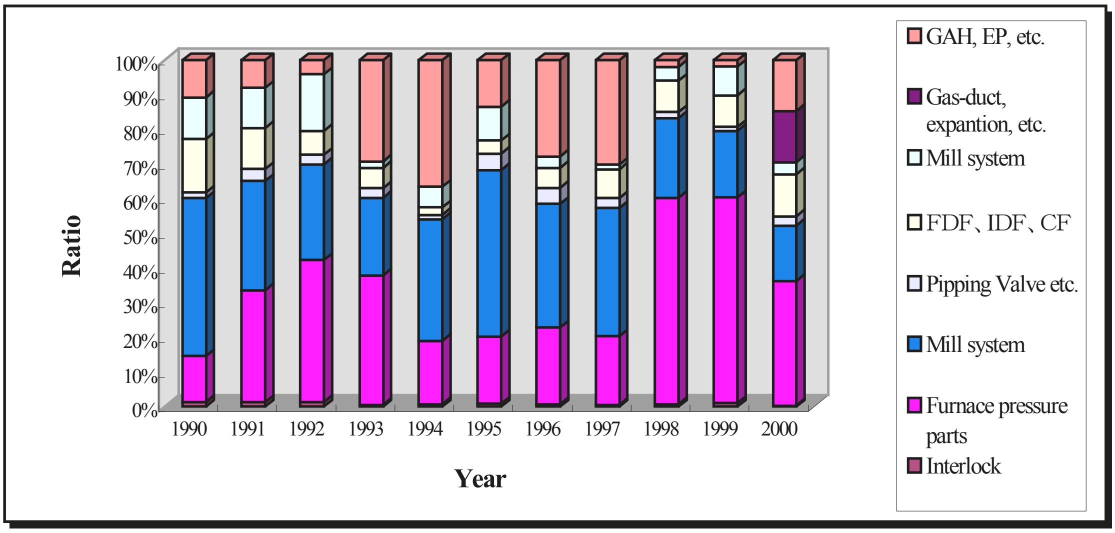


Fig. 4.2-5 The Transition of Boiler Shutdown Time by Individual Root Cause

4.2.3 Turbine-Generator Facilities

The utility factor of each turbine and generator is shown in Fig. 4.2-6 and the transition of the shutdown factor by individual root cause is shown in Fig. 4.2-7. Periodic inspection (usual inspection: once every 2 years, detailed inspection: once every 4 years) has been carried out.

However, by the figure of Fig. 4.2-6, the failure in No.1, No.5 and No.6 turbine of 80 MW of their outputs captured 89% of the failure repair time in the turbine main part, and as one of the root causes, it is assumed that there must be a problem in the design which prompted the capability increase from 60 MW to 80 MW. Thus, modification and/or the rehabilitation for its life extension will be needed.

Also, maintenance on the boiler feed water pumps and the condensate pumps has been periodically carried out by the supervisors dispatched from each manufacturer. Especially, in connection with the boiler feed pumps, modification has been carried out so that its operation condition and so forth can be monitored from the central control room.

However, in recent years, failure has originated in equipment superannuation, and since then, the frequency of failure has been often. So, it is necessary to perform rehabilitation. In addition, vacuum aggravation of the condenser has been progressing. Thus, since 1994, we have been aware of the performance decrement of the ejectors, the suction leak into the atmosphere from the valve and the expansions of the vacuum system.

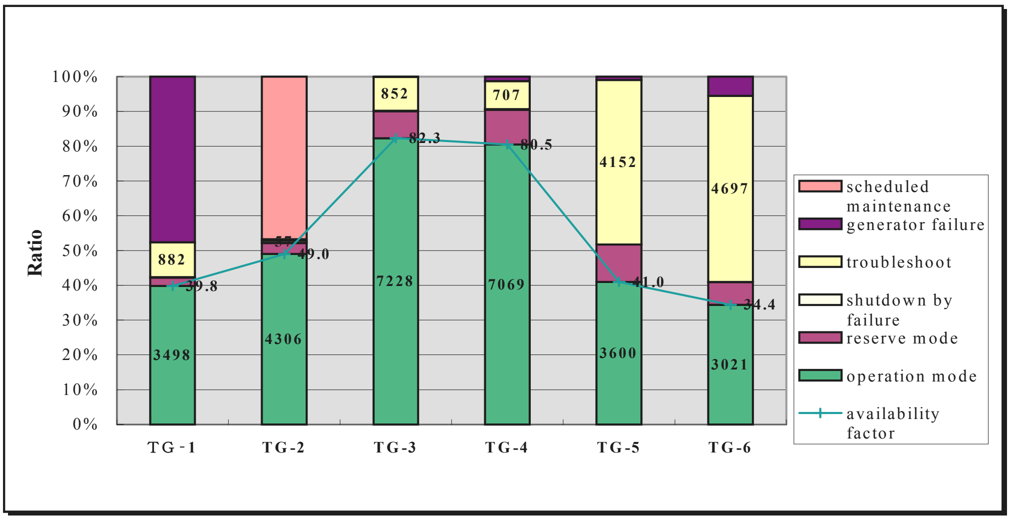


Fig. 4.2-6 Utilization Factor & Transition of Shutdown Time at Turbine & Generator

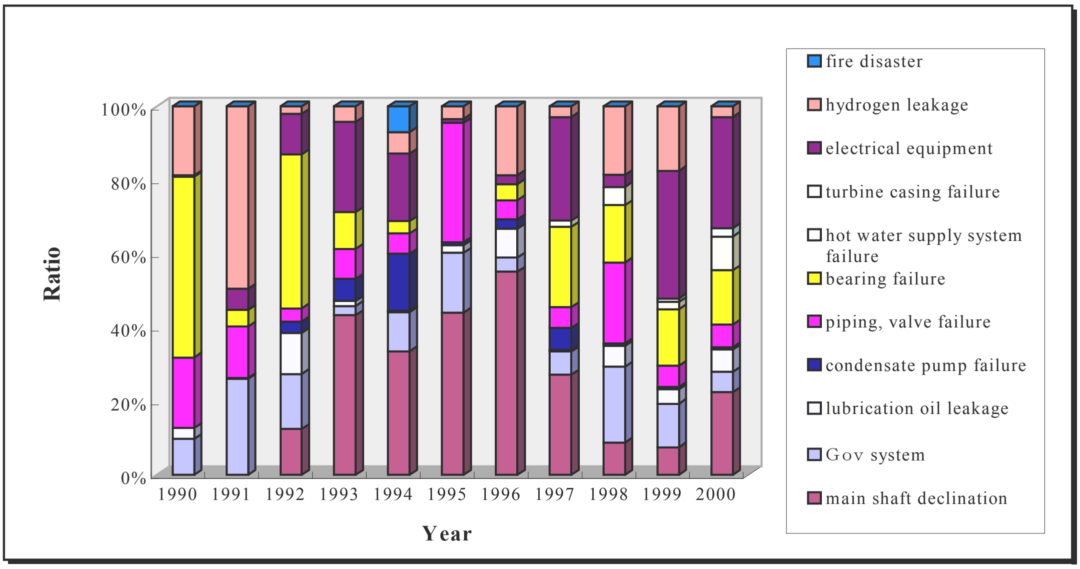


Fig. 4.2-7 The Transition of the Shutdown Factor by Individual Root Cause

4.2.4 Electric Facilities

Turbine and generator repair time ratio by individual root cause in TES4 in 2000 is shown in Fig. 4.2-8. And the result of the number of electrical failures equipment-by-equipment in TES4 in 2000 is shown in Fig. 4.2-9. As shown in Fig. 4.2-8, the ratio of failure, for which electric equipment takes into account the turbine and generator sum total failure repair time, reached approximately 33% (generator:

28%, excitation system: 4%, power transformer and others: 1%) of the whole in 2000. Among all this, in relation to the excitation system, since the rehabilitation project has been planned as a static system by Phase-II, an improvement in equipment failure would be expected.

Also, as shown in Fig. 4.2-9, is the ratio of failure, for which protection devices accounted for 44% of all electric equipment failure (sum total of 918 times), low-voltage motor accounted for 15% and panel board accounted for 13% in 2000. Among this, in relation to the root cause of low-voltage motors, most of the trouble occurred due to burnout by insulating degradation etc., so the issue which was generated 189 times in 1999, was reduced by one fourth (1/4) or less compared to all others by the introduction of a coil re-winding machine in 2000.

However, the failure of protection devices and/or the panel board has been caused by the decrepit equipment, so it is necessary to perform equipment replacement, for which it is difficult to procure spare parts for repair at an early date.

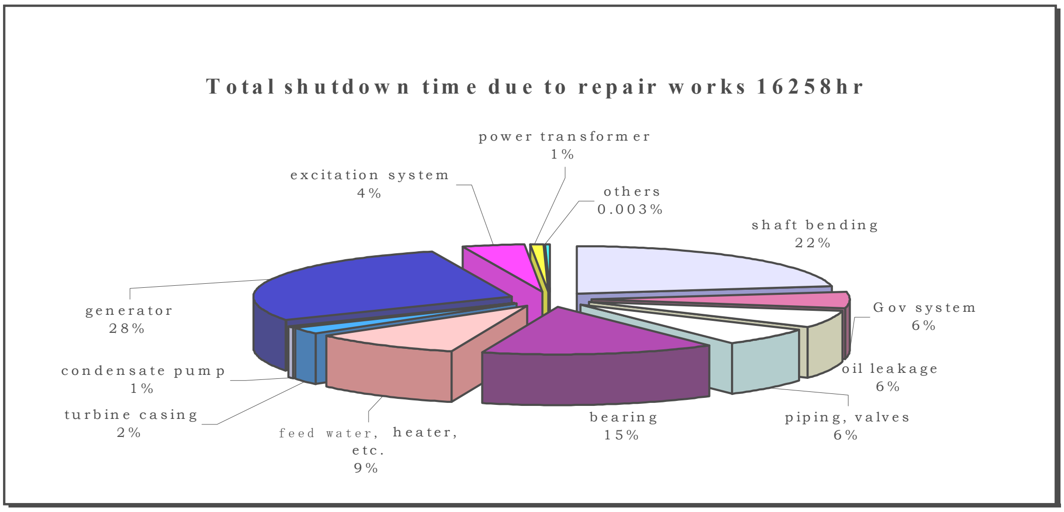


Fig. 4.2-8 Turbine and Generator Repair Time Ratio by Individual Root Cause in 2000

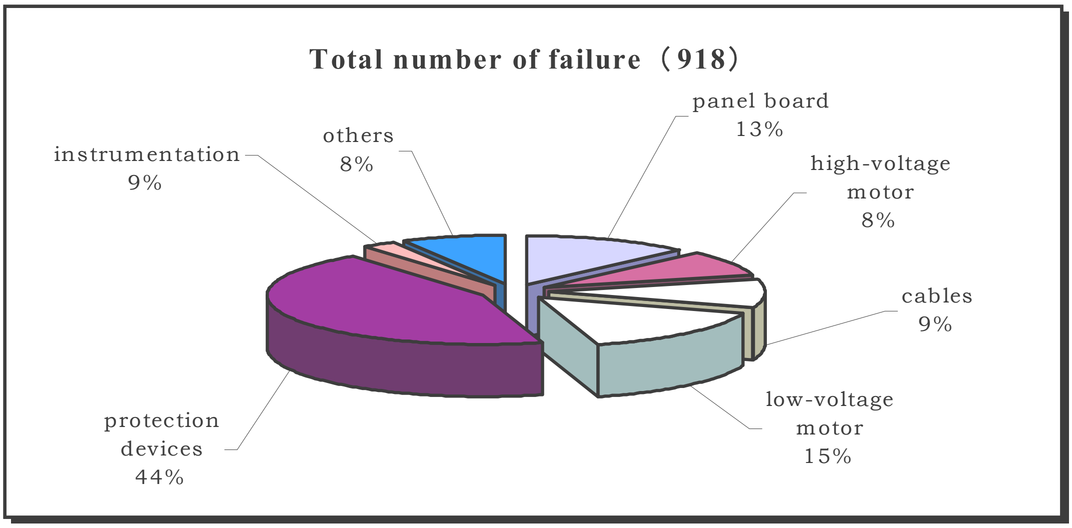


Fig. 4.2-9 Number of Electric Failures Equipment-by-Equipment in 2000

4.2.5 C&I Facilities

As for the present condition of control and instrumentation, the monitoring instruments and detection elements of the turbine and generator repair and modification works have been periodically carried out in some part by TES4 engineers, and remote monitoring from the central control room, not possible before, has been made possible.

However, the procurement of spare parts for the repair could not be made for the reason that most of the existing equipment was made in the former Soviet Union, so the additional order of charts and part changes for recorders, installed in the central control room, could not be performed even if repair of those local instruments was performed.

Those monitoring instruments are important for the records of aged deterioration and operation monitoring at the power plant, and it is necessary to perform the replacement of the existing equipment at an early date.

As for the motor operated valves and the control valves for the turbine facility, since the situation is such that no replacement or refurbishment etc. has been done, the system around the feed water heaters and the condensers has deteriorated significantly, and approximately 20 units of the equipment have been damaged among a total of 80 units. It is also necessary to perform equipment replacement here in future.

4.2.6 Fuel Handling Facilities

The fuel handling system is one of the important pieces of equipment in the power plant, and the maintenance condition of the conveyers is in no way inferior to the maintenance condition in Japan.

However, the maintenance of equipment used to protect the work environment from dust and firefighting equipment is not adequate. And the coal used in TES4 is produced by domestic coal mines; it is carried by freight cars (railway wagon) and the power plant has also been performing maintenance as the railway cars come in. Moreover, the coal mine and the railroad facility has caused trouble in the operation and maintenance of equipment since the Soviet Union collapse as well in the TES4 facility, and the block coal (lump coal) and foreign matter in the coal, which is sent from the coal mine, have caused the failure of the crusher in the fuel handling system, and also the increase of utility cost by external factors such as cleaning business of the freight cars borrowed from China.

Also, as for coal mine facilities, the replacement and reinforcement of the equipment and other measure to improve the coal quality have been carried out since 1997, continuing up to 2003 supported by NEDO, JICA and JBIC, and improvement of coal quality and reduction of the amount of block coal and foreign matter can be expected in and after 2002 when renewal equipment will go into formal operation.

4.2.7 Others

Although the water treatment plant, which comes under the chemical operation section, is a job site in which chemicals are used and it is used as the model for other parts of the power plant sections in a management situation, such as the condition of facility clean up and adoption of reminder cards to personnel, the equipment has superannuated remarkably and has been operated by manual operation from the dissolution of chemicals to washing of the processing bath. Therefore, variations in the concentration of chemicals, such as lining damage in the water treatment plant, have occurred.

Thus, automation of the dissolution equipment of chemicals and water treatment equipment, and maintenance of the water quality monitoring meters are required.

4.2.8 Evaluation of the Current Situation in TES4 Facilities

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.

The following can be considered as the main factors of failure mentioned above:

- The level deployment (the repair work result for other equipment) and improvement is not enough when a similar failure occurs often in equipment of the same class;
- Periodical repair work has not been performed due to financing deficit (By the result of a hearing, recognized as the present condition, budget demand has only been about 50%);
- Shortage of repair tools etc.;
- On the occasion of repair works, incomplete repair works by the disapprobation of spare parts delivery and use of substitute material and/or spare parts;
- The technical advice for a measure against equipment life extension and equipment replacement is insufficient.

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; as mentioned in Fig. 4.1-7 of clause 4.1, 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% (the average of maintenance and repairs was 15% in 1999 in Japan. For details please refer to clause 4.1.2), 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. Furthermore, it will also lead to a decrease in personnel expenses, which were spent on correspondence regarding the problems, which frequently occurred in the TES4 facility.

Based on the above results, the necessary recommendation including evaluation details for the future rehabilitation and maintenance plan of TES4, indispensable to maintenance and rehabilitation works, and the power plant operation and management plan, for the power plant are described in Chapter 5 and Chapter 6.

4.3 The Situation of the 3rd Thermal Power Plant in Ulaanbaatar

To look at the operation and maintenance situation of another power plant, a field survey was conducted at the 3rd thermal power plant (TES3). The result of the investigation is described below.

TES3 is located in Ulaanbaatar city as is TES4, and is a combined heat and power plant (CHP) (capacity of 148 MW), which provides electric power mainly to the CES including the Ulaanbaatar area and the heat supply in the city. TES3 started heat supply for the city from 1968, and started the production of electric power in addition to heat supply from 1973; it was the largest CHP plant in Mongolia before commencement of the commercial operation of TES4. In its present condition, about 30% of the electric power and about 40% of the heat supply are created in the CES in Mongolia.

The outline of the power plant main equipment is shown in Table 4.3-1. Also, the actual production and the thermal efficiency result in 2000 are shown in Table 4.3-2.

Table 4.3-1 The Outline of TES3 Main Equipment

Item	*Unit*	*LP side*	*HP side*
1 Capacity	MW	100	48
2. Boiler			
Number of unit		6	7
Steam production（each unit）	t/h	75	220
Boiler outlet pressure	kg/cm^2	39	100
Boiler outlet temperature	℃	440	540
3. Turbine- generator			
Number of unit		4	4
Rated capacity	MWt	12	25
rpm	rpm	3,000	3,000
Vacuum（in condenser）	%	91	91
Type of generator cooling		Air cooling	Air cooling
Voltage	V	6,000	6,000
Frequency	Hz	50	50
4. Auxiliaries			
Coal yard capacity	t	180,000	
Chimney height	m	100	150
Cooling tower capacity (three-set sum total)	m^3	4,852	

Table 4.3-2 TES3 Actual Production And Thermal Efficiency in 2000

Item	*Unit*	*Result in 2000*	*Remarks*
1. Net Generation of Electricity	GWh	382.1	
2. Net Generation of Heat			
District Heating	T cal	1095.647	
Industrial Steam Extraction	T cal	144.337	
3. Boiler Efficiency	%	78.2 / 75.6	LP / HP- side
4. Utilization Factor	%	27.8	
5. Boiler Operating Hours	h	41,485	
6. Turbine Operating Hours	h	33,836	

The power plant is constituted and managed by about 1,000 employees (O&M relation: about 600 people) in each organization as of 2001. About 260 personnel reductions have been made over the past five (5) years, compared to about 1,260 in 1996. Moreover, regarding the operation of the power plant, shift operations are performed in the 3 shift x 4 groups system (one shift = about 50 - 70 staff).

The existing equipment, which was made in the former Soviet Union, the same as TES4, consists mainly of a total of six (6) sets of high-pressure side boilers, rehabilitated after Russia collapsed by the financial support of ADB from 1996 till 2000. Also, the rehabilitation and the modification of turbines and their accessory equipment on the high-pressure side have been carried out by the financial support of the Nordic Development Fund (NDF). Regarding the low-pressure side boilers, one (1) set has been converted into a fluidized bed-combustion (FBC) boiler, and plant operation started from 2000. The main items including the rehabilitation for the high-pressure side boilers are described below.

(1) Rehabilitation and Reconstruction Items of High-pressure-side Boilers

- Rehabilitation of combustion equipment (reconstruction to the direct combustion system from the indirect combustion system)
- Rehabilitation of instruments and control system
- Rehabilitation of boiler main steam piping, and installation of emergency stop valve (ESV)
- Replacement of condensate pumps (4 sets)
- Replacement of turbine control valves
- Rehabilitation of the venturi-scrubber type of dust collector

(2) Rehabilitation and Modification of the Low-pressure-side Boilers

- Rehabilitation of boiler No.3 to an FBC boiler, and replacement of the control system with a CRT-operation system.