

ANNEX VIII

**ENERGY COST AND SALES
REVENUE IN BPDB**

1977

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ANNEX VIII-1 ENERGY COST AND SALES REVENUE IN BPDB (1977/78)

Description		East Zone	West Zone	Total
1	Installed Capacity (kW)	525,575	226,563	752,138
2	Maximum Capability (kW)	408,406	148,587	556,993
3	Generation in 1,000 kWh/Year	1,444,291	468,499	1,912,790
4	Fuel cost in 1,000 TK	61,524	336,789	398,313
5	Generation Expenditure in 1,000TK	124,440	363,753	488,193
6	Energy Sales in 1,000 kWh	908,839	295,661	1,204,501
7	Energy Sales in 1,000 TK	418,820	138,106	556,926
8	Supply cost in 1,000 TK	369,565	439,469	809,034
9	Generation Cost/kWh in Paisa	8.6	77.6	25.5
10	Sales cost/kWh in Paisa	40.7	148.6	67.2
11	Average tariff/kWh in Paisa	46.1	46.7	46.2

Calculation Method

(1) Generation Costs

Generation Expenditure (Total)	488,193 x 10 ³ TK
(-) Fuel Cost	398,313 "
<hr/>	
Miscellaneous Generation Costs	89,880 x 10 ³ TK

Assuming that miscellaneous generation costs are in proportion to the ratio of installed capacity in each zone of 7 : 3, the cost per zone can be calculated as follows:

$$\text{Eastern zone} \quad 89,880 \times 10^3 \times 0.7 = 62,916 \times 10^3 \text{ TK}$$

$$\text{Western zone} \quad 89,880 \times 10^3 \times 0.3 = 26,964 \times 10^3 \text{ TK}$$

Total generation costs for each zone can be obtained by adding fuel cost to miscellaneous generation costs.

Total Generation Costs:

$$\text{Eastern zone} \quad 61,524 \times 10^3 \text{ TK} + 62,916 \times 10^3 \text{ TK} = 124,440 \times 10^3 \text{ TK}$$

$$\text{Western zone} \quad 336,789 \times 10^3 \text{ TK} + 26,964 \times 10^3 \text{ TK} = 363,753 \times 10^3 \text{ TK}$$

(Note) Costs exclude depreciation.

(2) Total Costs

Costs other than for fuel cost can be obtained by subtracting fuel cost from supply cost,

$$\text{that is, } 410,721 \times 10^3 \text{ TK}$$

The ratio of energy sales in kWh for the eastern and western zones is:

$$0.75 : 0.25$$

Then, respective costs other than for fuel for the eastern and western zones can be obtained by allotting the above ratio.

Costs other than for fuel in each zone are:

$$\text{Eastern zone} \quad 410,721 \times 0.75 = 308,041 \times 10^3 \text{ TK}$$

$$\text{Western zone} \quad 410,721 \times 0.25 = 102,680 \times 10^3 \text{ TK}$$

Total costs for each zone are determined by adding fuel costs to the above costs.

That is,

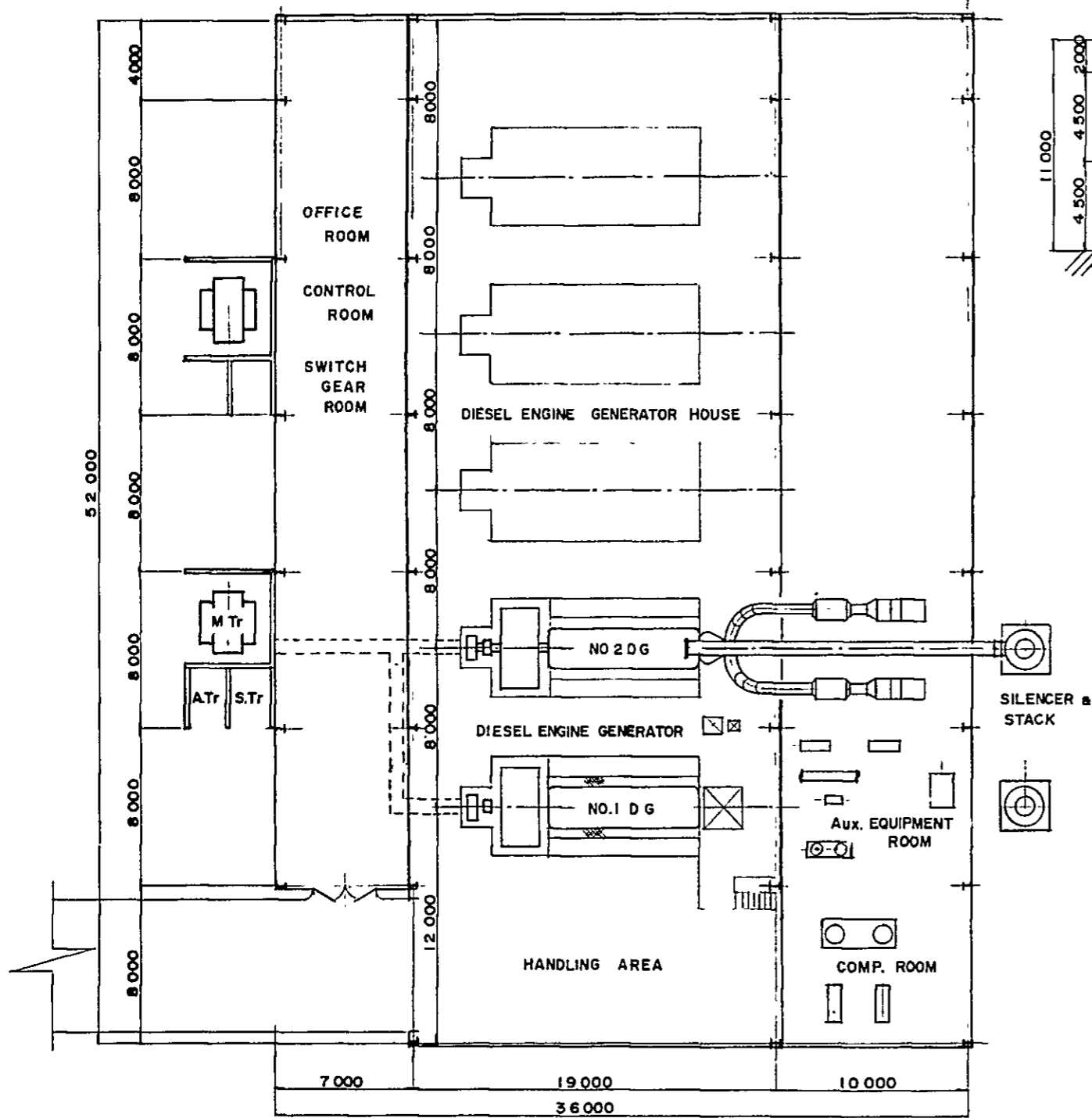
Eastern zone $61,524 \times 10^3$ TK + $308,041 \times 10^3$ TK = $369,565 \times 10^3$ TK

Western zone $336,789 \times 10^3$ TK + $102,680 \times 10^3$ TK = $439,469 \times 10^3$ TK

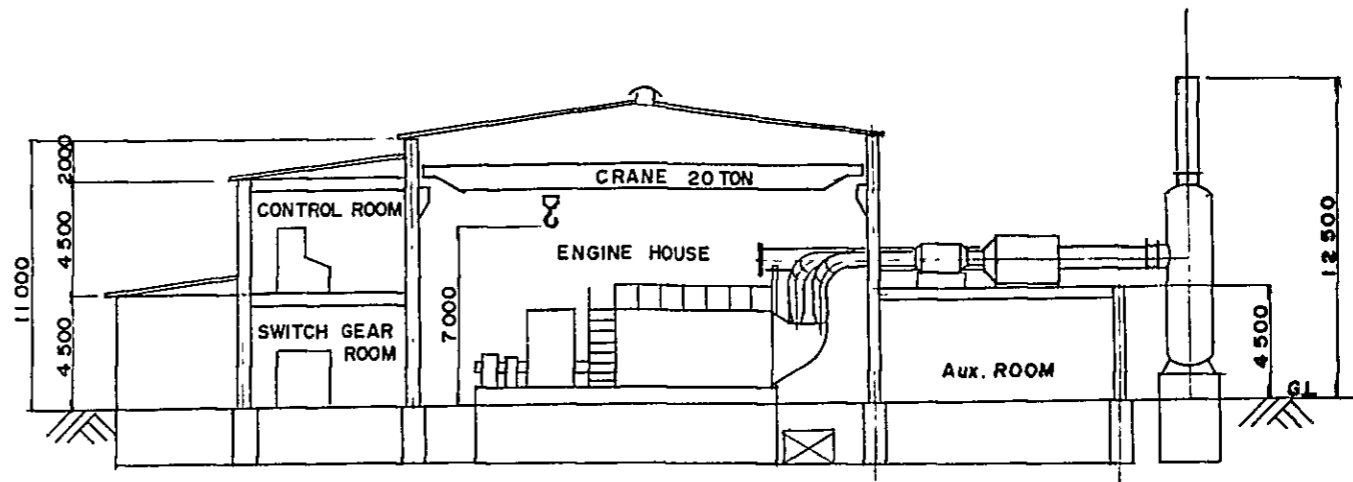
(Note) These figures include costs for "isolated areas".

ANNEX IX

**ARRANGEMENT OF EQUIPMENT FOR THERMAL
POWER STATIONS AS ALTERNATIVE**



PLAN



ELEVATION

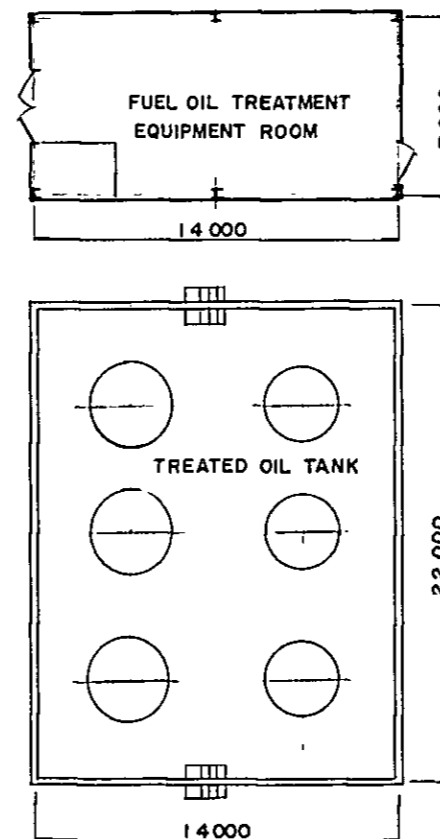


FIG. 11001
ARRANGEMENT OF DIESEL ENGINE
GENERATOR HOUSE
(PLANT CAPACITY : 6000 kw_{x2}, 7000kw_{x3})

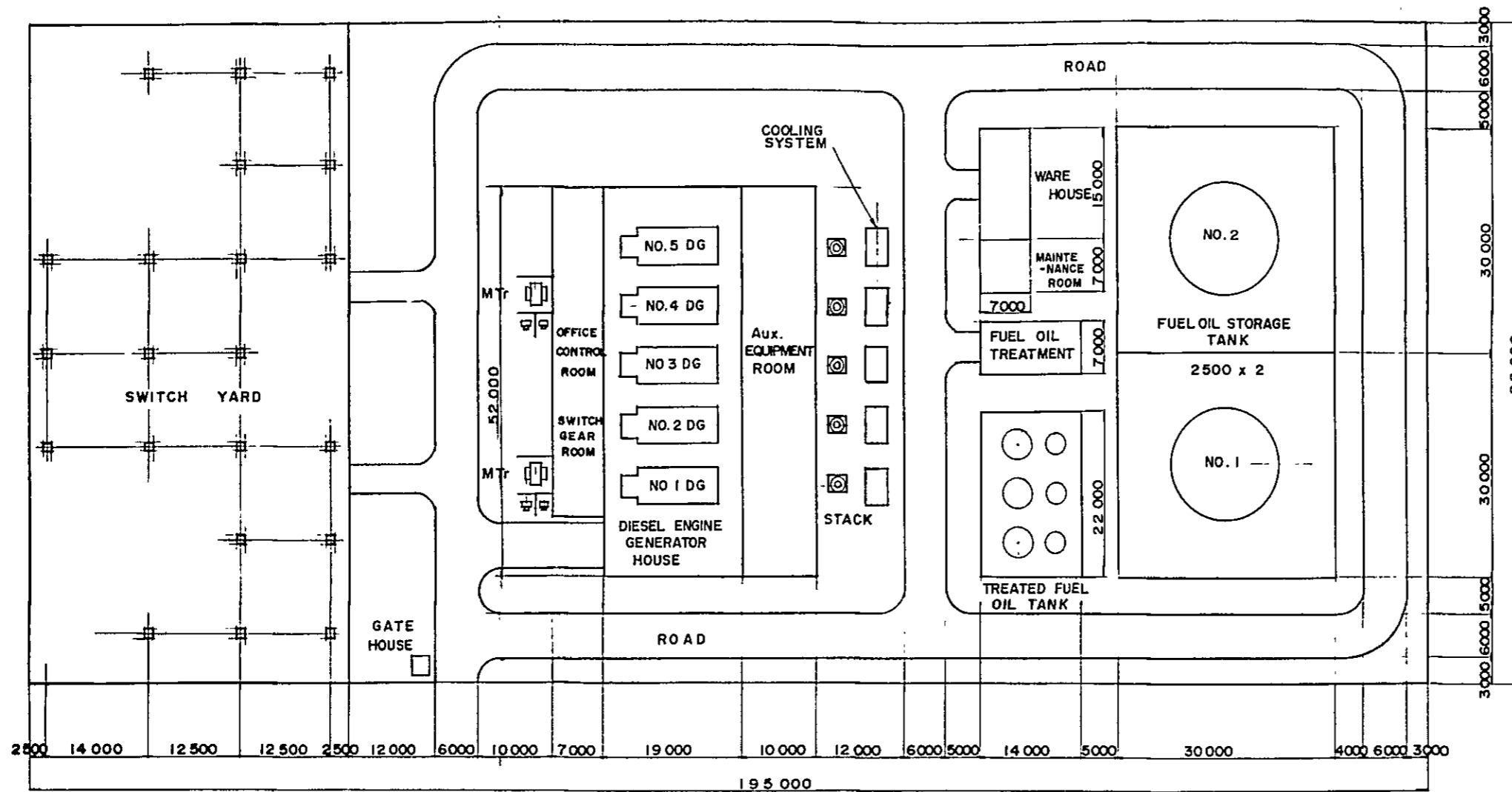


FIG. 11002
 SITE LAYOUT PLAN FOR DIESEL
 ENGINE POWER PLANT
 (PLANT CAPACITY : $6000^{kw} \times 2, 7000^{kw} \times 3$)

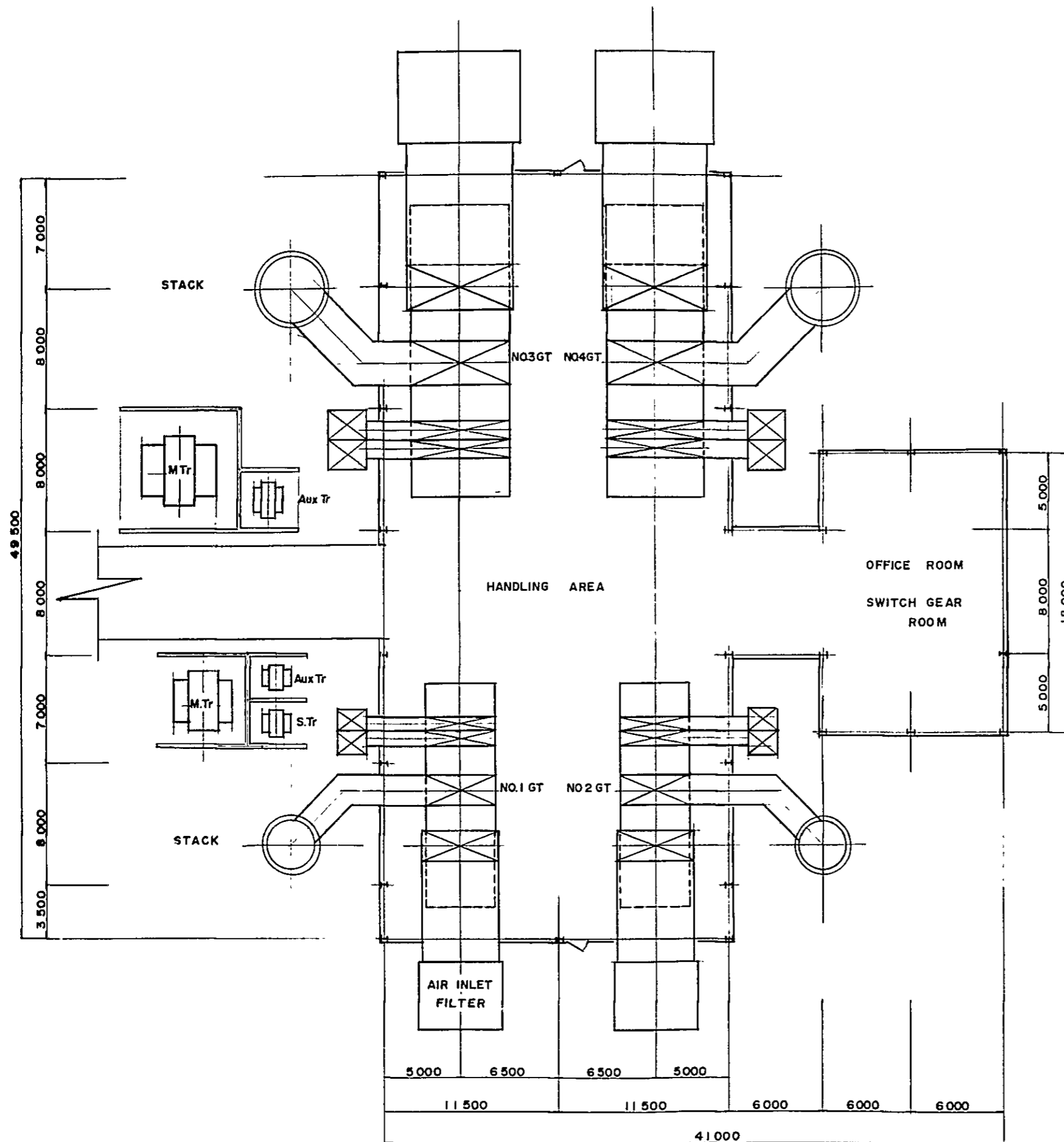


FIG. 11003
 ARRANGEMENT OF GAS TURBINE
 GENERATOR HOUSE
 (PLANT CAPACITY : 10000^{kw} x2, 20000^{kw} x2)

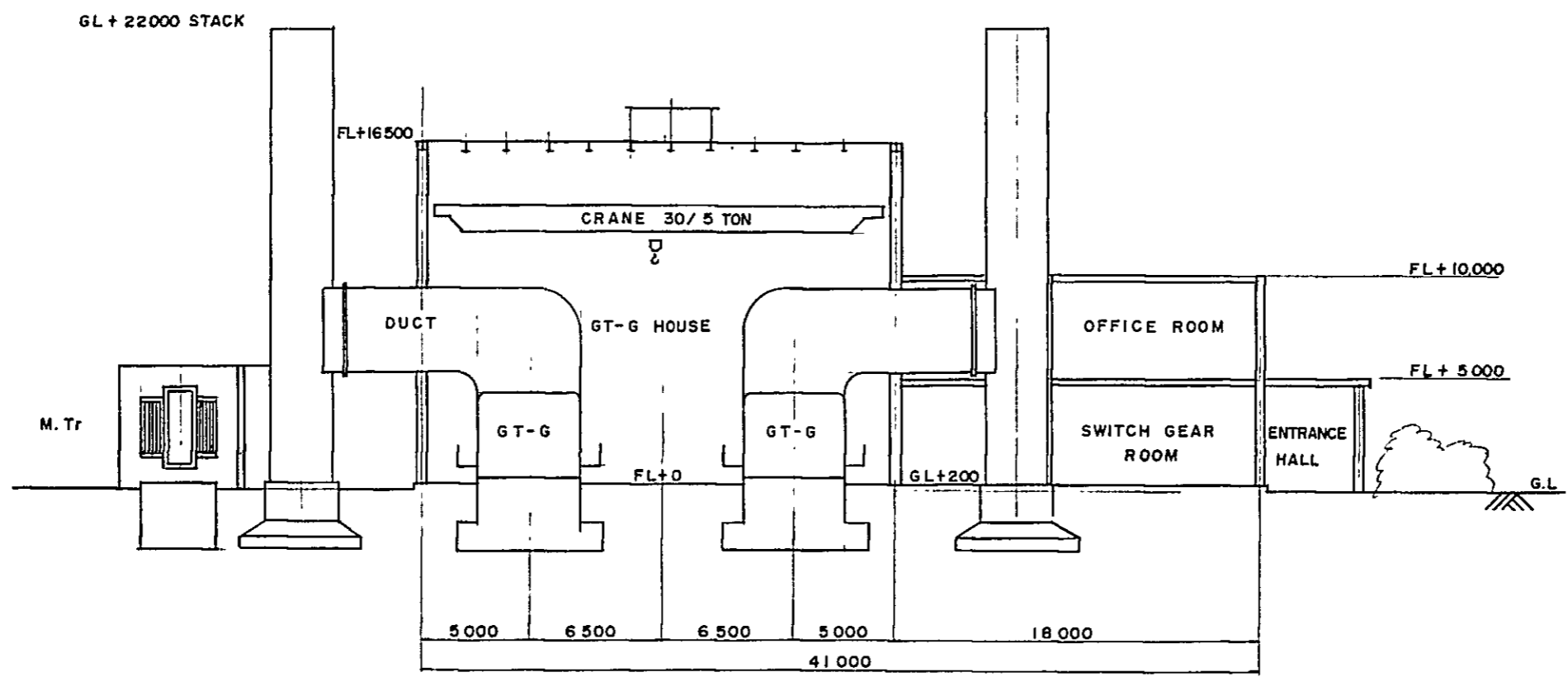


FIG. 11004
 ELEVATION OF GAS-TURBINE
 GENERATOR HOUSE
 (PLANT CAPACITY : 10000kw x2, 20000kw x2)

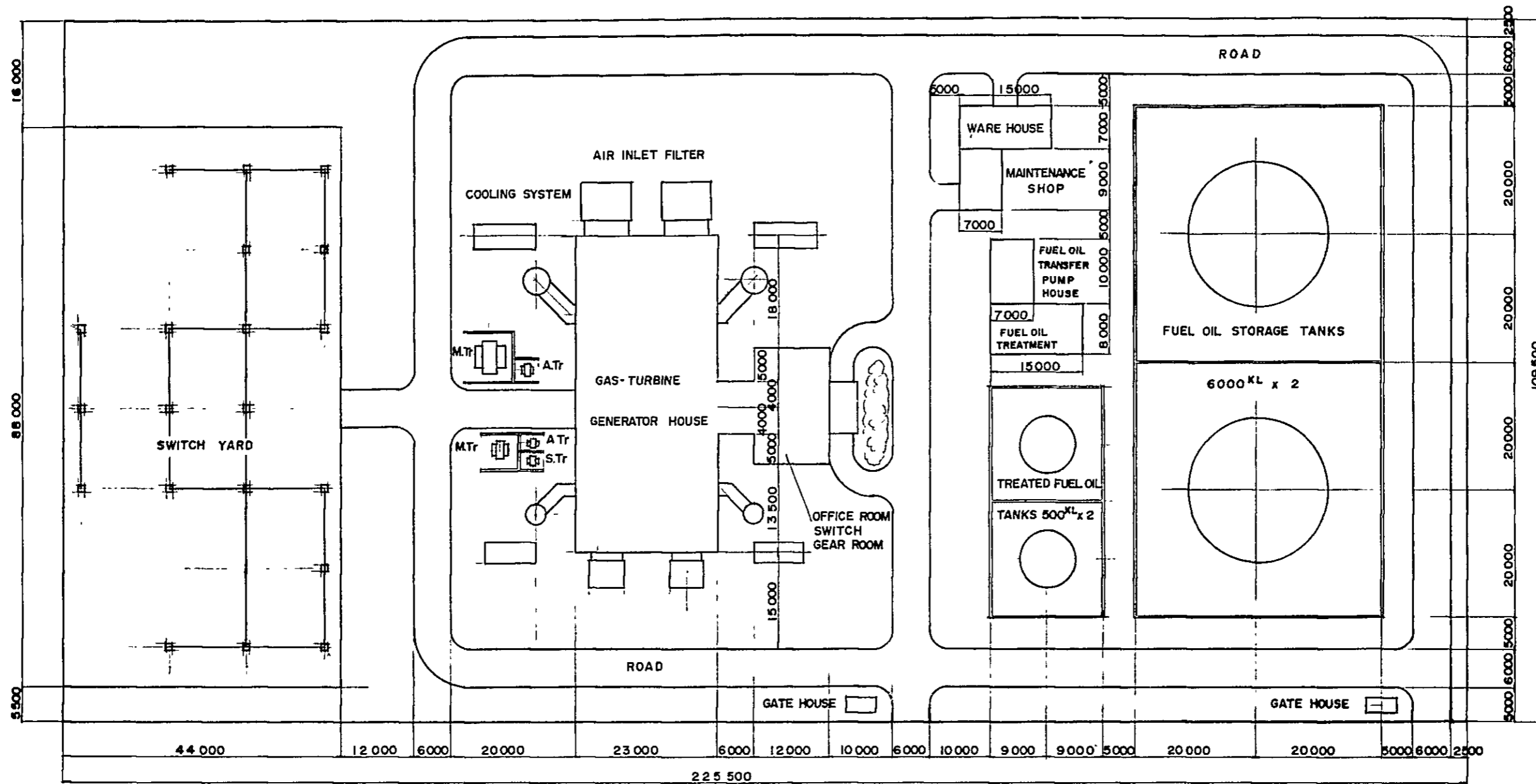


FIG. 11005
 SITE LAYOUT PLAN FOR
 GAS-TURBINE POWER PLANT
 (PLANT CAPACITY : 10000kw x2, 20000kw x 2)

ANNEX X

ESTIMATION OF BENEFIT AND COST RATIO (B/C RATIO) ON THIS PROJECT (FOR REFERENCE)

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1. Given Conditions for Evaluation

(1) Demand Forecast

According to section 5-1-2, the growth rate of power demand is assumed to be 16% till 1990, 11% till 1995, and 7% after 1995.

(2) Price Escalation

The price is fixed at the level of the year of tender 1981-82. In the case of financial analysis, the increase in price thereafter is appropriated in the form of price contingency, however, this step is not taken in the case of economic analysis.

(3) Electric Tariff

With regard to the management of BPDB, a statement of income and expenditure on electric power results in a loss as is shown in Annex VIII. For this result, a rise in electric tariff has been applied at present and it is certain that new electric tariff will have been adopted by 1986-87 when the main transmission line will be commissioned. The average unit sales price on electric power is almost envisaged to be 65 paisa/kWH.

(4) Power Cost for Project Evaluation

Power cost at each bus which BPDB is now adopting for project evaluation is shown as Figure 10-1. If it is assumed that this proportional relation might be kept when electric tariff amounts to 65 paisa/kWH, power cost at 132kV bus, that of 33kV bus and sales prices will be calculated as follows:

$$\begin{aligned} - \text{Cost at 132kV bus} & \quad 22 \text{ paisa} \times \frac{65.0}{46.2} = 30 \text{ paisa} \\ - \text{Cost at 33kV bus} & \quad 27.5 \text{ paisa} \times \frac{65.0}{46.2} = 39 \text{ paisa} \end{aligned}$$

However, in consideration of decrease of power cost due to the east-west interconnector line, the cost at 132kV bus is determined to be 25 paisa as below explanation.

$$(30 - 5* = 25 \text{ paisa})$$

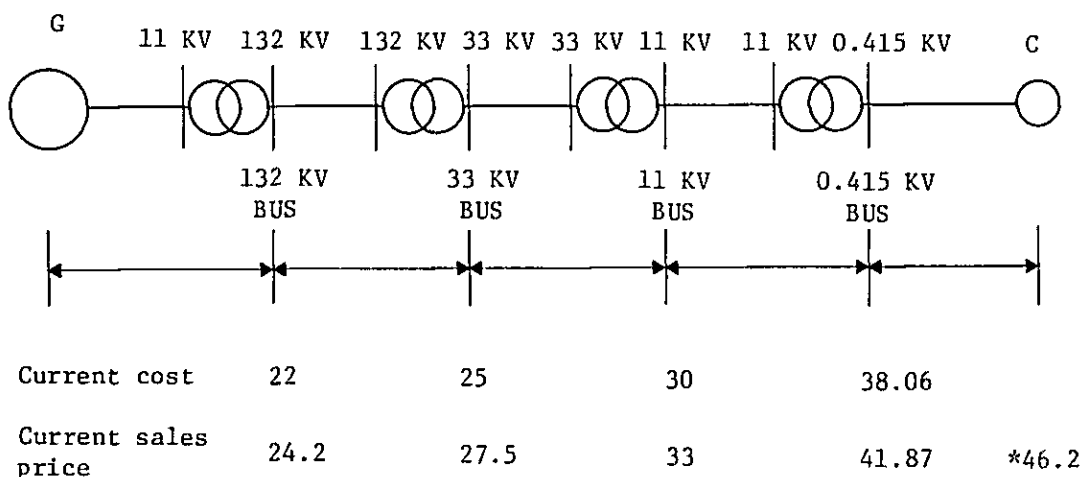
* The decrease of power cost due to east-west interconnector line.

As shown in Annex XIII, average power-generating cost in the country was 25.5 paisa during 1977-78. If one-third of the electric energy in the western grid is supplied through east-west interconnector line, its effect on power-generating cost with this supply will be:

$$25 - 20 = 5 \text{ paisa.}$$

$$\frac{(1,444,291 + \frac{468,499}{3}) \times 8.6 + \frac{468,499 \times 2}{3} \times 77.6}{1,912,790} \doteq 20 \text{ paisa}$$

Fig. X-1 Power cost at each bus



* : Calculated from Annual Report, 1977/78

2. Financial and Economic Analysis

2-1 Method of Analysis and Conditions

(1) Study Method

B/C ratio (discount rate: 15% and 4%) will be adopted.

(2) Period of Analysis

1980/81 - 2009/2010, 30 years

(3) Annual Construction Cost

a. Till 1985/86 Table 10-8 is referred.

b. After 1986/87

Future plan as below based on power flow analysis is to be involved.

- 1987/88 Additional installation of Faridpur substation
13MVA
- 1989/90 New installation of Rajbari substation 13MVA
- 1990/91 Installation of capacitor in each of three (3)
substations
- 1992/93 Duplicating of transmission line
Additional installation of Rajbari substation
13MVA
- 1998/99 New installation of Madaripur substation 13MVA
- 1999/2000 Additional installation of Faridpur substation
26MVA
- 2002/03 Additional installation of Rajbari substation
26MVA

(4) Power Demand

With regard to power demand concerned with this project, the following districts will be considered and load factor is assumed to be 50%.

- Demand for the G.K. project
- Demand for Rajbari district (at the outset, it will be
supplied from Faridpur SS)

- Demand for Faridpur district
- Demand for Madaripur district
- 25% of demand for Barisal substation
 - i) Maximum power demand (MW)
See Table X-1.
 - ii) Electric energy (GWH)
See Table X-2.

(5) Benefit and Cost

- a. Benefits: Sales revenue minus maintenance cost
Sales revenue means the difference between the cost at which the transmission line 132kV purchases electric power from power source and the sales amount at which this line sells it to the distribution line 33kV.
- b. Costs: Construction costs

2-2 Financial Analysis

(1) The Benefits and Costs On This Project

See Table X-2.

(2) B/C Ratio

See Table X-3.

- a. Discount rate 15% 0.198/1.0
- b. Discount rate 4% 0.667/1.0

2-3 Economic Analysis

(1) Deducted Items

The costs in economic analysis will be calculated by deducting below items from the costs in financial analysis.

- a. Wage of unskilled labor
Among the construction costs of transmission lines, substations and buildings, wage of unskilled labor will be deducted at 50% and the half of the wage will be restored to the society since this wage should not be paid but for the construction work.

- b. Import duties are collected at the rate of 20% at CIF price on equipment from foreign countries. Thus, this is a transfer item to the country.
- c. Commodity tax is collected at the rate of 5% of the price of domestic produced materials. This amount is also transferred to the country.
- d. Interests during the construction period.
- e. Land purchasing cost and compensation of right-of-way.

(2) Construction and Maintenance Costs after Deduction

See Table X-4.

(3) Benefit and Cost of Main Transmission Line (after deduction)

See Table VIII-5.

(4) B/C Ratio

See Table VIII-5.

a. Discount rate	15%	0.231/1.0
b. Discount rate	4%	0.771/1.0

Table X-1 Power Demand Forecast in each Area

Unit: MW

Year	G.K Project	Rajbari	Faridpur	Modaripur	Borisal	Total
1984/1985	13.5	4.2	5.1	-	-	22.8
85/86	13.5	4.9	5.9	-	-	24.3
86/87	13.5	5.7	6.8	3.7	3.5	33.2
87/88	13.5	6.6	7.9	4.3	4.1	36.4
88/89	13.5	7.6	9.2	4.9	4.8	40.0
89/90	13.5	8.9	10.6	5.7	5.5	44.2
90/91	13.5	9.9	11.8	6.3	6.1	47.6
91/92	13.5	11.0	13.1	7.0	6.8	51.4
92/93	13.5	12.2	14.5	7.8	7.6	55.6
93/94	13.5	13.5	16.1	8.7	8.4	60.2
94/95	13.5	15.0	17.9	9.6	9.3	65.3
95/96	13.5	16.1	19.2	10.3	10.0	69.1
96/97	13.5	17.2	20.5	11.0	10.6	72.8
97/98	13.5	18.4	21.9	11.8	11.4	77.0
98/99	13.5	19.7	23.4	12.6	12.2	81.4
99/2000	13.5	21.0	25.1	13.5	13.1	86.2
2000/01	13.5	22.5	26.8	14.5	14.0	91.3
01/02	13.5	23.6	28.1	15.2	14.7	95.1
02/03	13.5	24.8	29.5	16.0	15.4	99.2
03/04	13.5	26.0	31.0	16.8	16.2	103.5
04/05	13.5	27.3	32.6	17.6	17.0	108.0
05/06	13.5	28.7	34.2	18.5	17.9	112.8
06/07	13.5	30.2	35.9	19.4	18.8	117.8
07/08	13.5	31.7	37.7	20.4	19.7	123.0
08/09	13.5	33.2	39.6	21.4	20.7	128.4
09/10	13.5	34.9	41.6	22.5	21.7	134.2

Note: The growth ratios in Power Demand, except the G.K. project, are estimated as follows:

up to 89/90 16%, 90/91 - 94/95 11%,
 95/96 - 2,000/2001 7%,
 after 01/02 5%.

Table X-2 Benefit and Cost of the Project (Financial)

Year	Power Demand MW	Energy GWH	Benefit (10 ³ TK)			Cost (10 ³ TK) (Construction - Costs)
			Sales Margin (+)	Maintenance Cost (-)	Net Benefit	
79/80						6,263
80/81						9,710
81/82						154,190
82/83						104,077
83/84	21.5	94.2	13,188	5,485	7,703	141,267
84/85	22.8	99.9	13,986	8,310	5,676	114,064
85/86	30.6	134.0	18,760	10,591	8,169	
86/87	33.2	145.4	20,356	10,591	9,765	
87/88	36.4	159.4	22,316	10,591	11,725	8,390
88/89	40.0	175.2	24,528	10,759	13,769	
89/90	44.2	193.6	27,104	10,759	16,345	28,796
90/91	47.6	208.5	29,190	11,335	17,855	4,413
91/92	51.4	225.1	31,514	11,423	20,091	
92/93	55.6	243.5	34,090	11,423	22,667	93,320
93/94	60.2	263.7	36,918	13,518	23,400	
94/95	65.3	286.0	40,040	13,518	26,522	
95/96	69.1	302.7	42,378	13,518	28,860	
96/97	72.8	318.9	44,646	13,518	31,128	
97/98	77.0	337.3	47,222	13,518	33,704	
98/99	81.4	356.5	49,910	13,518	36,392	8,390
99/2000	86.2	377.6	52,864	13,686	39,178	16,782
2000/01	91.3	399.9	55,986	14,022	41,964	
01/02	95.1	416.5	58,310	14,022	44,288	
02/03	99.2	434.5	60,830	14,022	46,808	16,782
03/04	103.5	453.3	63,462	14,358	49,104	
04/05	108.0	473.0	66,220	14,358	51,862	
05/06	112.8	494.1	69,174	14,358	54,816	
06/07	117.8	516.0	72,240	14,358	57,882	
07/08	123.0	538.7	75,418	14,358	61,060	
08/09	128.4	562.4	78,736	14,358	64,378	

Table X-3 Benefit Cost Ratio (Financial)

10³ TK

Year	15% Discount Rate		4% Discount Rate	
	Net Benefit	Cost (Construction)	Net Benefit	Cost (Construction)
79/80		6,263		6,263
80/81		8,443		9,337
81/82		116,590		142,557
82/83		68,432		92,524
83/84	4,404	80,770	6,585	120,756
84/85	2,822	56,710	4,665	93,752
85/86	3,532		6,456	
86/87	3,671		7,421	
87/88	3,833	2,743	8,567	6,130
88/89	3,914		9,674	
89/90	4,040	7,118	11,042	19,454
90/91	3,838	949	11,598	2,867
91/92	3,755		12,549	
92/93	3,684	15,165	13,613	56,048
93/94	3,307		13,513	
94/95	3,259		14,727	
95/96	3,084		15,409	
96/97	2,893		15,980	
97/98	2,723		16,637	
98/99	2,557	590	17,273	3,982
99/2000	2,394	1,025	17,880	7,659
2000/01	2,230		18,415	
01/02	2,046		18,688	
02/03	1,880	674	18,991	6,809
03/04	1,715		19,157	
04/05	1,575		19,454	
05/06	1,448		19,772	
06/07	1,330		20,074	
07/08	1,220		20,362	
08/09	1,118		20,643	
Total	72,272	365,472	379,145	568,138

B/C ratio 0.198/1.0

0.667/1.0

Table X-4 Maintenance and Construction Costs
Using in Economic Analysis

10³ TK

Year	Maintenance Costs				Construction Costs					
	Sales Margin (+)	Unskilled labor cost to be reserved to social (-)	Maintenance Cost after reservation (-)	Net Benefit after reservation	Construction cost	Import duties	Taxes for locally produced material	Unskilled labor cost to be reserved to social	Total of reservation	Construction cost after reservation
79/80					6,263					6,263
80/81					9,710	243		3070	3,313	6,397
81/82					154,190	15,839	762	534	17,135	137,055
82/83					104,077	6,692	895	633	8,220	95,857
83/84	13,188	429	5,056	8,132	141,267	12,900	762	534	14,196	127,071
84/85	13,986	429	7,881	6,105	114,064	6,687	916	649	8,252	105,812
85/86	18,760	858	9,733	9,027						
86/87	20,356	858	9,733	10,623						
87/88	22,316	858	9,733	12,583	8,390	1,053	4	3	1,060	7,330
88/89	24,528	871	9,888	14,640						
89/90	27,104	871	9,888	17,216	28,796	3,445	43	32	3,520	25,276
90/91	29,190	914	10,421	18,769	4,413	496	12	9	517	3,896
91/92	31,514	921	10,502	21,012						
92/93	34,090	921	10,502	23,588	93,320	12,830	105	78	13,013	80,307
93/94	36,918	1078	12,440	24,478						
94/95	40,040	1078	12,440	27,600						
95/96	42,378	1078	12,440	29,938						
96/97	44,646	1078	12,440	32,206						
97/98	47,222	1078	12,440	34,782						
99/99	49,910	1078	12,440	37,470	8,390	1,053	4	3	1,060	7,330
99/2000	52,864	1091	12,595	40,391	16,782	2,105	8	6	2,119	14,663
2000/01	55,986	1116	12,906	43,080						
01/02	58,310	1116	12,906	45,404						
02/03	60,830	1116	12,906	47,924	16,782	2,105	8	6	2,119	14,663
03/04	63,462	1141	13,217	50,245						
04/05	66,220	1141	13,217	53,003						
05/06	69,174	1141	13,217	55,957						
06/07	72,240	1141	13,217	59,023						
07/08	75,418	1141	13,217	62,201						
08/09	78,736	1141	13,217	65,519						

*Land purchasing cost and compensation for right-of-way

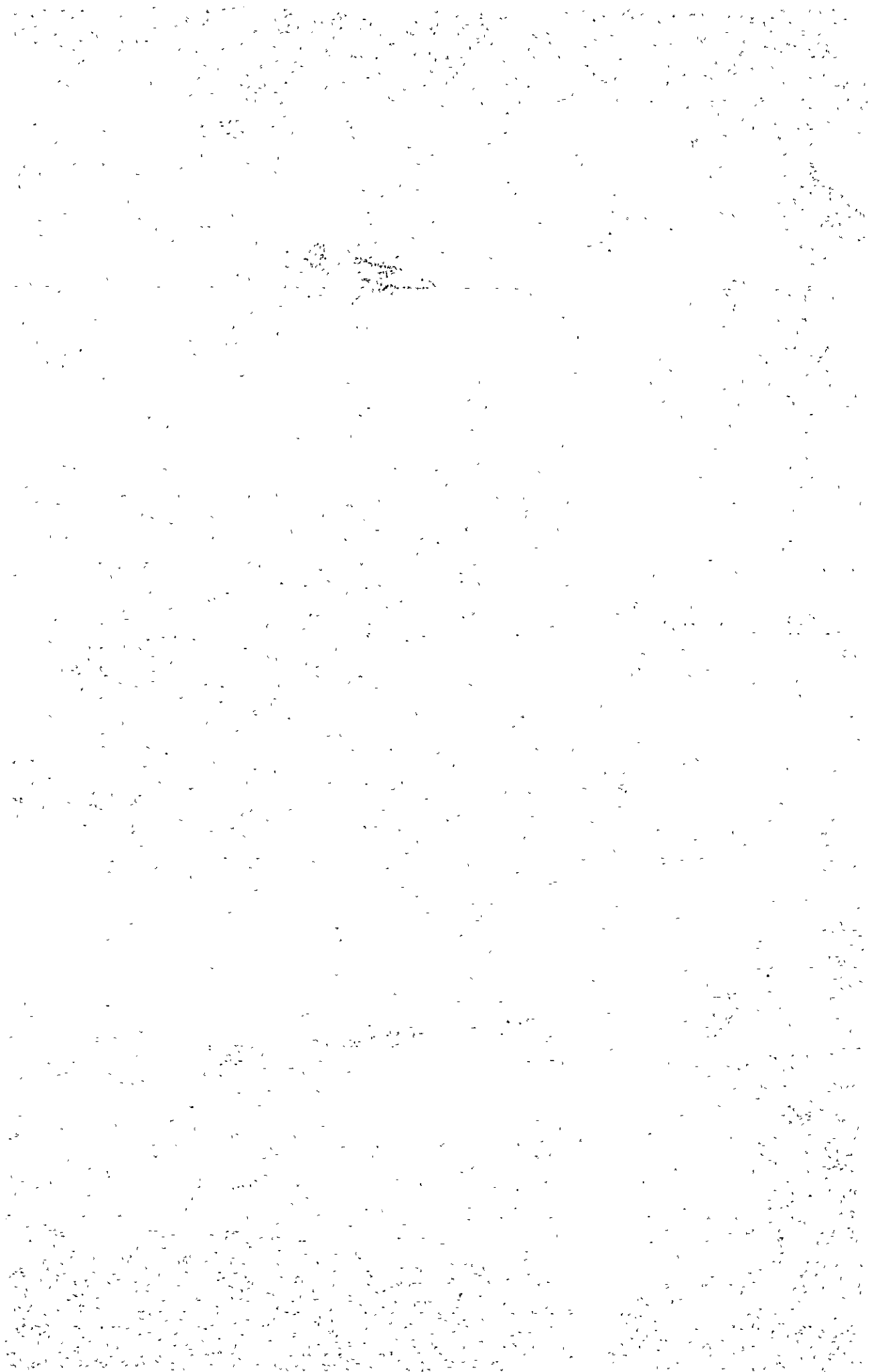
Table X-5 Benefit Cost Ratio (Economic)

Year	Net Benefit	Cost (Construction)	Present Value (15% discount)		Present Value (4% discount)	
			Benefit	Cost	Benefit	Cost
1979/80		6,263		6,263		6,263
80/81		6,397		5,563		6,151
81/82		137,055		103,633		126,715
82/83		95,857		63,028		85,217
83/84	8,132	127,071	4,649	72,653	6,951	108,621
84/85	6,105	105,812	3,035	52,607	5,018	86,970
85/86	9,027		3,903		7,134	
86/87	10,623		3,994		8,073	
87/88	12,583	7,330	4,113	2,396	9,194	5,356
88/89	14,640		4,162		10,286	
89/90	17,216	25,276	4,256	6,248	11,631	17,076
90/91	18,769	3,896	4,034	837	12,192	2,531
91/92	21,012		3,927		13,124	
92/93	23,588	80,307	3,834	13,050	14,166	48,232
93/94	24,478		3,459		14,135	
94/95	27,600		3,392		15,325	
95/96	29,938		3,199		15,984	
96/97	32,206		2,993		16,534	
97/98	34,782		2,811		17,169	
98/99	37,470	7,330	2,633	515	17,785	3,479
99/2000	40,391	14,663	2,468	896	18,434	6,692
2000/01	43,080		2,289		18,905	
01/02	45,404		2,098		19,158	
02/03	47,924	14,663	1,925	589	19,444	5,949
03/04	50,245		1,755		19,602	
04/05	53,003		1,610		19,882	
05/06	55,957		1,478		20,183	
06/07	59,023		1,356		20,470	
07/08	62,201		1,242		20,743	
08/09	65,519		1,138		21,009	
Total			75,753	328,278	392,531	509,252

B/C ratio 0.231/1.0 0.771/1.0

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