8-4 EXECUTION PLAN OF CONSTRUCTION WORKS

In accordance with the construction schedule prepared by EEA the contractors will submit the overall construction, installation programs to EEA, and will carry out the following preparatory works after EEA's approval.

8-4-1 Electric Power and Water for Construction Works

1) Electric Power for Construction Works

Since the existing high voltage distribution line is not available near the Ayun Musa site, temporary diesel engine generator will be installed for the power source for construction works. Approximately 500 kVA will be needed at the peak demand.

2) Water for Construction Works

Since there is no water source such as river, lake and industrial water near the Ayun Musa site, desalination plant will be constructed to supply water for construction works. Approximately 1,000 tons/day will be needed at the peak demand.

8-4-2 Construction Offices and Accommodations

Contractor for each works should prepare, in accordance with EEA's instructions, his construction office and accommodations for the construction workers and labors at the vacant space along the national road Route No. 66 near the power plant site and the accommodations near the New Suez Substation for the purpose of total management of the respective construction works.

8-4-3 Storage Area for Equipment and Materials

Storage area for equipment and materials required for construction works for the power plant will be arranged at the vacant spaces between the power plant site and the national road, Route No. 66, and the storage area for equipment and materials for construction works of New Suez Switchyard Station near the site, and each contractor should use the spaces as divided separately.

8-4-4 Construction Equipment

1) Equipments List

a. Common Equipment

Crane for unloading, batcher plant, concrete mixer, crawler crane, truck crane, shovel loader, forklift truck, truck, air compressor, winch and welding machine, others

b. Equipment for Power Plant

Ginpoles, pole-up equipment for generator, winch for drum lifting, others

c. Equipment for Civil Works

Dredger, floating pile driver, pile driver, dump truck, trailer, scraper, bulldozer, road roller, asphalt drying and mixing plant, surface finisher, others

d. Equipment for Architectural Works

Pile driver, concrete pump, others

e. Equipment for Electrical Works

Pile driver, cable extender, cable winding machine and jacking derrik, others

2) Vehicles, Liner and Cargo Ship

Buses, liner, cargo ship, tug boat

3) Procurement of Equipment

Equipment and materials procurable in Egypt will be used as much as possible.

The capacities and quantities of the equipment will be determined after approval by EEA of the detailed working program submitted by the contractors.

8-4-5 Construction Materials

Construction materials available in Egypt such as cement, sand, pebbles, lumber, steel and fuel will be procured in Egypt.

8-4-6 Construction Workers

1) Workers

Excepting the special technicians, skilled labors, foremen, etc. requiring high techniques and coordination among various works for the construction works of the coal fired thermal power station, Egyptian workers experienced in the thermal power plant construction works will be employed as much as possible. Common laborers will be hired in Egypt.

2) Accommodations for the Workers

Accommodations for workers will be prepared near the construction site, in accordance with the direction of EEA.

8-4-7 Equipment Transportation Plan

1) Transportation by Sea

The imported equipment and materials will be transported by sea to the Gulf of Suez.

The international port nearest to the Ayun Musa site is Suez Port. If the equipment are to be unloaded at Suez Port and transported to the site by land, they have to go through the Suez Canal crossing Ahmed Hamdi Tunnel but large sized and/or heavy equipment such as the generators, main transformers, boiler, drums, etc. cannot pass through this tunnel.

Therefore, these large and heavy equipment and materials will be unloaded directly at the site.

The equipment and materials will be transferred from the ocean-going vessels to barges in Suez Port or off shore and will be unloaded from the barges by the floating crane at the site.

A temporary unloading pier enough for a 600-ton floating crane and 1,000 ton barges will be built adjacent to the circulating water intake.

2) Land Transportation

The smaller equipment and materials unloaded at Suez Port will be transported from the port to the site by trucks and trailers.

The heavy equipment unloaded at the pier in site will be transported into respective positions with the winch and roller method.

3) Custom Clearance

The large and heavy equipment to be unloaded at the site pier will be cleared through the customs on board the ships in Suez Port, and other ordinary and small sized items will be cleared through the customs at Suez Port in the conventional manner.

4) List of Major Equipment

a. Generator Stator

- 9 m (W) x 5 m (L) x 5 m (H)
- Approx. 250 tons

b. Main Transformer

- 4 m (W) x 6 m (L) x 6 m (H)
- Approx. 200 tons

c. Boiler Drum

- 3.5 m (W) x 24 m (L) x 4 m (H)
- Approx. 150 tons

5) List of Unloading Equipment (Procurable in Egypt)

a. 600 ton class floating crane

b. 1,000 ton class barge

c. Tug boat (no need in case of self-driven barge)

d. 35 ton class truck crane

This transportation plan has been prepared based on the assumption and estimations in availability for ship transportation, custom clearance and heavy construction equipment, therefore, these should be confirmed by further study of actual site situation.

8-4-8 Construction Works

Prior to the start of the construction works, the contractor will prepare the detailed actual survey map of the plot, and carry out the test piling, loading test and concrete test, etc. so that the construction works may be executed precisely and smoothly.

1) Civil Works

a. Civil Works for Power Plant

a) Temporary access road for construction works will be constructed from the national road, Route No. 66 to the power plant site.

b) Batcher plant, temporary generating facilities and desalination plant, water distribution head tank, and pipings as well as worker's accommodations and construction offices will be constructed and installed.

c) Sand and pebbles for land reclamation will be used for causeway, inlet and outlet of circulating water facilities and temporary road for wharf. Land reclamation works will be conducted in order of powerhouse, coal storage yard and oil tank yard.

d) As for the construction works for circulating water facilities, seaside inlet and outlet points of the facilities will be shut off by steel sheet piles and then open channel will be constructed, and the works for water intake pit will be conducted by temporary shutting off by steel sheet piles.

Transmission piping works will be installed from power plant side to seaside and discharge piping works from seaside to power plant side instantaneously, respectively.

e) Oil storage tank foundation and oil dyke will be constructed following the above works.

f) Construction works for coal handling and unloading facilities and coal storage yard will be conducted in the end.

g) Construction works for bulkhead of ash disposal area and harbor facilities will be conducted at the same time when the construction works for circulating water facilities begin.

h) Construction and erection works for foundation of lighting pole, ash sluicing piping, cable trench, foundation of oil supply piping, neutralization pond, other tanks, desalination plant, etc. will be conducted after the land reclamation.

i) Station road, greening and gardening, bebble spreading will be conducted after the completion of all of the buildings and structures.

b. Harbor Facilities

a) Coal unloading wharf

Steel pipe piles of 900 ø x 16 t will be driven to a solid bearing stratum by a large pile driving barge, and after the piling is finished, the timbering and scaffolding works are made and then the top bed will be constructed. The concrete will be transported by sea on material transport boats from the batcher plant in the block yard.

Rubblestones will be thrown in between the piles from the carrier boats with grab buckets, and will be finished with a slope of 1:3 by divers.

b) Oil unloading wharf and small vessels wharf

The bed will be dredged carefully by the Pristman dredger and rubblestones will be thrown in from the carrier boats with grab buckets. And after the rubble stones are leveled by divers, the blocks manufactured in the block yard will be transported by material boats and set in place by divers. The front face will be covered solidly with armor stones. The top will be finished with concrete transported from the batcher plant.

c) Dredging Work

The dredging work will be executed by 5,000 - 8,000 PS pump dredgers, after the pipelines are prepared. The dredging volume will be 3,900,000 m^3 (anchorage: 2,700,000 m^3 and waterway: 1,200,000 m^3).

In this case, the area in front of the coal unloading wharf will be dredged first in consideration of the piling work, and then the dredging will be carried out in the order of the channel and the basin.

d) Causeway

To economize the construction cost, the bed of the causeway between the power plant and the berth will be filled with good quality dredged soil up to EL +1 m and the excavated land soil will be filled on it, and then the stone-pitched embankment and parapet will be made. The pavement will be made to finish the road. The volume of dredged soil and the filling requirement are nearly balanced.

e) Others

After the dredging work is completed, the navigational aids, anchorage buoys and range lights will be installed.

2) Architectural Works

a. After land reclamation works for powerhouse, the powerhouse will be constructed in the order of foundation works, reinforcement, formwork, concrete works interior finishing and painting works.

b. Construction works for appurtenant building and equipment foundations will be conducted in parallel with the construction works of powerhouse or in accordance with separate construction schedule.

3) Mechanical Works

a. After the concrete works for the powerhouse, some parts of turbine and boiler will be hauled in, erected and fabricated in the powerhouse.

b. After the foundation works for outdoor equipment, boiler structure will be constructed and equipment will be hauled in and installed.

c. As for boiler proper, drum lifting will be conducted at first, and then the boiler will be fabricated in order of upper parts and lower parts. After completion of major structures, erection works for auxiliary equipment, ducts and pipings will be conducted.

d. After completion of foundation works, coal handling and unloading facilities will be carried in and fabricated.

e. After completion of foundation works for auxiliaries, auxiliary equipment and tanks will be carried in and fabricated.

4) Electrical and Instrumentation Works

a. Cabling works will be conducted with the advance of civil and architectural works.

b. After the completion of equipment installation, cable connections with equipment terminals will be conducted.

c. After the completion of foundation works for switching station and New Suez Switchingyard Station, the frame works fabrication and erection will be conducted.

d. After the fabrication, overhead connection works will be conducted, and then various tests will be conducted.

5) Transmission Line Works

a. Upon the completion of foundations works for transmission towers, the transmission towers will be fabricated and erected.

b. After the erection, overhead conductors will be extended and then various tests will be conducted.

6) Preparatory before Test Operations

a. At first, connection checks, installation of instruments and control devices, alarm and interlock tests will be conducted.

b. Station auxiliary power buses will be energized after the measurement of insulation resistance and dielectric tests for transformers, generator, high and low voltage auxiliary machines and circuit breakers are completed in accordance with the insulation classes.

c. Upon the completion of dielectric tests for respective auxiliary machines, tests and fine tuning will be conducted.

d. After the completion of auxiliary mechanical equipment, leak tests and hydraulic pressure tests will be conducted for the respective system, and then pipings will be flushed out with fresh water and finally heat insulation and painting works will be conducted.

e. For turbine and generator, oil flushing will be conducted, in addition leak test will be conducted for the generator.

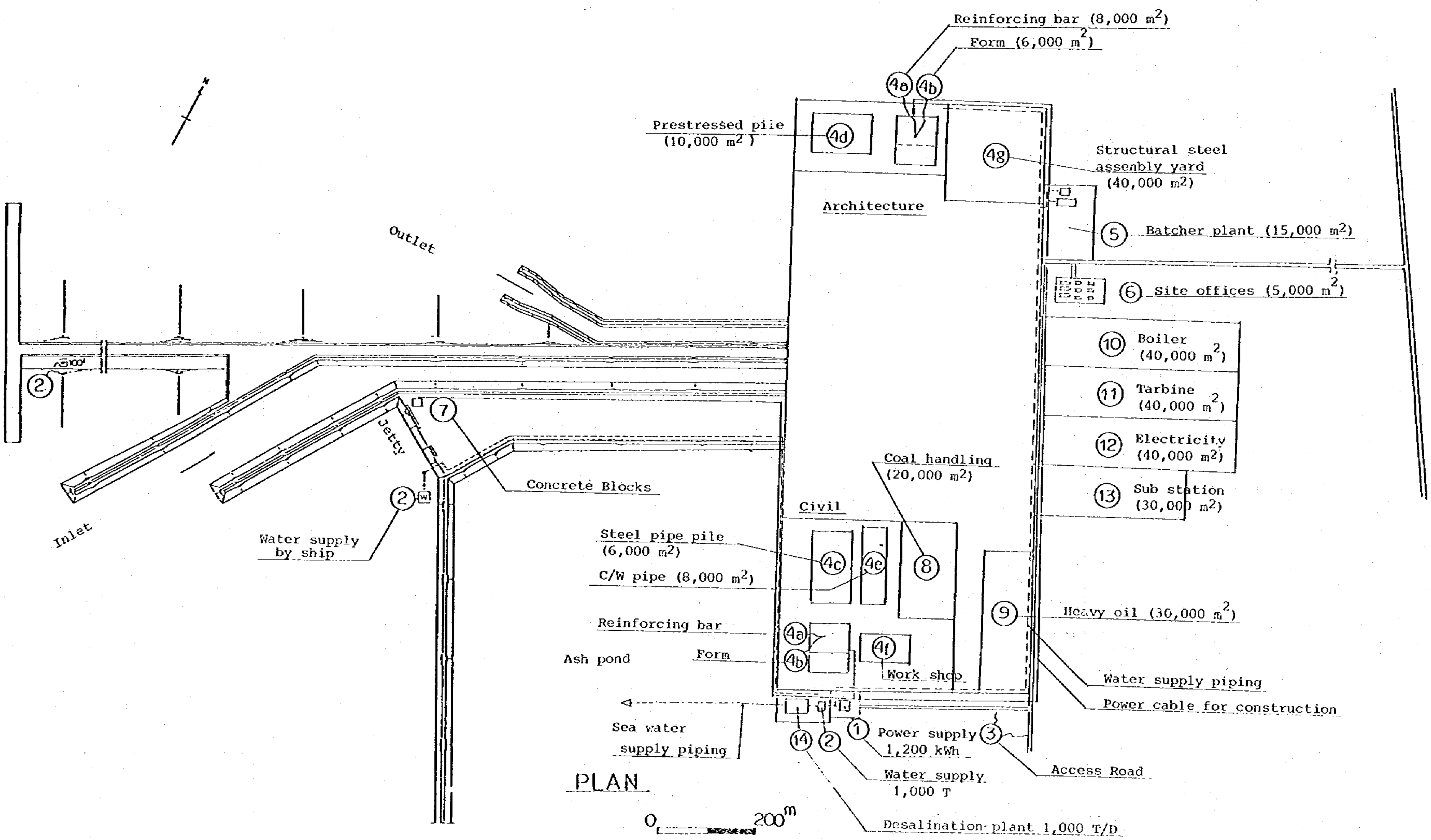
f. When the initial boiler firing is conducted blowing out and chemical cleaning for pipings and tubes will be conducted instantaneously prior to turbine drive test.

g. After the above flushing, boiler will be pressurized to conduct the tests on the safety valves.

7) Overall Trial Operation

After the confirmation of no abnormality on all the equipment by the boiler pressurization, silica purge, turbine drive test, etc., the overall trial operation will be conducted.

Fig. 8-2 TEMPORARY FACILITIES PLOT PLAN



CHAPTER 9

PROCUREMENT PROGRAM FOR THE PROJECT

(1st Stage 300 MW x 2 Units)

CHAPTER 9 PROCUREMENT PROGRAM FOR THE PROJECT

9-1 PROCUREMENT PROGRAM

With regard to the development time for this Coal-fired Thermal Power Project, commissioning of the first unit by August 1988 and the second unit by January 1989 is required.

As financing sources for the Project, an Egyption Government fund, a private fund, a government-to-government fund from foreign country, a found by suppliers' credit, etc. are considered. Since the Project implementation is urgently required, several funding conditions like required period and procedures, interest rates, disbursement conditions, etc. must be carefully studied, and optimum financing sources satisfying the project construction schedule should be sought for.

1) Since the required fund for the Project is so big that recovery of the capital will take a remarkably long period, a long-term loan with a low interest rate is required. Therefore, the required fund is divided into two portions; foreign currency (FC) and local currency (LC) portions, and the study was made on assumption that the foreign currency will be borrowed from foregin countries on the government-to-government basis or from international financing institutions, while the local currency will be made available by a financial institutes in Egypt which the government agencies normally use. And the Project scale is so big with a long construction period that the procurement program is studied dividing into three phases.

2) Terms of Loan

a. Foreign Currency

The proportion of the foreign currency portion is assumed that 80% of FC will be loaned with an interest rate of 4% per annum, and repayment over 30 years including a grace period of 5 years, and 20% of FC with an interest rate of 9% per annum and repayment over 15 years including a grace period of 5 years. And as to the repayment method, the principal and interest during construction will be deferred for 5 years, and after completion of the Project, the principal and interest (including the interest on the principal and the interest on the interest deferred during construction) will be repaid in equal installments.

b. Local Currency

An applicable interest rate of the local currency is assumed to be 8% per annum. And it is assumed that a 3-year grace period for repayment of principal and interest during construction is granted and the repayment of principal and interest (including the interest on the principal and the interest on the interest deferred during construction) is made in equal installments for 12 years.

*Note: In procurement of foreign currency portion for the Project, 80% of the portion could be borrowed with a soft loan and 20% with a hard loan.

	Interest(%)	Repayment Period
Soft loan	4 %	30 years including a grace period of 5 years
Hard loan	9 %	15 years including a grace period of 5 years

9-2 FINANCIAL ANALYSIS

9-2-1 Method of Analysis

The financial conditions of the Project is analyzed by making comparison of the present costs between the total capital invested to the Project and sales revenue of electricity generated by the Project. The process of analysis is as follows:

1) An equalizing discount rate (so-called a financial internal rate of return), with which the present value of the total cost of the Project including operating expenses and the total sales revenue of electricity could be equalized, it calculated. And the financial feasibility of the Project is evaluated by making comparison between the obtained discount rate and EEA's targeted discount rate of 12%.

2) Based on the assumed conditions for fund procurement, the following items of analysis are made:

   a. Preparation of repayment schedule

   b. Preparation of statement of income

   c. Cash flow analysis

9-2-2 Conditions for Analysis

1) Electricity Tariff

In Egypt, electricity is sold to consumers at a extremely low price at present. According to the EEA's policy, however, the rise of tariff is now planned and the current tariff will be increased to 15.666 mill./kWh in 1983/1984, 26.709 mill./kWh in 1986/1987, and reach 28.85 mill./kWh in 1987/1988, 31.15 mill./kWh in 1988/1989 and 33.64 mill./kWh in 1989/1990 if the escalation rate after 1986/1987 is assumed to be 8%. Although the new proposed tariff has not yet approved by the government, it is anticipated that the new proposed tariff will be effective by the year of commissioning of the Project.

Therefore, in order to estimate electricity sales revenue of the project, the new proposed tariff in 1988/1989 and 1989/1990 are applied in the analysis.

2) Price Escalation

It is expected that both the electricity tariff and the running costs of the project after commissioning of the project will rise as price of general commodities rise. However, the price rise of commodities will equally affects to the revenue and expenses in operation of the Project. Such an inflational trend except electricity tariff by 1990 is not considered in this financial analysis.

3) Coal Price

Since the EEA's new tariff system is planned with subsidized oil price (Mazout: 7.5 LE/ton), the subsidized coal price is also used for the financial analysis of the Project. With a proportion of oil and coal prices per Kcal, the subsidized coal price as an upper limit of the price is obtained as follows:

$$7.5 \text{ LE/ton} \times \frac{6{,}500 \text{ kcal/kg}}{10{,}000 \text{ kcal/kg}} = 4.9 \text{ LE/ton}$$

The price above is used for the financial analysis of the Project as an upper limit of of coal price. The value is still considered to be conservative one.

By appropriating the oil equivalent to the coal used by the Project for additional export, the Ministry of Petroleum could save about 71.1 million L.E. annually. On the other hand with such a surplus, EEA could cope with the increase of both the capital cost and operation and maintenance cost by constructing the coal-fired thermal power plants instead of oil-fired plants. Hence, EEA proposes to be compensated the amount for the increase in operation and maintenance cost and depreciation.

4) Allocation of Electricity Sales Revenue to Generation Sector

The electricity tariff is established to cover production costs such as generating cost, transmission and substation costs, administration cost and financial expenses (interest).

In the case of Egypt, component ratio of generation cost, transmission and transforming cost and distribution cost in the total supply cost of electricity is roughly allocated as follows:

- Generation cost	70%
- Transmission and substation cost	15%
- Distribution cost	15%
Total	100%

Note: Common expenses (administration cost, financial cost, etc.) are allocated to generating, transmission and substation according to their respective values of fixed assets.

5) Average Rate per Unit Sold

The overall average rate per unit sold in the new proposed tariff is as follows:

1987/88	28.846 mill./kWh
1988/89	31.154 mill./kWh
1989/90	33.646 mill./kWh

6) Operating Revenue (Energy Sales Revenue)

Salable annual energy will be 3,700,224 MWh by 300 MW x 2 units and annual energy sales revenue in each year will be as follows:

Table 9-1 Salable Energy and Revenue

	Capacity	1988	1989 -2017	2018	Remark
Annual Operating Hour	No.1 320MW	4,665		2,342	.Utilization factor for Generation ; 80%
	No.2 320MW	1,133	7,008	5,875	
Total	640MW	5,798	203,232	8,217	
Annual Sending End Energy at P/S Tr. End (Gwh)	No.1 300MW	1,400		703	.Utilization factor for Generation ; 80% .Transmission and Distribution loss ; 12%
	No.2 300MW	340	4,205	1,762	
Total	600MW	1,740	121,945	2,465	
Annual Salable Energy at Consumer End (GWh)	No.1 300MW	1,232		619	
	No.2 300MW	299	3,700	1,550	
	Subtotal	1,531	107,300	2,169	
Sales Rate (Mill./kWh) (Generation Portion)	-	21.81	23.55	23.55	
Annual Revenue (Million L.E)	No.1 300MW	26.870		14.577	
	No.2 300MW	6.521	87.135	36.503	
Total	600MW	33.391	2,526.915	51.080	

7) Cost

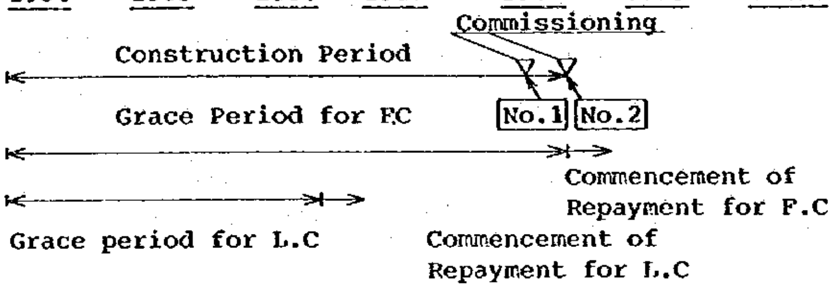
a. Construction Cost

Construction cost and interest during construction are shown in Table 9-2.

Table 9-2 Construction Cost and Interest During Construction

(Unit: x 10^6 LE)

Schedule



Fiscal Year	1984	1985	1986	1987	1988	1989	Total
Construction Cost							
FC	4.0	54.0	121.6	183.9	58.7	13.2	435.4
LC	1.2	8.2	19.0	29.5	15.9	1.2	75.0
Total	5.2	62.2	140.6	213.4	74.6	14.4	510.4
***Interest During Construction**							
FC						54.1	54.1
LC				3.2			3.2
Total				3.2		54.1	57.3
Total							
FC	4.0	54.0	121.6	183.9	58.7	67.3	489.5
LC	1.2	8.2	19.0	32.7	15.9	1.2	78.2
Grand Total	5.2	62.2	140.6	216.6	74.6	68.5	567.7

It is noted that the figures in the interest during consutruction are accumulated amount of the compound interest during the construction.

b. Annual Operation/Maintenance Cost and Administrative Expenses

Annual Operation/maintenance cost: 2% of the construction cost

$$LE\ 510.4 \times 10^6 \times 0.02 = LE\ 10.2 \times 10^6$$

Administration cost : 0.5% of the construction cost

$$LE\ 510.4 \times 10^6 \times 0.005 = LE\ 2.6 \times 10^6$$

c. Fuel Cost

Annual energy generation at generator end will be 4,485,120 MWh, and annual fuel cost will be calculated as follows.

(Refer to page 9-4).

$$\frac{2{,}205\ kcal/kWh}{6{,}500\ kcal/kg} \times 4.9\ LE/ton \times 4{,}485{,}120\ MWh$$

$$= LE\ 7.5 \times 10^6\ (1.66\ mill./kWh)$$

d. Depreciation Cost

Depreciation is calculated on the construction cost which includes interest during construction, without residual value.

Therefore, the depreciation cost of this project will be as follows:

$$LE\ \frac{567.7 \times 10^6}{30} = LE\ 18.9 \times 10^6\ \text{(Durable Year: 30 years)}$$

9-3 RESULT OF ANALYSIS

9-3-1 Equalizing Discount Rate (FIRR)

As shown in Table 9-3, the equalizing discount rate (FIRR) derived from the above figures is 11.29%.

9-3-2 Analysis of Cashflow Statement

1) Fund Procurement and Repayment Schedule

The Repayment schedule for foreign and local currencies is shown in Table 9-4.

2) Statement of Income

Operating revenue (energy sales revenue), operating expenses (Operation and maintenance cost, administrative expense and depreciation) and financial expense (interest) are shown in Table 9-5.

3) Analysis of Cashflow Statement

Table 9-6 shows incoming cashflow (net income, fund procurement and depreciation) and outgoing cashflow (capital expenditures and repayment of principal), and cash balance of each year is also shown in this table.

Difference between incoming and outgoing cashflow is surplus. The project keeps the black from the year of commissioning, and the reserve accumulated during the service life of the Project amounts to 1,099 million LE as shown in Table 9-6.

4) Conclusion

Sinai Coal-fired Thermal Power Project is concluded to be feasible from the view point of financial aspect as follows.

a. Obtained equalizing discount rate (11.29%) is near the EEA's targeted discount rate of 12% for financial evaluation.

b. Cashflow balance in surplus will be secured on and after the commissioning year.

. Discount rate 11% 12%
. Revenue/cost 1.0240 0.9399
.'. Revenue/cost = 1.00 ; Discount rate = 11.29%

Table 9 - 3 Equalizing Discount Rate
(Financial Internal Rate of Return)

(EDR =11.29 (%)) (UNIT : x 10^3 L.E.)

No. of Year	Fiscal Year	Project Cost (A)	Operating Expenses Total (Excl.Depre.Cost) (B)	Operating Revenue (C)	Balance (D)=C-(A+B)	<< PRESENT WORTH >>					
						Disc.Rate 11.0(%) (E)	Value		Disc.Rate 12.0(%) (E)'	Value	
							Investment (F)=A*E	Benefit (G)=(C-B)*E		Investment (F)'=A*E'	Benefit (G)=(C-B)*E'
0	1984	5,200	0	0	-5,200	1.000000	5,200	0	1.000000	5,200	0
1	1985	62,200	0	0	-62,200	0.900901	56,036	0	0.892857	55,536	0
2	1986	140,600	0	0	-140,600	0.811622	114,114	0	0.797194	112,085	0
3	1987	213,400	0	0	-213,400	0.731191	156,036	0	0.711781	151,894	0
4	1988	74,600	8,390	33,391	-49,599	0.658731	49,141	16,469	0.635518	47,410	15,889
5	1989	14,400	20,300	87,135	52,435	0.593451	8,546	39,663	0.567427	8,171	37,924
6	1990	0	20,300	87,135	66,835	0.534641	0	35,733	0.506632	0	33,861
7	1991	0	20,300	87,135	66,835	0.481658	0	32,192	0.452350	0	30,233
8	1992	0	20,300	87,135	66,835	0.433926	0	29,001	0.403884	0	26,994
9	1993	0	20,300	87,135	66,835	0.390924	0	26,127	0.360611	0	24,101
10	1994	0	20,300	87,135	66,835	0.352184	0	23,538	0.321974	0	21,519
11	1995	0	20,300	87,135	66,835	0.317283	0	21,206	0.287477	0	19,213
12	1996	0	20,300	87,135	66,835	0.285841	0	19,104	0.256676	0	17,155
13	1997	0	20,300	87,135	66,835	0.257514	0	17,211	0.229175	0	15,317
14	1998	0	20,300	87,135	66,835	0.231995	0	15,505	0.204620	0	13,676
15	1999	0	20,300	87,135	66,835	0.209004	0	13,969	0.182697	0	12,211
16	2000	0	20,300	87,135	66,835	0.188292	0	12,584	0.163122	0	10,902
17	2001	0	20,300	87,135	66,835	0.169632	0	11,337	0.145645	0	9,734
18	2002	0	20,300	87,135	66,835	0.152822	0	10,214	0.130040	0	8,691
19	2003	0	20,300	87,135	66,835	0.137677	0	9,202	0.116107	0	7,760
20	2004	0	20,300	87,135	66,835	0.124034	0	8,290	0.103667	0	6,929
21	2005	0	20,300	87,135	66,835	0.111742	0	7,468	0.092560	0	6,186
22	2006	0	20,300	87,135	66,835	0.100669	0	6,728	0.082643	0	5,523
23	2007	0	20,300	87,135	66,835	0.090692	0	6,061	0.073788	0	4,932
24	2008	0	20,300	87,135	66,835	0.081705	0	5,461	0.065882	0	4,403
25	2009	0	20,300	87,135	66,835	0.073608	0	4,920	0.058824	0	3,931
26	2010	0	20,300	87,135	66,835	0.066313	0	4,432	0.052521	0	3,510
27	2011	0	20,300	87,135	66,835	0.059742	0	3,993	0.046894	0	3,134
28	2012	0	20,300	87,135	66,835	0.053821	0	3,597	0.041869	0	2,798
29	2013	0	20,300	87,135	66,835	0.048488	0	3,241	0.037383	0	2,499
30	2014	0	20,300	87,135	66,835	0.043683	0	2,920	0.033378	0	2,231
31	2015	0	20,300	87,135	66,835	0.039354	0	2,630	0.029802	0	1,992
32	2016	0	20,300	87,135	66,835	0.035454	0	2,370	0.026609	0	1,778
33	2017	0	20,300	87,135	66,835	0.031940	0	2,135	0.023758	0	1,588
34	2018	0	11,920	51,080	39,160	0.028775	0	1,127	0.021212	0	831
TOTAL		510,400	609,010	2,611,386	1,491,976	---	389,073	398,428	---	380,296	357,445
							9,354			-22,851	

Table 9 - 4 Repayment Schedule

No. or Year	Fiscal Year	Fund Requirement			Repayment Schedule														
					Foreign Currency 1 (4.0%)				Foreign Currency 2 (9.0%)				Foreign Currency Total				Local Currency (8		
		Foreign Currency	Local Currency	Total	Principal	Interest	Total	Outstanding Balance	Principal	Interest	Total	Outstanding Balance	Principal	Interest	Total	Outstanding Balance	Principal	Interest	Total
0	1984	4.00	1.20	5.20	0.00	(0.69)	(0.69)	0.00	0.00	(0.43)	(0.43)	0.00	0.00	(1.12)	(1.12)	0.00	0.00	(0.31)	(0.
1	1985	54.00	8.20	62.20	0.00	(7.34)	(7.34)	0.00	0.00	(4.45)	(4.45)	0.00	0.00	(11.78)	(11.78)	0.00	0.00	(1.36)	(1.
2	1986	121.60	19.00	140.60	0.00	(12.15)	(12.15)	0.00	0.00	(7.18)	(7.18)	0.00	0.00	(19.32)	(19.32)	0.00	0.00	(1.52)	(1.
3	1987	183.90	29.50	213.40	0.00	(12.00)	(12.00)	0.00	0.00	(6.92)	(6.92)	0.00	0.00	(18.92)	(18.92)	0.00	4.12	6.26	10.
4	1988	58.70	15.90	74.60	0.00	(1.88)	(1.88)	382.38	0.00	(1.06)	(1.06)	107.11	0.00	(2.93)	(2.93)	489.49	4.45	5.93	10.
5	1989	13.20	1.20	14.40	9.18	15.30	24.48	373.20	7.05	9.64	16.69	100.06	16.23	24.94	41.17	473.26	4.81	5.57	10.
6	1990	0.00	0.00	0.00	9.55	14.93	24.48	363.65	7.68	9.01	16.69	92.37	17.23	23.94	41.17	456.02	5.19	5.19	10.
7	1991	0.00	0.00	0.00	9.93	14.55	24.48	353.72	8.38	8.31	16.69	84.00	18.31	22.86	41.17	437.72	5.61	4.77	10.
8	1992	0.00	0.00	0.00	10.33	14.15	24.48	343.39	9.13	7.56	16.69	74.87	19.46	21.71	41.17	418.26	6.05	4.33	10.
9	1993	0.00	0.00	0.00	10.74	13.74	24.48	332.65	9.95	6.74	16.69	64.92	20.69	20.48	41.17	397.57	6.54	3.84	10.
10	1994	0.00	0.00	0.00	11.17	13.31	24.48	321.48	10.85	5.84	16.69	54.07	22.02	19.15	41.17	375.55	7.06	3.32	10.
11	1995	0.00	0.00	0.00	11.62	12.86	24.48	309.86	11.82	4.87	16.69	42.25	23.44	17.73	41.17	352.11	7.63	2.75	10
12	1996	0.00	0.00	0.00	12.08	12.40	24.48	297.78	12.89	3.80	16.69	29.36	24.97	16.20	41.17	327.14	8.24	2.14	10
13	1997	0.00	0.00	0.00	12.57	11.91	24.48	285.21	14.05	2.64	16.69	15.31	26.62	14.55	41.17	300.52	8.90	1.48	10
14	1998	0.00	0.00	0.00	13.07	11.41	24.48	272.14	15.31	1.38	16.69	0.00	28.38	12.79	41.17	272.14	9.60	0.78	10
15	1999	0.00	0.00	0.00	13.59	10.89	24.48	258.55	0.00	0.00	0.00	0.00	13.59	10.89	24.48	258.55	0.00	0.00	0
16	2000	0.00	0.00	0.00	14.13	10.35	24.48	244.42	0.00	0.00	0.00	0.00	14.13	10.35	24.48	244.42	0.00	0.00	0
17	2001	0.00	0.00	0.00	14.70	9.78	24.48	229.72	0.00	0.00	0.00	0.00	14.70	9.78	24.48	229.72	0.00	0.00	0
18	2002	0.00	0.00	0.00	15.29	9.19	24.48	214.43	0.00	0.00	0.00	0.00	15.29	9.19	24.48	214.43	0.00	0.00	0
19	2003	0.00	0.00	0.00	15.90	8.58	24.48	198.53	0.00	0.00	0.00	0.00	15.90	8.58	24.48	198.53	0.00	0.00	0
20	2004	0.00	0.00	0.00	16.54	7.94	24.48	181.99	0.00	0.00	0.00	0.00	16.54	7.94	24.48	181.99	0.00	0.00	0
21	2005	0.00	0.00	0.00	17.20	7.28	24.48	164.80	0.00	0.00	0.00	0.00	17.20	7.28	24.48	164.80	0.00	0.00	0
22	2006	0.00	0.00	0.00	17.89	6.59	24.48	146.91	0.00	0.00	0.00	0.00	17.89	6.59	24.48	146.91	0.00	0.00	0
23	2007	0.00	0.00	0.00	18.60	5.88	24.48	128.31	0.00	0.00	0.00	0.00	18.60	5.88	24.48	128.31	0.00	0.00	0
24	2008	0.00	0.00	0.00	19.34	5.14	24.48	108.97	0.00	0.00	0.00	0.00	19.34	5.14	24.48	108.97	0.00	0.00	0
25	2009	0.00	0.00	0.00	20.12	4.36	24.48	88.85	0.00	0.00	0.00	0.00	20.12	4.36	24.48	88.85	0.00	0.00	0
26	2010	0.00	0.00	0.00	20.92	3.56	24.48	67.92	0.00	0.00	0.00	0.00	20.92	3.56	24.48	67.92	0.00	0.00	0
27	2011	0.00	0.00	0.00	21.76	2.72	24.48	46.16	0.00	0.00	0.00	0.00	21.76	2.72	24.48	46.16	0.00	0.00	0
28	2012	0.00	0.00	0.00	22.63	1.85	24.48	23.53	0.00	0.00	0.00	0.00	22.63	1.85	24.48	23.53	0.00	0.00	0
29	2013	0.00	0.00	0.00	23.53	0.95	24.48	0.00	0.00	0.00	0.00	0.00	23.53	0.95	24.48	0.00	0.00	0.00	0
30	2014	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
31	2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
32	2016	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
33	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
34	2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Total		435.40	75.00	510.40	382.38	229.62	612.00	---	107.11	59.79	166.90	---	489.49	289.41	778.90	---	78.20	46.36	124

Table 9 - 4 Repayment Schedule

(UNIT: Million L.E.)

	Repayment Schedule																			
	Foreign Currency 1 (4.0%)				Foreign Currency 2 (9.0%)				Foreign Currency Total				Local Currency (8.0%)				Total			
	Principal	Interest	Total	Outstanding Balance	Principal	Interest	Total	Outstanding Balance	Principal	Interest	Total	Outstanding Balance	Principal	Interest	Total	Outstanding Balance	Principal	Interest	Total	Outstanding Balance
0	0.00	(0.69)	(0.69)	0.00	0.00	(0.43)	(0.43)	0.00	0.00	(1.12)	(1.12)	0.00	0.00	(0.31)	(0.31)	0.00	0.00	(1.43)	(1.43)	0.00
0	0.00	(7.34)	(7.34)	0.00	0.00	(4.45)	(4.45)	0.00	0.00	(11.78)	(11.78)	0.00	0.00	(1.36)	(1.36)	0.00	0.00	(13.14)	(13.14)	0.00
0	0.00	(12.15)	(12.15)	0.00	0.00	(7.18)	(7.18)	0.00	0.00	(19.32)	(19.32)	0.00	0.00	(1.52)	(1.52)	78.20	0.00	(20.84)	(20.84)	567.69
0	0.00	(12.00)	(12.00)	0.00	0.00	(6.92)	(6.92)	0.00	0.00	(18.92)	(18.92)	0.00	4.12	6.26	10.38	74.08	4.12	6.26	10.38	563.57
0	0.00	(1.88)	(1.88)	382.38	0.00	(1.06)	(1.06)	107.11	0.00	(2.93)	(2.93)	489.49	4.45	5.93	10.38	69.63	4.45	5.93	10.38	559.12
0	9.18	15.30	24.48	373.20	7.05	9.64	16.69	100.06	16.23	24.94	41.17	473.26	4.81	5.57	10.38	64.82	21.04	30.51	51.55	538.08
00	9.55	14.93	24.48	363.65	7.68	9.01	16.69	92.37	17.23	23.94	41.17	456.02	5.19	5.19	10.38	59.63	22.42	29.13	51.55	515.65
00	9.93	14.55	24.48	353.72	8.38	8.31	16.69	84.00	18.31	22.86	41.17	437.72	5.61	4.77	10.38	54.02	23.92	27.63	51.55	491.74
00	10.33	14.15	24.48	343.39	9.13	7.56	16.69	74.87	19.46	21.71	41.17	418.26	6.05	4.33	10.38	47.97	25.51	26.04	51.55	466.23
00	10.74	13.74	24.48	332.65	9.95	6.74	16.69	64.92	20.69	20.48	41.17	397.57	6.54	3.84	10.38	41.43	27.23	24.32	51.55	439.00
00	11.17	13.31	24.48	321.48	10.85	5.84	16.69	54.07	22.02	19.15	41.17	375.55	7.06	3.32	10.38	34.37	29.08	22.47	51.55	409.92
00	11.62	12.86	24.48	309.86	11.82	4.87	16.69	42.25	23.44	17.73	41.17	352.11	7.63	2.75	10.38	26.74	31.07	20.48	51.55	378.85
00	12.08	12.40	24.48	297.78	12.89	3.80	16.69	29.36	24.97	16.20	41.17	327.14	8.24	2.14	10.38	18.50	33.21	18.34	51.55	345.64
00	12.57	11.91	24.48	285.21	14.05	2.64	16.69	15.31	26.62	14.55	41.17	300.52	8.90	1.48	10.38	9.60	35.52	16.03	51.55	310.12
00	13.07	11.41	24.48	272.14	15.31	1.38	16.69	0.00	28.38	12.79	41.17	272.14	9.60	0.78	10.38	0.00	37.98	13.57	51.55	272.14
00	13.59	10.89	24.48	258.55	0.00	0.00	0.00	0.00	13.59	10.89	24.48	258.55	0.00	0.00	0.00	0.00	13.59	10.89	24.48	258.55
00	14.13	10.35	24.48	244.42	0.00	0.00	0.00	0.00	14.13	10.35	24.48	244.42	0.00	0.00	0.00	0.00	14.13	10.35	24.48	244.42
00	14.70	9.78	24.48	229.72	0.00	0.00	0.00	0.00	14.70	9.78	24.48	229.72	0.00	0.00	0.00	0.00	14.70	9.78	24.48	229.72
00	15.29	9.19	24.48	214.43	0.00	0.00	0.00	0.00	15.29	9.19	24.48	214.43	0.00	0.00	0.00	0.00	15.29	9.19	24.48	214.43
00	15.90	8.58	24.48	198.53	0.00	0.00	0.00	0.00	15.90	8.58	24.48	198.53	0.00	0.00	0.00	0.00	15.90	8.58	24.48	198.53
00	16.54	7.94	24.48	181.99	0.00	0.00	0.00	0.00	16.54	7.94	24.48	181.99	0.00	0.00	0.00	0.00	16.54	7.94	24.48	181.99
00	17.20	7.28	24.48	164.80	0.00	0.00	0.00	0.00	17.20	7.28	24.48	164.80	0.00	0.00	0.00	0.00	17.20	7.28	24.48	164.79
00	17.89	6.59	24.48	146.91	0.00	0.00	0.00	0.00	17.89	6.59	24.48	146.91	0.00	0.00	0.00	0.00	17.89	6.59	24.48	146.90
00	18.60	5.88	24.48	128.31	0.00	0.00	0.00	0.00	18.60	5.88	24.48	128.31	0.00	0.00	0.00	0.00	18.60	5.88	24.48	128.30
.00	19.34	5.14	24.48	108.97	0.00	0.00	0.00	0.00	19.34	5.14	24.48	108.97	0.00	0.00	0.00	0.00	19.34	5.14	24.48	108.96
.00	20.12	4.36	24.48	88.85	0.00	0.00	0.00	0.00	20.12	4.36	24.48	88.85	0.00	0.00	0.00	0.00	20.12	4.36	24.48	88.84
.00	20.92	3.56	24.48	67.92	0.00	0.00	0.00	0.00	20.92	3.56	24.48	67.92	0.00	0.00	0.00	0.00	20.92	3.56	24.48	67.92
.00	21.76	2.72	24.48	46.16	0.00	0.00	0.00	0.00	21.76	2.72	24.48	46.16	0.00	0.00	0.00	0.00	21.76	2.72	24.48	46.16
.00	22.63	1.85	24.48	23.53	0.00	0.00	0.00	0.00	22.63	1.85	24.48	23.53	0.00	0.00	0.00	0.00	22 63	1.85	24.48	23.53
.00	23.53	0.95	24.48	0.00	0.00	0.00	0.00	0.00	23.53	0.95	24.48	0.00	0.00	0.00	0.00	0.00	23.53	0.95	24.48	0.00
.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
.40	382.38	229.62	612.00	---	107.11	59.79	166.90	---	489.49	289.41	778.90	---	78.20	46.36	124.56	---	567.69	335.77	903.46	---

Table 9 - 5 Statement of Income

(UNIT : x 10^3 L.E.)

No. of Year	Fiscal Year	<< Operating Revenue >> Aval.Energy at Sending End (gwh) (A)	Sala.Energy at Consumer End (gwh) (B)	Salable Price (Mills/kwh) (C)	Total (D)=B*C	<< Operating Expenses >> Depre-ciation	Operating & Maintenance	General Expense	Fuel Cost	Total (E)	Operating Income (F)=D-E	Financial Expenses (Interest) (G)	Net Income (H)=F-G	Accumulated Net Income
0	1984	0	0	0.00	0	0	0	0	0	0	0	0	0	0
1	1985	0	0	0.00	0	0	0	0	0	0	0	0	0	0
2	1986	0	0	0.00	0	0	0	0	0	0	0	0	0	0
3	1987	0	0	0.00	0	0	0	0	0	0	0	6,260	-6,260	-6,260
4	1988	1,740	1,531	21.81	33,391	7,820	4,220	1,070	3,100	16,210	17,181	5,930	11,251	4,991
5	1989	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	30,510	17,425	22,416
6	1990	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	29,130	18,805	41,221
7	1991	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	27,630	20,305	61,526
8	1992	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	26,040	21,895	83,421
9	1993	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	24,320	23,615	107,036
10	1994	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	22,470	25,465	132,501
11	1995	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	20,480	27,455	159,956
12	1996	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	18,340	29,595	189,551
13	1997	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	16,030	31,905	221,456
14	1998	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	13,570	34,365	255,821
15	1999	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	10,890	37,045	292,866
16	2000	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	10,350	37,585	330,451
17	2001	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	9,780	38,155	368,606
18	2002	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	9,190	38,745	407,351
19	2003	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	8,580	39,355	446,706
20	2004	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	7,940	39,995	486,701
21	2005	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	7,280	40,655	527,356
22	2006	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	6,590	41,345	568,701
23	2007	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	5,880	42,055	610,756
24	2008	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	5,140	42,795	653,551
25	2009	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	4,360	43,575	697,126
26	2010	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	3,560	44,375	741,501
27	2011	4,205	3,700	23.55	97,135	18,900	10,200	2,600	7,500	39,200	47,935	2,720	45,215	786,716
28	2012	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	1,850	46,085	832,801
29	2013	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	950	46,985	879,786
30	2014	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	0	47,935	927,721
31	2015	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	0	47,935	975,656
32	2016	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	0	47,935	1,023,591
33	2017	4,205	3,700	23.55	87,135	18,900	10,200	2,600	7,500	39,200	47,935	0	47,935	1,071,526
34	2018	2,465	2,169	23.55	51,080	11,080	5,990	1,530	4,400	23,000	28,080	0	28,080	1,099,606
TOTAL		126,150	111,000	---	2,611,386	567,000	306,010	78,000	225,000	1,176,010	1,435,376	335,770	1,099,606	---

Remarks: 1) Operating & Maintenence Cost: 2% of the Construction Cost. (L.E 510.4 x 10^6 x 0.02 = L.E 10.2 x 10^6)

2) Administration Cost (General Expense): 0.5% of the Cosntruction Cost. (L.E 510.4 x 10^6 x 0.005 = L.E 2.60 x 10^6)

3) Fuel Cost: $\frac{2,205\ kcal/kwh}{6,500\ kcal/kg}$ X 4.9 L.E/ton x 4,485,120 Mwh = L.E 7.5 x 10^6

4) Depreciation Expenses: $\frac{567.7 \times 10^6}{30}$ = L.E 18.9 x 10^6

Table 9 - 6 Cashflow Statement

(UNIT : x 10^3 L.E.)

No. of Year	Fiscal Year	<< INCOMING CASHFLOW >> Net Income + Depreciation (A)	Foreign Currency	Local Currency	Total (B)	Grand Total (C)=A+B	<< OUTGOING CASHFLOW >> Capital Expend. (Constructions)	Repay. of Principal (Incl. Intersest during Const.)	Total (D)	<< CASH BALANCE >> (Benefitable Amount) Annual Amount C-D	Accumulated Amount
0	1984	0	4,000	1,200	5,200	5,200	5,200	0	5,200	0	0
1	1985	0	54,000	8,200	62,200	62,200	62,200	0	62,200	0	0
2	1986	0	121,600	19,000	140,600	140,600	140,600	0	140,600	0	0
3	1987	-6,260	183,900	29,500	213,400	207,140	213,400	4,120	217,520	-10,380	-10,380
4	1988	19,071	58,700	15,900	74,600	93,671	74,600	4,450	79,050	14,621	4,241
5	1989	36,325	13,200	1,200	14,400	50,725	14,400	21,040	35,440	15,285	19,526
6	1990	37,705	0	0	0	37,705	0	22,420	22,420	15,285	34,811
7	1991	39,205	0	0	0	39,205	0	23,920	23,920	15,285	50,096
8	1992	40,795	0	0	0	40,795	0	25,510	25,510	15,285	65,381
9	1993	42,515	0	0	0	42,515	0	27,230	27,230	15,285	80,666
10	1994	44,365	0	0	0	44,365	0	29,080	29,080	15,285	95,951
11	1995	46,355	0	0	0	46,355	0	31,070	31,070	15,285	111,236
12	1996	48,495	0	0	0	48,495	0	33,210	33,210	15,285	126,521
13	1997	50,805	0	0	0	50,805	0	35,520	35,520	15,285	141,806
14	1998	53,265	0	0	0	53,265	0	37,980	37,980	15,285	157,091
15	1999	55,945	0	0	0	55,945	0	13,590	13,590	42,355	199,446
16	2000	56,485	0	0	0	56,485	0	14,130	14,130	42,355	241,801
17	2001	57,055	0	0	0	57,055	0	14,700	14,700	42,355	284,156
18	2002	57,645	0	0	0	57,645	0	15,290	15,290	42,355	326,511
19	2003	58,255	0	0	0	58,255	0	15,900	15,900	42,355	368,866
20	2004	58,895	0	0	0	58,895	0	16,540	16,540	42,355	411,221
21	2005	59,555	0	0	0	59,555	0	17,200	17,200	42,355	453,576
22	2006	60,245	0	0	0	60,245	0	17,890	17,890	42,355	495,931
23	2007	60,955	0	0	0	60,955	0	18,600	18,600	42,355	538,286
24	2008	61,695	0	0	0	61,695	0	19,340	19,340	42,355	580,641
25	2009	62,475	0	0	0	62,475	0	20,120	20,120	42,355	622,996
26	2010	63,275	0	0	0	63,275	0	20,920	20,920	42,355	665,351
27	2011	64,115	0	0	0	64,115	0	21,760	21,760	42,355	707,706
28	2012	64,985	0	0	0	64,985	0	22,630	22,630	42,355	750,061
29	2013	65,885	0	0	0	65,885	0	23,530	23,530	42,355	792,416
30	2014	66,835	0	0	0	66,835	0	0	0	66,835	859,251
31	2015	66,835	0	0	0	66,835	0	0	0	66,835	926,086
32	2016	66,835	0	0	0	66,835	0	0	0	66,835	992,921
33	2017	66,835	0	0	0	66,835	0	0	0	66,835	1,059,756
34	2018	39,160	0	0	0	39,160	0	0	0	39,160	1,098,916
TOTAL		1,666,606	435,400	75,000	510,400	2,177,006	510,400	567,690	1,078,090	1,098,916	---

CHAPTER 10

ECONOMIC ANALYSIS

(1st Stage 300 MW x 2 Units)

CHAPTER 10. ECONOMIC ANALYSIS

10-1 METHOD OF ANALYSIS

The economic evaluation of the Sinai coal-fired thermal power project shall be made by the comparison between the present worth of the total costs incurred from the start of its construction works to the end of its service life and the present worth of the corresponding costs of an alternative oil-fired thermal power project. The total costs of the oil-fired power project is considered to be the "benefit" of the coal-fired thermal power project and the coal-fired power project should be economically justified, in comparing the following ratio with a so-called social rate of discount.

- Benefit/cost ratio

In the above comparison, the most important is how to assume the value of the social rate of discount. Generally speaking, the direct portion of the costs needed for power development project is financed mainly by the international and governmental financial institutions, and the services produced from the project are to increase social welfare. Therefore, the discount rate to be used in such economic evaluation should be determined from social standpoint. For this reason, this discount rate should be a prescriptive function which reflects accurately an overall evaluation of the society on the so-called consumption benefit at different points of time, or the social time-preference ratio, and should be decided by the government judging from its social policy as well as its provision on the country's future economic conditions.

However, a concrete method for measuring the social rate of discount has not yet established.

In Egypt, EEA's Planning Department applys the discount rate at 8% for economic evaluation of projects. Therefore, in this study the discount rate of 8% is adopted. And also the discount rates of 10% and 12% are studied as alternative plan.

10-2 CONDITIONS FOR ANALYSIS

Conditions adopted for this economic evaluation are as follows:

1) Construction cost, operation and maintenance cost, administration cost, fuel cost, etc., shall be estimated at the weighted mean year during the construction works.

2) All the costs shall be converted to the present worth as of the beginning of 1984 which is the starting year of construction of the Project.

3) The service life of both the coal-fired and oil-fired power plants shall be 30 years.

4) For fuel prices, the following two assumptions shall be applied:

   a) Theoretical basis which forecasts a long range energy situation of Egypt

      - coal: 48.6 LE(US$59) ..... International price as per opportunity cost

      - oil :148.1 LE(US$180) .... International price

   b) Actual basis which takes into account the actual financial conditions in which EEA is placed.

      -coal: 46.5 LE(US$56.5)

      * Annual fuel consumption:

        Domestic coal: 300,000 tons

        Imported coal: 1,221,000 tons

      *Domestic coal price was applied 44 LE/ton, which is average price of selling price of Maghara coal (48 LE/ton; tentative) and annual operating cost (40.5 LE/ton; including transportation cost), and improted coal price was applied 47.1 LE/ton (Australian coal).

- oil : 7.5 LE(US$9.1) ..... Subsidized price

It is noted that in case of b) the saving obtained by using coal instead of oil shall be reduced from costs of the Sinai Coal-fired Thermal Power Project.

10-3 DATA FOR ANALYSIS OF THE PROJECT

The data for analysis of the project (installed capacity, annual generation, station service loss, transmission loss, thermal efficiency, etc.) are shown in Table 10-1.

Table 10-1 Data for Analysis

	Oil-fired	Coal-fired	Remarks
A. Installed capacity	620 MW	640 MW	
B. Sending end capacity	600 MW	600 MW	
C. Station service loss(kW)	3.5%	6.25%	
D. Utilization factor	80%	80%	
E. Transmission and distribution losses	12%	12%	
F. Annual generation at Generator end	A x 8,760 x D/100 4,344,960 MWh	4,485,120 MWh	
G. Annual Salable energy at consumer end	F x (1 - C/100)(1 - E/100) 3,689,740 MWh	3,700,200 MWh	
H. Construction cost	466.4×10^6 LE	510.4×10^6 LE	
I. Operation and maintenance cost	H x 2%	H x 2%	
J. Administration cost	H x 0.5%	H x 0.5%	
K. Annual Fuel consumption	958.1×10^3 ton	$1,521.5 \times 10^3$ ton	
L. Fuel price	$180(148.1 LE)/ton	$59(48.6 LE)/ton	- Theoretical basis $9.1
M. Durable years	30 years	30 years	
N. Plant efficiency	39%(2,205 kcal/kwh)	39%(2,205 kcal/kwh)	
O. Calorific value	10,000 kcal/kg	6,500 kcal/kg	

10-4 EXPENSES - Theoretical Fuel Cost Basis (International Price Basis)

10-4-1 Construction Cost

The construction costs of the coal-fired and oil-fired (alternative) power plants shall be the net construction cost, not including the interest during construction.

Sinai Coal-Fired Power Plant : 510.4×10^6 LE

Alternative Oil-fired Power Plant: 466.4×10^6 LE

The annual disbursement of the construction costs is estimated as shown in the following table.

Table 10-2 Construction Cost by Year (Unit: $\times 10^6$ LE)

	Sinai Power Plant			Oil-fired Plant		
	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total
1984	4.0	1.2	5.2	3.7	1.1	4.8
1985	54.0	8.2	62.2	49.4	7.4	56.8
1986	121.6	19.0	140.6	111.4	17.1	128.5
1987	183.9	29.5	213.4	168.5	26.6	195.1
1988	58.7	15.9	74.6	53.8	14.3	68.1
1989	13.2	1.2	14.4	12.1	1.0	13.1
Total	435.4	75.0	510.4	398.9	67.5	466.4

10-4-2 Operation and Maintenance Cost

Operation and maintenance cost is estimated to be 2% of the construction cost for both coal-fired power plant and oil-fired power plant as follows.

Sinai Power Plant : $510.4 \times 10^6 \times 0.02 = 10.2 \times 10^6$ LE

Oil-fired Power Plant: $466.4 \times 10^6 \times 0.02 = 9.3 \times 10^6$ LE

10-4-3 Administration Cost

Administration cost is estimated to be 0.5% of the construction cost for both Sinai Coal-Fired Power Plant and oil-fired power plant. Thus,

Sinai Power Plant : $510.4 \times 10^6 \times 0.005 = 2.6 \times 10^6$ LE

Oil-fired power plant: $466.4 \times 10^6 \times 0.005 = 2.3 \times 10^6$ LE

10-4-4 Fuel Cost

The thermal efficiency will be 39% (2,205 kcal/kWh) for both Sinai Coal-Fired Power Plant and oil-fired power plant.

The fuel cost per kWh will be as follows:

Sinai Power Plant : $\frac{2,205}{6,500} \times 48.6$ mill./kg = 16.48 mill./kWh

Oil-fired power plant: $\frac{2,205}{10,000} \times 148.1$ mill./kg = 32.66 mill./kWh

Thus, the annual fuel cost will be:

Sinai Power Plant : 4,485,120 MWh x 16.48 mill./kWh

$= 73.9 \times 10^6$ L.E.

Oil-fired power plant: 4,344,960 MWh x 32.66 mill./kWh

$= 141.9 \times 10^6$ L.E.

10-4-5 Total Annual Cost

From the foregoing, the total annual costs will be as follows:

Sinai Power Plant : $10.2 + 2.6 + 73.9 = 86.7 \times 10^6$ LE

Oil-fired power plant: $9.3 + 2.3 + 141.9 = 153.5 \times 10^6$ LE

10-4-6 Benefit/Cost Ratio

When the social discount rate is assumed to be 8%, 10% and 12%, the benefit/cost ratio will be as follows.

1) Present Worth of Construction Cost

The present worth of construction cost will be calculated by the following formula:

$$(\text{Construction cost}) \times \frac{1}{(1 + i)^n}$$

i : Socaial Discount Rate

n : Number of Year

(Unit: $\times 10^6$ LE)

Discount Rate / Year	Sinai Power Plant 8%	10%	12%	Oil-fired Power Plant 8%	10%	12%
1984	5.2	5.2	5.2	4.8	4.8	4.8
1985	57.6	56.5	55.5	52.6	51.6	50.7
1986	120.5	116.2	112.1	110.2	106.2	102.4
1987	169.4	160.3	151.9	154.9	146.6	138.9
1988	54.8	51.0	47.4	50.1	46.5	43.3
1989	9.8	8.9	8.2	8.9	8.1	7.4
Total	417.3	398.1	380.3	381.5	363.8	347.5

2) Present Worth of Annual Costs

The present worth of annual costs for 30 years will be calculated by the following formula:

$$(\text{Annual costs}) \times \frac{(1 + i)^{30} - 1}{i \times (1 + i)^{30}} \times \frac{1}{(1 + i)^5}$$

i : Social Discount Rate

$$i = 8\% : \frac{(1 + 0.08)^{30} - 1}{0.08 \times (1+0.08)^{30}} \times \frac{1}{(1+0.08)^5} = 7.662$$

$$i = 10\%: \frac{(1 + 0.10)^{30} - 1}{0.10 \times (1+0.10)^{30}} \times \frac{1}{(1 + 0.10)^5} = 5.853$$

$$i = 12\%: \frac{(1 + 0.12)^{30} - 1}{0.12 \times (1+0.12)^{30}} \times \frac{1}{(1+0.12)^5} = 4.571$$

Therefore, the present worth of annual costs for 30 years becomes as follows.

Sinai Power Plant:

$$86.7 \times 10^6 \times 7.662 = 664.3 \times 10^6 \text{ LE } (i = 8\%)$$

$$86.7 \times 10^6 \times 5.853 = 507.5 \times 10^6 \text{ LE } (i = 10\%)$$

$$86.7 \times 10^6 \times 4.571 = 396.3 \times 10^6 \text{ LE } (i = 12\%)$$

Oil-fired power plant:

$$153.5 \times 10^6 \times 7.662 = 1{,}176.1 \times 10^6 \text{ LE } (i = 8\%)$$

$$153.5 \times 10^6 \times 5.853 = 898.4 \times 10^6 \text{ LE } (i = 10\%)$$

$$153.5 \times 10^6 \times 4.571 = 701.6 \times 10^6 \text{ LE } (i = 12\%)$$

Thus, the benefit/cost ratio becomes,

$$\frac{381.5 + 1{,}176.1}{417.3 + 664.3} = 1.440 \quad (i = 8\%)$$

$$\frac{363.8 + 898.4}{398.1 + 507.5} = 1.394 \quad (i = 10\%)$$

$$\frac{347.5 + 701.6}{380.3 + 396.3} = 1.351 \quad (i = 12\%)$$

Accordingly, at the any social discount rate of 8%, 10% and 12% in theoretical basis, the ratio of Benefit/Cost is fairly higher than 1, and prove that the Sinai coal-fired Thermal Power Project is feasible.

10-5 EXPENSES - Actual Basis

10-5-1 Construction Cost

The net construction costs of the coal-fired and oil-fired (alternative) power plants are as follows.

Sinai Coal-fired Power Plant : 510.4×10^6 LE

Alternative Oil-fired Power Plant : 466.4×10^6 LE

The annual disbursement of the construction costs of the both plants is estimated as shown in the following table.

Table 10-3 Construction Cost by Year (Unit: $\times 10^6$ LE)

	Sinai Power Plant			Oil-fired Plant		
	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total
1984	4.0	1.2	5.2	3.7	1.1	4.8
1985	54.0	8.2	62.2	49.4	7.4	56.8
1986	121.6	19.0	140.6	111.4	17.1	128.5
1987	183.9	29.5	213.4	168.5	26.6	195.1
1988	58.7	15.9	74.6	53.8	14.3	68.1
1989	13.2	1.2	14.4	12.1	1.0	13.1
Total	435.4	75.0	510.4	398.9	67.5	466.4

10-5-2 Operation and Maintenance Cost

The operation and maintenance cost is estimated to be 2% of the construction cost of both the coal-fired power plant and oil-fired power plant.

Sinai Coal-fired Power Plant : 10.2×10^6 LE

Alternative Oil-fired Power Plant : 9.3×10^6 LE

10-5-3 Administration Cost

Administration cost is estimated to be 0.5% of the construction cost for both Sinai Coal-Fired Power Plant and oil-fired power plant.

Sinai Power Plant : 2.6×10^6 LE

Oil-fired power plant: 2.3×10^6 LE

10-5-4 Fuel Cost

The thermal efficiency will be 39% (2,205 kcal/kWh) for both Sinai Coal-Fired Power Plant and oil-fired power plant.

The fuel cost per kWh will be as follows:

Sinai Power Plant : $\frac{2,205}{6,500} \times 46.5$ mill./kg = 15.77 mill./kWh

Oil-fired power plant: $\frac{2,205}{10,000} \times 7.5$ mill./kg = 1.65 mill./kWh

Thus, the annual fuel cost will be:

Sinai Power Plant : 4,485,120 MWh x 15.77 mill./kWh

$= 70.7 \times 10^6$ LE

Oil-fired power plant: 4,344,960 MWh x 1.65 mill./kWh

$= 7.2 \times 10^6$ L.E.

10-5-5 Annual Saving

Coal price (Imported + Domestic): 46.5 LE/ton

International Oil Price : 148.1 LE/ton

Thus, annual saving of total fuel cost by construction of a coal-fired power plant isntead of a oil-fired power plant amounts to the following:

$(1.521.5 \times 10^3 \times 46.5) - (958.1 \times 10^3 \times 148.1) = -71.1 \times 10^6$ LE

10-5-6 Total Annual Cost

From the foregoing, the total annual costs will be as follows:

Sinai Power Plant : 10.2 + 2.6 + 70.7 - 71.1

= 12.4×10^6 LE

Oil-fired power plant: 9.3 + 2.3 + 7.2 = 18.8×10^6 LE

10-5-7 Benefit/Cost Ratio

When the social discount rate is assumed to be 8%, 10% and 12%, the benefit/cost ratio will be as follows.

1) Present Worth of Construction Cost

(Unit: $\times 10^6$ LE)

Discount Rate / Year	Sinai Power Plant 8%	10%	12%	Oil-fired Power Plant 8%	10%	12%
1984	5.2	5.2	5.2	4.8	4.8	4.8
1985	57.6	56.5	55.5	52.6	51.5	50.7
1986	120.5	116.2	112.1	110.2	106.2	102.4
1987	169.4	160.3	151.9	154.9	146.6	138.9
1988	54.8	51.0	47.4	50.1	46.5	43.3
1989	9.8	8.9	8.2	8.9	8.1	7.4
Total	417.3	398.1	380.3	381.5	363.8	347.5

2) Present Worth of Annual Costs

The present worth of annual costs for 30 years will be calculated by the following formula:

$$(\text{Annual costs}) \times \frac{(1+i)^{30} - 1}{i \times (1+i)^{30}} \times \frac{1}{(1+i)^5}$$

i : Social Discount Rate

$$i = 8\% : \frac{(1+0.08)^{30} - 1}{0.08 \times (1+0.08)^{30}} \times \frac{1}{(1+0.08)^5} = 7.662$$

$$i = 10\% : \frac{(1+0.10)^{30} - 1}{0.10 \times (1+0.10)^{30}} \times \frac{1}{(1+0.10)^5} = 5.853$$

$$i = 12\%: \quad \frac{(1 + 0.12)^{30} - 1}{0.12 \times (1+0.12)^{30}} \times \frac{1}{(1+0.12)^{5}} = 4.571$$

Therefore, the present worth of annual costs for 30 years becomes as follows.

Sinai Power Plant:

$$12.4 \times 10^{6} \times 7.662 = 95.0 \times 10^{6} \text{ LE } (i = 8\%)$$

$$12.4 \times 10^{6} \times 5.853 = 72.6 \times 10^{6} \text{ LE } (i = 10\%)$$

$$12.4 \times 10^{6} \times 4.571 = 56.7 \times 10^{6} \text{ LE } (i = 12\%)$$

Oil-fired power plant:

$$18.8 \times 10^{6} \times 7.662 = 144.0 \times 10^{6} \text{ LE } (i = 8\%)$$

$$18.8 \times 10^{6} \times 5.853 = 110.0 \times 10^{6} \text{ LE } (i = 10\%)$$

$$18.8 \times 10^{6} \times 4.571 = 85.9 \times 10^{6} \text{ LE } (i = 12\%)$$

Thus, the benefit/cost ratio becomes,

$$\frac{381.5 + 144.0}{417.3 + 95.0} = 1.026 \; (i = 8\%)$$

$$\frac{363.8 + 110.0}{398.1 + 72.6} = 1.007 \; (i = 10\%)$$

$$\frac{347.5 + 85.9}{380.3 + 56.7} = 0.992 \; (i = 12\%)$$

Accordingly, at the social discount rate of 8% and 10% in actual basis, the ratio of Bnefit/Cost ratio is higher than one (1). And at the rate of 12%, the ratio of Benefit/Cost is near one (0.992). Therefore this project is still feasible even in actual basis.

Fig.10-1 Benefit/Cost Ratio
Oil/Coal

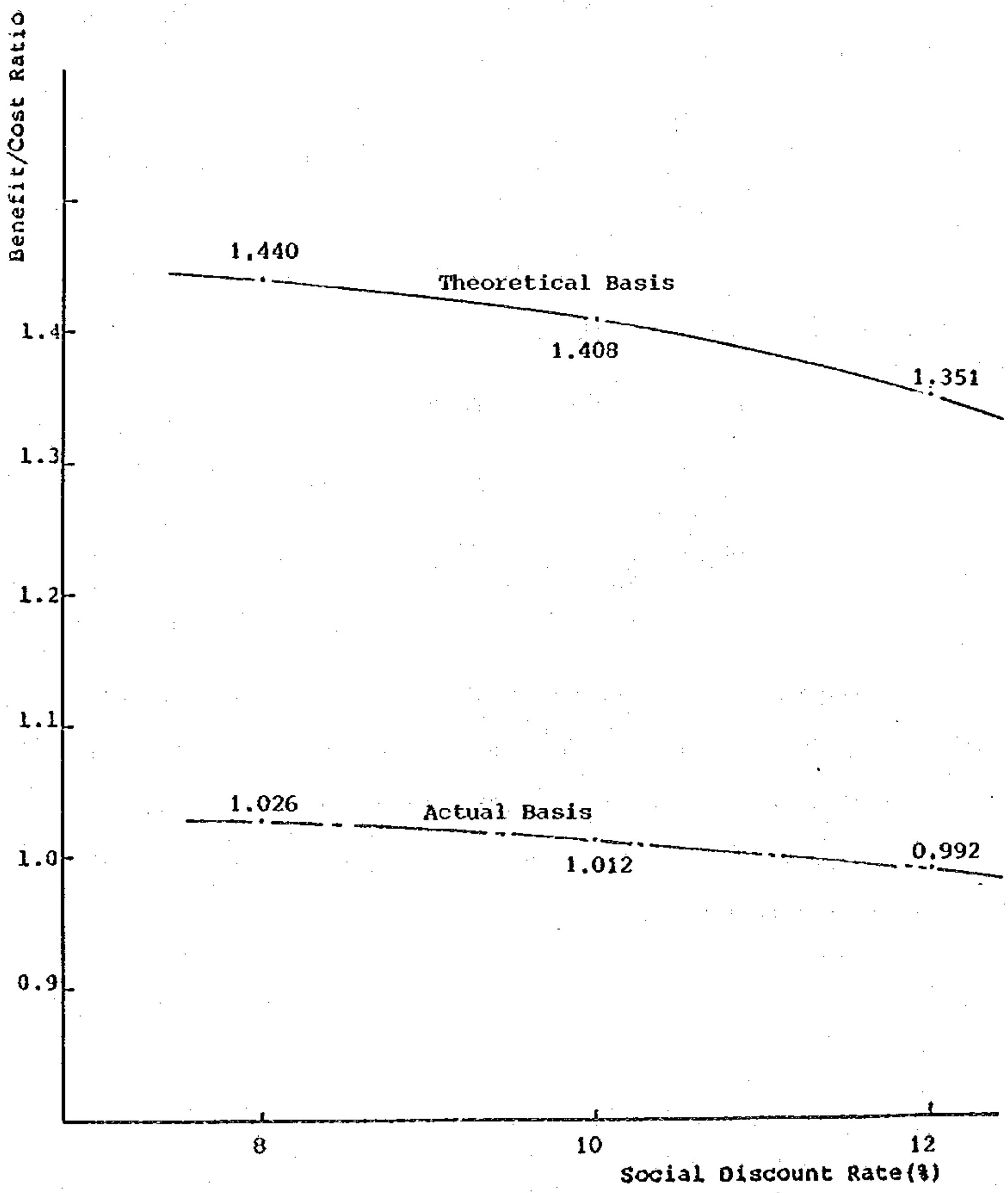
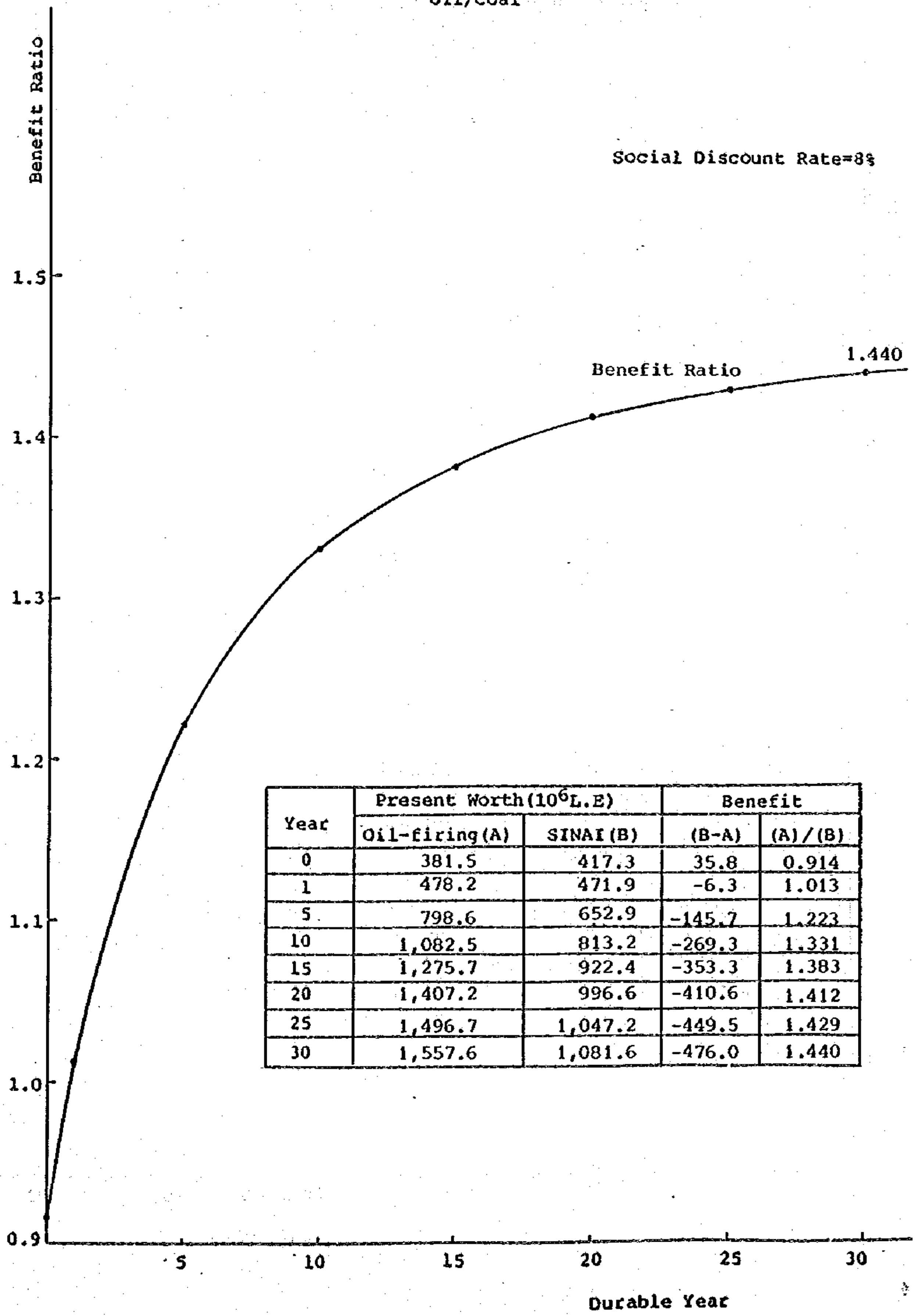


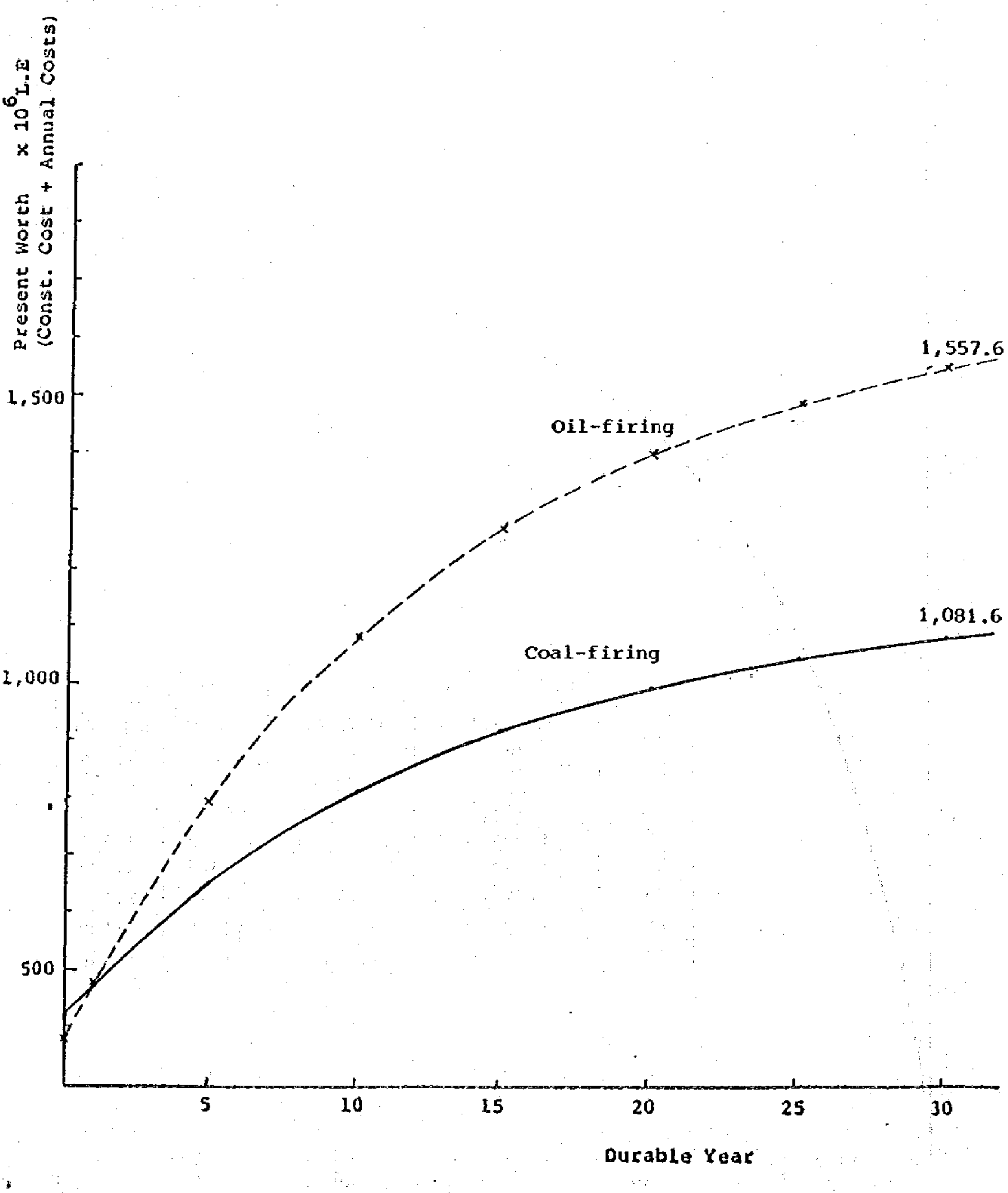
Fig.10-2 Benefit Curve (Benefit Ratio)
Oil/Coal



Year	Present Worth(10^6L.E)		Benefit	
	Oil-firing(A)	SINAI(B)	(B-A)	(A)/(B)
0	381.5	417.3	35.8	0.914
1	478.2	471.9	-6.3	1.013
5	798.6	652.9	-145.7	1.223
10	1,082.5	813.2	-269.3	1.331
15	1,275.7	922.4	-353.3	1.383
20	1,407.2	996.6	-410.6	1.412
25	1,496.7	1,047.2	-449.5	1.429
30	1,557.6	1,081.6	-476.0	1.440

Fig.10-3 Comparison of Annual Costs Curve by Present Worth
Coal and Oil

Social Discount Rate=8%



APPENDIX - A

OUTLINE OF PLAN FOR ULTIMATE OUTPUT OF 1,200 MW

OUTLINE OF PLAN FOR ULTIMATE OUTPUT OF 1,200 MW

1. OUTLINE OF PLAN

This project is to realize as the first stage, the construction of 300 MW x 2 units of coal-fired thermal power plant at Ayun Musa on the Sinai Peninsula in 1988/1989, and it is planned that another 600 MW will be added in or 1990 as the second stage to meet the increasing demand. Therefore, in this chapter, the generating cost and the financial internal rate of return (FIRR) for the ultimate 1,200 MW coal-fired power plant are reviewed.

As seen in the outline of facilities for the 1st stage of the power plant, the advance investment on the condenser circulating water intake and discharge channels and fuel unloading facilities will be to satisfy the ultimate output of the plant made.

The power generating facilities for the second stage is assumed to be the same 300 MW x 2 units of dual type of coal- and oil-fired thermal power plants. As for the transmission facilities, the voltage raise to 500 kV of New Suez Substation, and the work of leading-in of the 220 kV transmission line from Abu Sultan to Suez Substation into New Suez Substation were included in the second stage.

The 108 km 500 kV x 1 circuit transmission line from New Suez Substation to Katamia Substation on the south-east of Cairo City will be constructed in the other project.

2. OUTLINE OF FACILITIES

Since the port facilities, unloading facilities, stackers and reclaimers at the coal storage yard, etc. for 1,200 MW plant output are already installed in the first stage, there is no need of their extension, but only the expansion of the coal yard would be required.

The condenser circulating water intake and discharge channels, etc. are also prepared in the first stage and the expansion can be made without shutting down the first 300 MW x 2 units.

The outline of facilities in the second stage will be similar to those in the first stage as follows.

Outline of Power Plant:

Output	: 300 MW x 2 units
Steam conditions:	
Main steam pressure	: 169 atg
Main steam temp.	: 538°C
Reheat steam temp.	: 538°C
Condenser vacuum	: 710 mmHg
Boiler	: Dual type boiler Outdoor type, balanced draft system, either natural or forced circulation, N.C.R. 320 MW x 2 (net output 300 MW x 2)
Stack	: Collective stack for 300 MW x 2, steel made, Height: 85 m

Turbine	:	Reheat, condensing, tandem compound type Rated output at generator 320 MW x 2 units (net output at PS Tr. end 300 MW x 2 units) Main steam pressure at turbine inlet: 169 kg/cm² Main steam temp.: 538°C Rated speed: 3,000 rpm
Generator	:	Horizontal-shaft, totally enclosed, hydrogen cooled type Rating: 400 MVA Power factor: 0.8 Rated voltage: 18.3 kV or appropriately No. of phase: 3 Frequency: 50 Hz
Fuel Storage Yard:		
for coal	:	Storage capacity: 300,000 ton, 60 days for 600 MW 50 m x 300 m x 16 m x 4 piles
for oil	:	Storage capacity: 100,000 kℓ, 30 days for 600 MW ø: 52.3 m, height: 15.22 m, Capacity: 32,000 kℓ x 3

Cooling Water System:

Intake pit

Scale of pit	:	61.4 m^3/sec for 1,200 MW
Capacity of pumping up	:	30.7 m^3/sec for 600 MW
Circulating water pipe	:	ϕ_i: 2.0 m/unit x 4
		Length: 800 m x 4 lines

Additional Ash Disposal Area for 10 Years of 600 MW

Ash produced per annum	:	Approx. 320,000 m^3/600 MW/annum
Required area of ash pond	:	1,616,000 m^2/600 MW/10 years

Outline of Transmission System (interconnection line)

Outline of T/L Route	:	Partial change of T/L for Abu Sultan P.S. - Suez S.S. to Abu Sultan P.S. - New Suez S.S.
		Length: about 2 km
Voltage & No. of circuits	:	220 kV x 2 cct
Conductor	:	400 mm^2 x 2 TACSR
Supporting structures	:	Overhead line, steel tower for 2 cct

Outline of New Suez Substation

Circuit breaker	:	500 kV x 3 units
		220 kV x 4 units
Transformer	:	500 kV/220 kV transformer
		Capacity 750 MVA x 2 units

3. CONSTRUCTION COST

1) Basic Conception of Construction Cost Estimate

The basic conception of construction cost estimate is the same as that for the first stage. (See Chapter 7.)

2) Scope and Conditions of Construction Cost Estimate

Out of the 1,200 MW Sinai Coal-fired Thermal Power Plant Project, the 300 MW x 2 units of power plants, coal unloading facilities transmission and substation facilities in the first stage and addition of 300 MW x 2 units of generating facilities, extension of transmission and substation facilities in the second stage are taken into the scope of estimate.

The specifications of facilities for the second stage are assumed to be the same as those of the first stage.

Scope of Works in the 2nd Stage

Civil and Harbor Works

- All harbor works are completed in the first stage and are not included in the 2nd stage.
- Addition of intake pump house, outdoor condenser cooling water pipe, discharge channel (box culvert), coal storage yard, tank foundation and oil retaining dyke and ash pond
- Others

Architectural

- Addition of powerhouse, boiler foundation, stack, water treatment house, seawater electrolysis house and other appurtenant buildings
- Others

Transmission and Substation Facilities

- Addition of 2 banks of 750 MVA 500 kV/220 kV transformers at New Suez Substation
- Connection of 220 kV Abu Sultan Power Station - Suez Substation Line into New Suez Substation

Note: A 500 kV 1 circuit transmission line from New Suez Substation to Katamia Substation (108 km) will be constructed under some other project.

Power Generating Facilities

- Addition of raw water tanks (2,000 tons x 2) and interconnection with the existing system
- Addition of circulating water intake screens and seawater electrolysis equipment
- Addition of boilers, turbines and generators
- Addition of main step-up transformers and extension of outdoor substation
- Addition of station service electrical system
- Extension of water spray system for the coal storage yard
- Addition of heavy oil storage tanks (36,000 kℓ x 3)
- Addition of boiler feedwater treatment facilities (incl. 500 tons x 2 demineralized water tanks)
- Addition of electrostatic precipitators, ash disposal facilities, drainage water treatment facilities, air preheaters with accessories, condenser circulating water piping, and other appurtenant equipment and facilities

Note: Equipment not needed in the 2nd stage

- Generator equipment for black start is not necessary if the second stage units are 300 MW x 2.
- Coal unloading and coal handling equipment are already furnished in the first stage and no addition is necessary in the second stage.
- Heavy oil receiving facility is not needed for the same reason.
- Addition of light oil tanks is not needed.

3) Conditions for Calculation of Construction Cost

The conditions for calculation of the construction cost for the second stage are assumed to be the same as those for the first stage.

However, as stated before, the works that have been finished in the first stage and the common facilities for the first stage and the second stage are excluded from the construction cost estimate for the second stage.

4) Prices

The conditions of pricing are the same as for the first stage.

However, the contingency of 2% is included for both the foreign currency portion and the domestic currency portion.

5) Construction Cost Estimation

The construction cost estimation on the basis of foregoing 1) - 4) is given on Table A-1.

The construction cost for the second stage is 345.7×10^6 L.E. and the total construction cost of the project becomes 856.1×10^6 L.E.

The budget by each year and the budget by each phase are shown on Tables A-2 and A-3, respectively.

Note: If the financing of the second stage should be obtained smoothly following the first stage and the same contractor as the first stage is selected, continuous use of the temporary facilities for construction, saving in design cost, shortening of construction period, etc. would be expected, and the decrease of construction cost from the foregoing may be expected.

Table A-1 Construction Cost

Unit: x 10^6 LE (x 10^6 US$)

Items	1st Stage F.C.		1st Stage L.C.		1st Stage Total		2nd Stage F.C.		2nd Stage L.C.		2nd Stage Total		Total F.C.		Total L.C.		Total Total	
1. Generating Facilities																		
1) Equipments	262.0	(318.3)	-		262.0	(318.3)	220.0	(267.3)	-		220.0	(267.3)	482.0	(585.6)	-		482.0	(585.6)
2) Erection	42.2	(51.3)	19.6	(23.8)	61.8	(75.1)	34.3	(41.7)	16.0	(19.4)	50.3	(61.1)	76.5	(93.0)	35.6	(43.2)	112.1	(136.2)
3) Civil works	10.4	(12.6)	18.3	(22.2)	28.7	(34.8)	5.4	(6.5)	9.4	(11.4)	14.8	(17.9)	15.8	(19.1)	27.7	(33.6)	43.5	(52.7)
4) Architectural works	34.0	(41.3)	16.1	(19.6)	50.1	(60.9)	24.4	(29.7)	11.5	(14.0)	35.9	(43.7)	58.4	(71.0)	27.6	(33.6)	86.0	(104.6)
5) Harbor facilities	28.3	(34.4)	7.6	(9.2)	35.9	(43.6)	0	(0)	0	(0)	0	(0)	28.3	(34.4)	7.6	(9.2)	35.9	(43.6)
Sub-total	376.9	(457.9)	61.6	(74.8)	438.5	(532.7)	284.1	(345.2)	36.9	(44.8)	321.0	(390.0)	661.0	(803.1)	98.5	(119.6)	759.5	(922.7)
Unit construction cost [LE/kW (US$/kW)]					730.8	(887.8)					535.0	(650.0)					632.9	(768.9)
2. Transmission Lines and Substation																		
1) Transmission Lines	25.6	(31.1)	7.5	(9.1)	33.1	(40.2)	1.0	(1.2)	0.3	(0.4)	1.3	(1.6)	26.6	(32.3)	7.8	(9.5)	34.4	(41.8)
Unit construction cost [x 10^3 LE/km (x 10^3 US$/km)]					760.9	(924.1)					650.0	(800.0)					756.0	(918.7)
2) Substation	10.8	(13.1)	2.3	(2.8)	13.1	(15.9)	10.1	(12.3)	2.9	(3.5)	13.0	(15.8)	20.9	(25.4)	5.2	(6.3)	26.1	(31.7)
Sub-total	36.4	(44.2)	9.8	(11.9)	46.2	(56.1)	11.1	(13.5)	3.2	(3.9)	14.3	(17.4)	47.5	(57.7)	13.0	(15.8)	60.5	(73.5)
3. Engineering Fee	5.4	(6.6)	-	-	5.4	(6.6)	3.6	(4.4)	-	-	3.6	(4.4)	9.0	(11.0)	-	-	9.0	(11.0)
Total (1 + 2 + 3)	418.7	(508.7)	71.4	(86.7)	490.1	(595.4)	298.8	(363.1)	40.1	(48.7)	338.9	(411.8)	717.5	(871.8)	111.5	(135.4)	829.0	(1,007.2)
4. Contingency	16.7	(20.3)	3.6	(4.4)	20.3	(24.7)	6.0	(7.3)	0.8	(1.0)	6.8	(8.3)	22.7	(27.6)	4.4	(5.4)	27.1	(33.0)
Grand Total (1 + 2 + 3 + 4)	435.4	(529.0)	75.0	(91.1)	510.4	(620.1)	304.8	(370.4)	40.9	(49.7)	345.7	(420.1)	740.2	(899.4)	115.9	(140.8)	856.1	(1,040.2)

Table 11-2 Budget for Each Year

Unit: x 10^6 LE (x 10^6 US$)

	1st Stage F.C.		1st Stage L.C.		1st Stage Total		2nd Stage F.C.		2nd Stage L.C.		2nd Stage Total		Total F.C.		Total L.C.		Total Total	
1984	4.0	(4.9)	1.2	(1.5)	5.2	(6.4)	-		-		-		4.0	(4.9)	1.2	(1.5)	5.2	(6.4)
1985	54.8	(65.6)	8.2	(10.0)	62.2	(75.6)	-		-		-		54.0	(65.6)	8.2	(10.0)	62.2	(75.6)
1986	121.6	(147.8)	19.0	(23.0)	140.6	(170.8)	38.1	(46.3)	4.5	(5.5)	42.6	(51.8)	159.7	(194.1)	23.5	(28.5)	183.2	(222.6)
1987	183.9	(223.4)	29.5	(35.8)	213.4	(259.2)	86.0	(104.4)	10.5	(12.8)	96.5	(117.2)	269.9	(327.8)	40.0	(48.6)	309.9	(376.4)
1988	58.7	(71.3)	15.9	(19.4)	74.6	(90.7)	129.8	(157.8)	16.4	(19.9)	146.2	(177.7)	188.5	(229.1)	32.3	(39.3)	220.8	(268.4)
1989	13.2	(16.0)	1.2	(1.4)	14.4	(17.4)	41.5	(50.4)	8.9	(10.8)	50.4	(61.2)	54.7	(66.4)	10.1	(12.2)	64.8	(78.6)
1990	-		-		-		9.4	(11.5)	0.6	(0.7)	10.0	(12.2)	9.4	(11.5)	0.6	(0.7)	10.1	(12.2)
Total	435.4	(529.0)	75.0	(91.1)	510.4	(620.1)	304.8	(370.4)	40.9	(49.7)	345.7	(420.1)	740.2	(899.4)	115.9	(140.8)	856.1	(1,040.2)

Table A-3 Budget by Each Phase

Unit: x 10^6 LE (x 10^6 US$)

Items	F.C.		L.C.		Total	
1st Stage						
1st Phase	63.4	(77.0)	24.1	(29.3)	87.5	(106.3)
2nd Phase	207.5	(252.1)	32.6	(39.6)	240.1	(291.7)
3rd Phase	164.5	(199.9)	18.3	(22.2)	182.8	(222.1)
Total	435.4	(529.0)	75.0	(91.1)	510.4	(620.1)
2nd Stage						
1st Phase	195.1	(237.1)	26.2	(31.8)	221.3	(268.9)
2nd Phase	109.7	(133.3)	14.7	(17.9)	124.4	(151.2)
Total	304.8	(370.4)	40.9	(49.7)	345.7	(420.1)
Grand Total	740.2	(899.4)	115.9	(140.8)	856.1	(1,040.2)

Table A-4 Generating Cost for 1,200 MW Power Generating Facilities

Item	Unit	Formula	1st Stage	1st Stage plus 2nd Stage
A. Unit Capacity	MW		320 x 2	320 x 4
B. Utilization Factor	%		80	80
C. Annual Gross kWh	$x10^6$ kWh	Ax8.760xB/100	4,485.1	8,970.2
D. Station Service Loss(kWh)	%		6.25	6.25
E. Annual Available Energy at P/S Tr. End	$x10^6$ kWh	Cx(1-D/100)	4,204.8	8,409.6
F. Plant Efficiency	%		39	39
G. Construction Cost including T/L	$x10^6$LE		510.4	856.1
H. Fuel Calorific Value	kcal/kg		6,500	6,500
I. Fuel Consumption	$x10^3$ ton	$\frac{860xC}{F \times H} \times 100$	1,521.5	3,043.0
J. Unit Price of Fuel	LE/ton		4.9	4.9
K. Fuel Cost	$x10^6$ LE	$IxJx10^{-3}$	7.5	15.0
L. Operation Maintenance Cost	$x10^6$ LE	Gx0.02	10.2	17.1
M. Administration Cost	$x10^6$ LE	Gx0.005	2.6	4.3
N. Depreciation	$x10^6$ LE	G/30	17.0	28.5
O. Annual Cost	$x10^6$ LE	K+L+M+N	37.3	64.9
P. Generating Cost at P/S Tr. End	Millimes/kWh	$O/Ex10^3$	8.87	7.72
Q. T/L and D/L Loss	%		12	12
R. Salable Energy at Consumer End	$x10^6$ kWh	Ex(1-Q/100)	3,700.2	7,400.4
S. Salable Unit Price	Millimes/kWh	33.646x0.7	23.55	23.55
T. Revenue/kWh	Millimes/kWh	S-P	14.68	15.83
U. Annual Revenue	$x10^6$ LE	$RxTx10^{-3}$	54.3	117.1

4. Generating Cost and FIRR

4-1 Generating Cost

The generating cost at the ultimate output of 1,200 MW is as shown on Table A-4, 7.72 mills/kWh at the main transformer terminal of the power station and is fairly lower than 8.87 mill./ kWh at the first stage.

Because of the advance investment in the harbor facilities, coal unloading and coal handling facilities, circulating water intake and discharge facilities, etc. in the first stage, the generating cost for the second stage gets lower.

The project in the first stage would increase its economic effect by the continued implementation of the second stage.

4-2 Financial Analysis

1) The method of analysis and the conditions (electricity tariff), price escalation, coal price, allocation of electricity sales, revenue to generation sector, conditions for fund procurement, etc.) are the same as the first stage.

2) Operating Revenue (Energy sales revenue)

No. 1 unit and No. 2 unit of the first stage are scheduled to start commercial operation in 1988 and 1989 respectively, and No. 3 and No. 4 units of the second stage are scheduled to start operation in 1990 and 1991 respectively.

The total revenue from energy sales will be double that in the first stage.

3) Operating expenses are assumed as follows.

a. Annual operation/maintenance cost:

$$\text{L.E. } (510.4 + 345.7) \times 10^6 \times 0.02 = \text{L.E. } 17.1 \times 10^6$$

b. Administration cost:

$$\text{L.E. } (510.4 + 345.7) \times 10^6 \times 0.005 = \text{L.E. } 4.3 \times 10^6$$

c. Fuel cost:

$$\frac{2{,}205 \text{ kcal/kWh}}{6{,}500 \text{ kcal/kg}} \times 4.9 \text{ L.E./ton} \times 4{,}485{,}120 \text{ kWh} \times 2$$

$$= \text{L.E. } 15 \times 10^6 \text{ (1.67 mill./kWh)}$$

4) Results of Analysis

As shown on Table 11-5, and the equalizing discount rate (FIRR) is 13.71%. This value is far better than 11.29% for the first stage, and it follows that if the second stage is implemented smoothly following the first stage, the project would prove far more favorable.

. Discount Rate 11% 12%
. Revenue/cost 1.0557 0.9763
∴ Revenue/cost = 1.00; Discount Rate = 13.71%

Table A - 5 Equalizing Discount Rate
(Financial Internal Rate of Return)

(EDR =13.71 (%)) (UNIT : x 10^3 L.E)

No. of Year	Fiscal Year	Project Cost (A)	Operating Expenses Total (Excl.Depre.Cost) (B)	Operating Revenue (C)	Balance (D)=C-(A+B)	<< PRESENT WORTH >> Disc.Rate 13.0(%) (E)	Value: Investment (F)=A*E	Value: Benefit (G)=(C-B)*E	Disc.Rate 14.0(%) (E)'	Value: Investment (F)'=A*E'	Value: Benefit (G)=(C-B)*E'
0	1984	5,200	0	0	-5,200	1.000000	5,200	0	1.000000	5,200	0
1	1985	62,200	0	0	-62,200	0.884956	55,044	0	0.877193	54,561	0
2	1986	183,200	0	0	-183,200	0.783147	143,473	0	0.769468	140,966	0
3	1987	309,900	0	0	-309,900	0.693051	214,776	0	0.674972	209,174	0
4	1988	220,800	8,390	33,391	-195,799	0.613319	135,421	15,334	0.592081	130,731	14,803
5	1989	64,800	26,815	123,190	31,575	0.542760	35,171	52,309	0.519369	33,655	50,054
6	1990	10,000	36,400	174,270	127,870	0.480319	4,803	66,222	0.455587	4,556	62,812
7	1991	0	36,400	174,270	137,870	0.425061	0	58,603	0.399638	0	55,098
8	1992	0	36,400	174,270	137,870	0.376160	0	51,861	0.350560	0	48,332
9	1993	0	36,400	174,270	137,870	0.332885	0	45,895	0.307508	0	42,396
10	1994	0	36,400	174,270	137,870	0.294589	0	40,615	0.269744	0	37,190
11	1995	0	36,400	174,270	137,870	0.260698	0	35,942	0.236618	0	32,622
12	1996	0	36,400	174,270	137,870	0.230706	0	31,807	0.207560	0	28,616
13	1997	0	36,400	174,270	137,870	0.204165	0	28,148	0.182070	0	25,102
14	1998	0	36,400	174,270	137,870	0.180677	0	24,910	0.159710	0	22,019
15	1999	0	36,400	174,270	137,870	0.159891	0	22,044	0.140097	0	19,315
16	2000	0	36,400	174,270	137,870	0.141497	0	19,508	0.122892	0	16,943
17	2001	0	36,400	174,270	137,870	0.125218	0	17,264	0.107800	0	14,862
18	2002	0	36,400	174,270	137,870	0.110813	0	15,278	0.094561	0	13,037
19	2003	0	36,400	174,270	137,870	0.098064	0	13,520	0.082949	0	11,436
20	2004	0	36,400	174,270	137,870	0.086783	0	11,965	0.072762	0	10,032
21	2005	0	36,400	174,270	137,870	0.076799	0	10,588	0.063826	0	8,800
22	2006	0	36,400	174,270	137,870	0.067964	0	9,370	0.055988	0	7,719
23	2007	0	36,400	174,270	137,870	0.060145	0	8,292	0.049112	0	6,771
24	2008	0	36,400	174,270	137,870	0.053225	0	7,338	0.043081	0	5,940
25	2009	0	36,400	174,270	137,870	0.047102	0	6,494	0.037790	0	5,210
26	2010	0	36,400	174,270	137,870	0.041683	0	5,747	0.033149	0	4,570
27	2011	0	36,400	174,270	137,870	0.036888	0	5,086	0.029078	0	4,009
28	2012	0	36,400	174,270	137,870	0.032644	0	4,501	0.025507	0	3,517
29	2013	0	36,400	174,270	137,870	0.028889	0	3,983	0.022375	0	3,085
30	2014	0	36,400	174,270	137,870	0.025565	0	3,525	0.019627	0	2,706
31	2015	0	36,400	174,270	137,870	0.022624	0	3,119	0.017217	0	2,374
32	2016	0	36,400	174,270	137,870	0.020021	0	2,760	0.015102	0	2,082
33	2017	0	36,400	174,270	137,870	0.017718	0	2,443	0.013248	0	1,826
34	2018	0	17,330	138,215	120,885	0.015680	0	1,895	0.011621	0	1,405
35	2019	0	9,465	51,080	41,615	0.013876	0	577	0.010194	0	424
TOTAL		856,100	1,081,200	5,225,436	3,288,136	---	593,888	626,944	---	578,844	565,108
							33,056			-13,736	

APPENDIX - B

DESIGN OF 220 kV BUSBAR (ALUMINIUM PIPE TYPE CONDUCTOR)

Design of 220 kV Busbar(Aluminium Pipe Type Conductor)

1. Design conditions of 220kV Bus bar

	Notation	Main Bus	Branch Bus
Circuit Voltage	V	220 kV	220 kV
Max. Current	Ic	*1 4000 A	*2 2000 A
Short circuit Current capacity	Is	*3 40 kA	*3 40 kA
Interval of Bus Conductor	D	4 m	4 m
Interval of Bus Support	S	16 m	12.5 m

Note: *1 The same current as rated current of 220 kV Gas circuit breaker for bus coupler.

*2 The same current as rated current of 220 kV Gas circuit breaker for Transmission line.

*3 The same capacity as rupturing capacity of 220 kV Gas circuit breaker.

2. Using conductor of Aluminum pipe

	Notation	Main Bus	Branch Bus
Conductor size (Outside diameter Thickness)	D x t	180mmx10mm	120mmx8mm
Current capacity at 80 °C		4420 Amp.	2810 Amp.
Cross-sectional area	A	5340 mm^2	2815 mm^2
Per unit weight	W	14.42 kg/m	7.6 kg/m
Modulus of section	Z	215.0 cm^3	73.93 cm^3
Moment of inertia	I	1936 cm^4	443.6 cm^4
Modulus of elasticity	E	7000 kg/mm^2	7000 kg/mm^2
Coefficient of Linear expansion	α	23×10^{-6} 1/°C	23×10^{-6} 1/°C
Strength	ρ	17 kg/mm^2	17 kg/mm^2
Wind load	Fw	6 kg/m	9 kg/m

3. Calculation

(1) Natural Vibration of Aluminum pipe : f_0

$$f_0 = \frac{\lambda^2}{2\pi S^2} \cdot \sqrt{\frac{g \cdot E \cdot I}{W}} \quad (\text{Hz})$$

Basic value, $f_0 \geqq 3$ Hz

Where,

λ : Modulus of Horizontal Vibration of bar = 3.93

S : Interval of Bus support (m)

g : Acceleration of gravity = 9.8

E : Modulus of elasticity (kg/mm^2)

I : Moment of ineatia (cm^4)

W : Per unit weight of pipe (kg/m)

1) Main Bus

$$f_{\circ} = \frac{3.93^2}{2 \times 3.14 \times 16^2} \cdot \sqrt{\frac{9.8 \times 7000 \times 10^6 \times 1936 \times 10^{-8}}{14.42}}$$

$= 3$ (Hz) O.K

2) Branch Bus

$$f_{\circ} = \frac{3.93^2}{2 \times 3.14 \times 12.5^2} \cdot \sqrt{\frac{9.8 \times 7000 \times 10^6 \times 443.6 \times 10^{-8}}{7.6}}$$

$= 3.14$ (Hz) $>$ 3 (Hz) O.K

(2) Electromagnetic force of short circuit : Fs

$$F_S = \frac{\sqrt{3}}{2} \cdot \frac{2.05 \times K \times I_S^2 \times 10^{-8}}{D} \quad (\text{ kg/m })$$

Where,

Is : Short circuit current = 40 kA

D : Interval of Bus conductor = 4 m

K : Factor of average electromagnetic force = 3

1) Main Bus

$$F_S = \frac{\sqrt{3}}{2} \cdot \frac{2.05 \times 3 \times (40 \times 10^3)^2 \times 10^{-8}}{4} = 21.3 \quad (\text{ kg/m })$$

2) Branch Bus

$$F_S = \frac{\sqrt{3}}{2} \cdot \frac{2.05 \times 3 \times (40 \times 10^3)^2 \times 10^{-8}}{4} = 21.3 \quad (\text{ kg/m })$$

(3) Total force of Aluminum pipe : T

$$T = \sqrt{W^2 + (F_S + F_W)^2} \quad (\text{ kg/m })$$

Where,

W : Per unit weight of pipe (kg/m)

Fs : Electromagnetic force of short circuit (kg/m)

Fw : Wind load (kg/m)

1) Main Bus

$$T = \sqrt{14.42^2 + (21.3 + 6)^2} = 30.9 \quad (kg/m)$$

2) Branch Bus

$$T = \sqrt{7.6^2 + (21.3 + 9)^2} = 31.2 \quad (kg/m)$$

(4) Stress of Aluminum pipe

Shearing force $Q_p = \frac{5 \cdot T \cdot S}{8} \cdot \frac{1}{A}$ (kg/cm)

Bending stress $M_p = \frac{T \cdot S^2}{8} \cdot \frac{100}{Z}$ (kg/cm)

Basic safety factor > 2.0

Where,

T : Total force of Aluminum pipe (kg/m)

S : Interval of Bus support (m)

A : Cross-section area of Aluminum pipe (mm^2)

Z : Modulus of section (cm^3)

1) Main Bus

$$Q_p = \frac{5 \times 30.9 \times 16}{8} \times \frac{1}{5340 \times 10^{-2}} = 5.8 \quad (kg/cm^2)$$

$$\text{Safety factor } S_q = \frac{\rho}{Q_p} = \frac{17 \times 10^2}{5.8} = 293 > 2.0 \quad \text{O.K}$$

$$M_p = \frac{30.9 \times 16^2}{8} \times \frac{100}{215.0} = 460 \quad (kg/cm^2)$$

$$\text{Safety factor } S_m = \frac{\rho}{M_p} = \frac{17 \times 10^2}{460} = 3.7 > 2.0 \quad \text{O.K}$$

2) Branch Bus

$$Q_p = \frac{5 \times 31.2 \times 12.5}{8} \times \frac{1}{2815 \times 10^{-2}} = 8.7 \quad (kg/cm^2)$$

$$\text{Safety factor } S_q = \frac{\rho}{Q_p} = \frac{17 \times 10^2}{8.7} = 195 > 2.0 \quad \text{O.K}$$

$$M_p = \frac{31.2 \times 12.5^2}{8} \times \frac{100}{73.93} = 824 \quad (kg/cm^2)$$

$$\text{Safety factor } S_m = \frac{\rho}{M_p} = \frac{17 \times 10^2}{824} = 2.1 > 2.0 \quad \text{O.K}$$

(5) Deflection of Aluminum pipe

Deflection is based on pipe weight : δ_1

$$\delta_1 = \frac{W \cdot S^4 \cdot 10^6}{185 \cdot E \cdot I} \quad (\text{ cm })$$

Deflection is based on fixed contact of pantograph type Disconnecting switch : δ_2

$$\delta_2 = 0.009317 \cdot \frac{W \cdot S^3}{E \cdot I} \times 10^6 \quad (\text{ cm })$$

Total Deflection $\delta = \delta_1 + \delta_2$ (cm)

Basic value, Total deflectio $<$ Diameter of pipe $\times \frac{1}{2}$

Where,

W : Per unit weight of pipe (kg/m)

S : Interval of Bus support (m)

E : Modulus of elasticity (kg/mm^2)

I : Moment of inertia (cm)

w : Weight of fixed contact of pantograph type disconnecting switch = 90 kg

1) Main Bus

$$\delta_1 = \frac{14.42 \times 16^4 \times 10^6}{185 \times 7000 \times 10^2 \times 1936} = 3.8 \quad (\text{ cm })$$

$$\delta_2 = 0.009317 \cdot \frac{90 \times 16^3 \times 10^6}{7000 \times 10^2 \times 1936} = 2.5 \quad (\text{ cm })$$

$$\delta = \delta_1 + \delta_2 = 6.3 \text{ cm} < 18 \times \frac{1}{2} \text{ cm} \quad \text{O.K}$$

2) Branch Bus

$$\delta_1 = \frac{7.6 \times 12.5^4 \times 10^6}{185 \times 7000 \times 10^2 \times 443.6} = 3.2 \quad (\text{ cm })$$

$$\delta_2 = 0$$

$$\delta = 3.2 \text{ cm} < 12 \times \frac{1}{2} \text{ cm} \quad \text{O.K}$$

(6) Stretch of Aluminum pipe

$$\Delta S = S \cdot \alpha \cdot t \cdot 10^2 \quad (\text{ cm })$$

Basic strech $\Delta S < 2.5$ cm

Where,

S : Interval of Bus support (m)

α : Coefficient of linear expansion (1/°C)

t : Temperature rise = 60 °C

1) Main Bus

$$S = 16 \times 23 \times 10^{-6} \times 60 \times 10^{2} = 2.2 \text{ cm} < 2.5 \text{ cm}$$

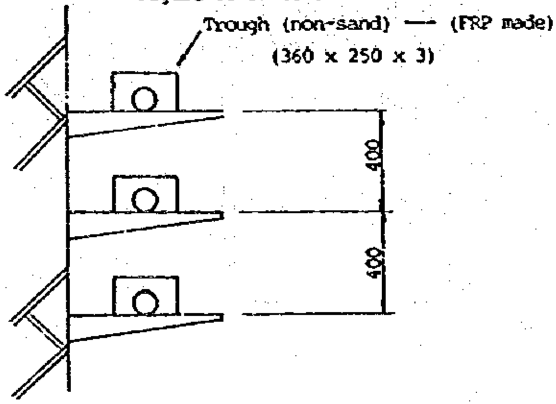
2) Branch Bus

$$S = 12.5 \times 23 \times 10^{-6} \times 60 \times 10^{2} = 1.7 \text{ cm} < 2.5 \text{ cm}$$

APPENDIX - C

REVIEW OF TEMPERATURE OF O.F. CABLES IN AHMED HAMDI TUNNEL

Figure of cable construction



220 kV 2000mm² OF CABLE AMPACITY

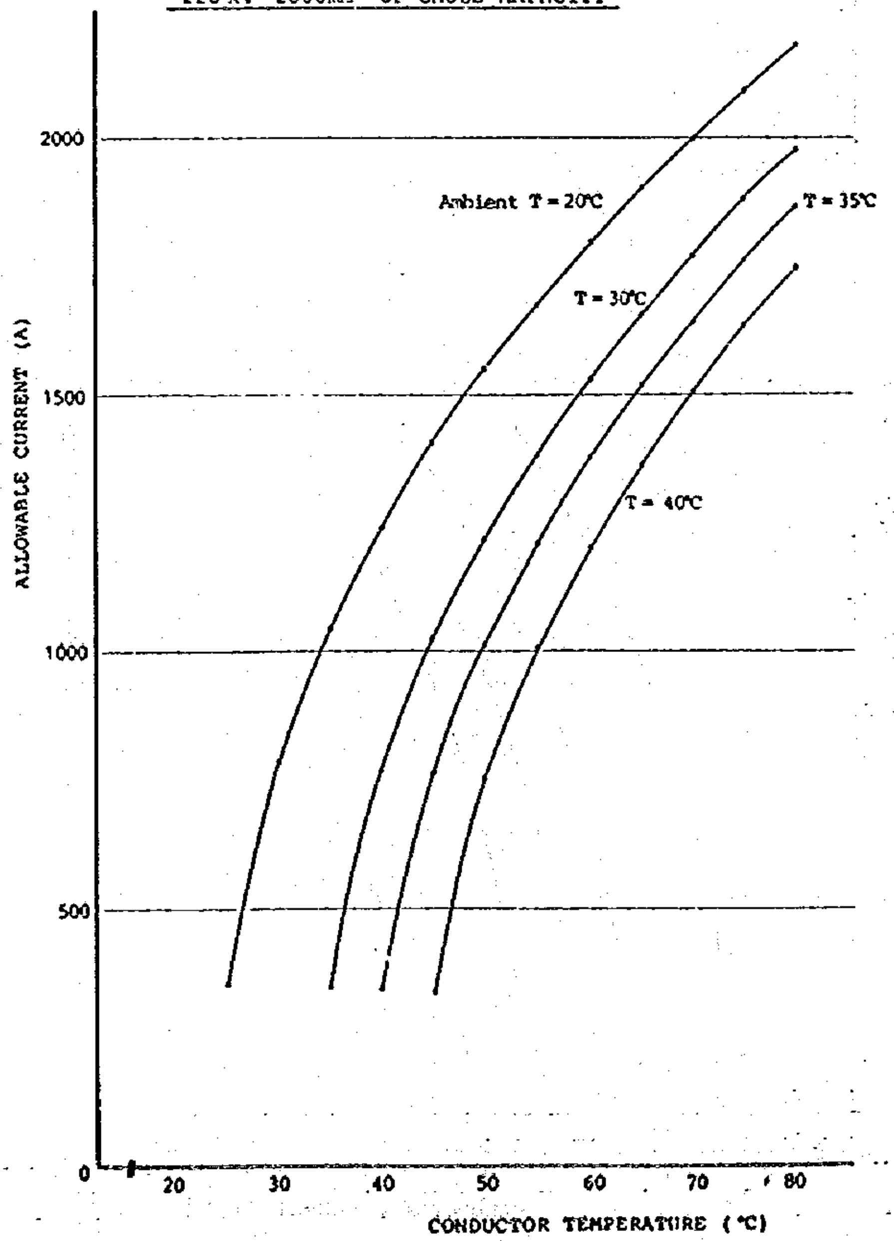
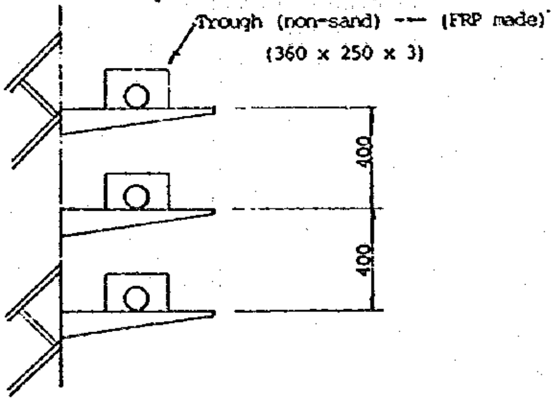
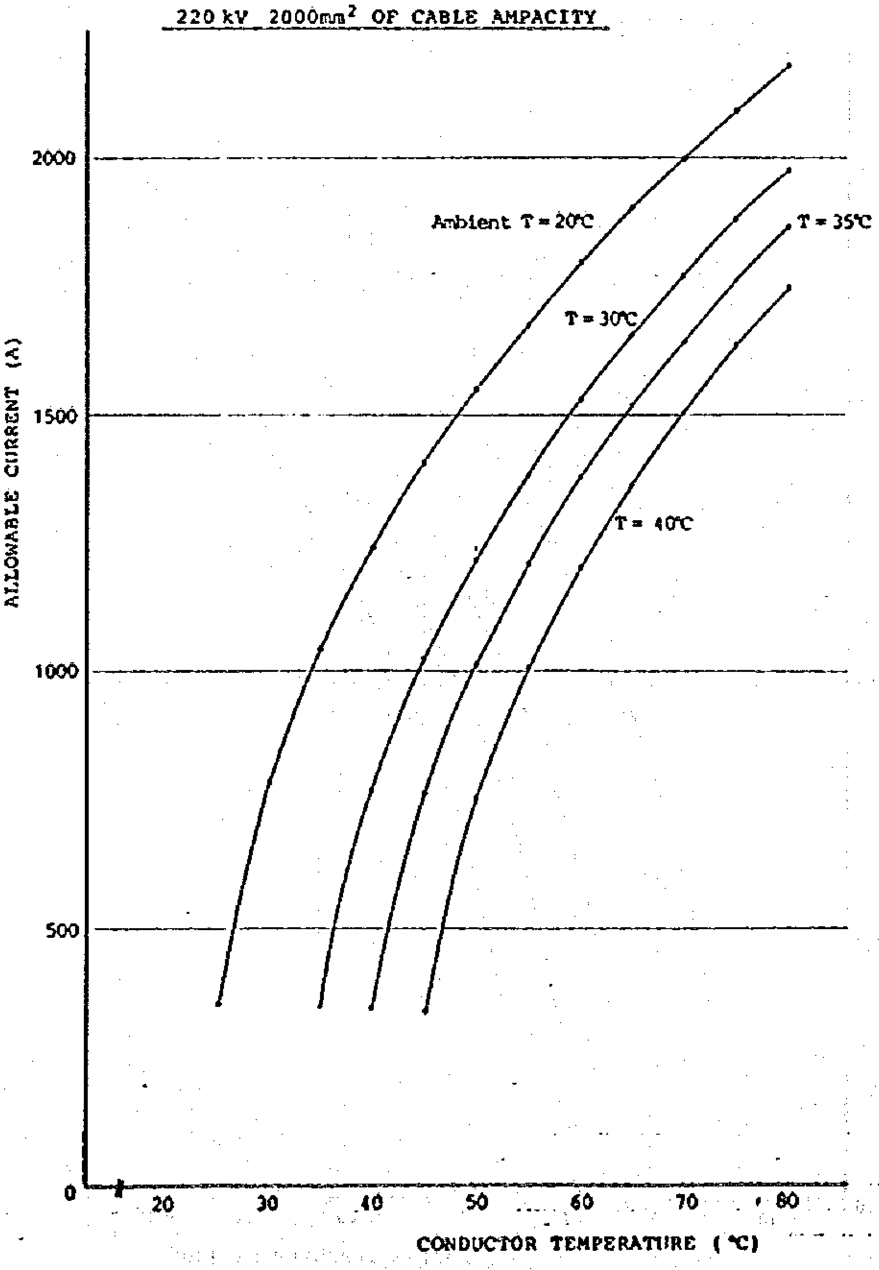


Figure of cable construction



220 kV 2000mm² OF CABLE AMPACITY



APPENDIX - D

REVIEW OF LOAD FLOW FOR YEARS OF 1989 - 1990

GENERATOR LIST

1/2

Node No.	NAME of SUBSTATION	No.of Gene x Out put	Rated Out put (MW)	Possib. Out put (MW)	Year of Operate	Out put operation 1 9 9 0 (MW)		
THERMAL POWER						P	D.T.	M.N.
659	AYUN MUSA	1 x 600	600	600	1990	570	570	570
562	EL KRIMAT	1 x 600	600	600	1990	570	570	570
562	EL KRIMAT	1 x 300	300	300	1989	285	285	285
562	EL KRIMAT	1 x 300	300	300	1989	285	285	285
659	AYUN MUSA	1 x 300	300	300	1988	285	285	285
659	AYUN MUSA	1 x 300	300	300	1988	285	285	285
652	DAMANHOUR	1 x 300	300	300	1986	285	285	285
556	SHOBURA	1 x 300	300	300	1986	285	285	285
656	ISMARIA	1 x 150	150	150	1986	142	142	107
556	SHOBURA	1 x 300	300	300	1985	285	285	285
556	SHOBURA	1 x 300	300	300	1985	285	285	285
651	DOUWER	1 x 110	110	110	1985	105	105	28
657	EL SUEZ	1 x 300	300	300	1985	285	285	285
651	DOUWER	1 x 110	110	110	1984	105	105	28
657	EL SUEZ	1 x 150	150	150	1984	142	142	107
657	EL SUEZ	1 x 150	150	150	1984	142	142	107
656	ISMARIA	1 x 150	150	150	1983	142	142	107
753	ABU QIR	1 x 150	150	150	1984	142	142	107
753	ABU QIR	1 x 150	150	150	1984	142	142	107
656	ISMARIA	1 x 150	150	150	1983	142	142	107
753	ABU QIR	1 x 150	150	150	1983	142	142	107
753	ABU QIR	1 x 150	150	150	1983	142	142	107
656	ISMARIA	1 x 150	150	150	1982	142	142	107
651	DOUWER	2 x 110	220	220	1980	210	210	56
552	CAIRO WEST	1 x 87.5	87.5	61.3	1979	55	46	--
552	CAIRO WEST	3 X 87.5	262.5	183.8	1966	165	46	--
652	DAMANHOUR	3 x 65	195	163.8	1968	147	--	--
653	EL SUIF	2 x 33	66	60	1969	54	--	--
654	TALKHA	3 x 30	90	73.8	1966	66	--	--
854	ASSIOUT	3 x 30	90	55	1966	50	--	--
658	SUEZ O	4 x 25	100	75	1965	67	--	--
557	CAIRO SOUTH	1 x 60	60	45	1965	40	--	--
653	EL SUIF	2 x 26	52	47	1961	42	--	--
652	DAMANHOUR	2 x 15	30	25	1960	22	--	--

GENERATOR LYST

2/2

Node No.	Name of Substation	No. of Gen. x Out put	Rated Out Put	Possible Out put	Year of Operate	Out put Operation 1 9 9 0 (MW)		
GAS POWER						P	D.T.	M.N.
652	DAMANHOUR	2 x 50	100	100	1984	95	--	--
560	WADI HOFF	3 x 33.3	100	100	1984	--	--	--
653	EL SUIF	3 x 33.3	100	100	1983	95	--	--
653	MOHMOUDIA	8 x 25	200	200	1983	190	--	--
653	EL SUIF	2 x 33.3	66.6	66	1982	63	--	--
653	MOHMOUDIA	1 x 50	50	50	1982	48	--	--
653	MOHMOUDIA	4 x 50	200	200	1981	--	--	--
561	EL SHABAB	3 x 33.3	100	100	1982	--	--	--
653	EL SUIF	1 x 33	33	33	1981	--	--	--
653	EL SUIF	1 x 33	33	30	1980	--	--	--
559	N. TEBBIN	2 x 25	50	45	1980	--	--	--
654	TALKHA	2 x 24.2	48.4	43	1980	--	--	--
558	HELWAN	5 x 24.2	121	110	1980	--	--	--
554	HELIOPOLIS	3 x12.5	37.5	35	1980	--	--	--
555	CAIRO EAST	2 x 25	50	45	1980	--	--	--
655	PORT SAID	2 x 20	40	36	1979	--	--	--
654	TALKHA	6 x 24.2	145.2	130.7	1979	--	--	--
553	CAIRO NORTH	1 x 20	20	18	1979	--	--	--
751	EL MATAMIA	1 x 23	23	20	1978	--	--	--
656	ISMARIA	1 x 22	22	15	1977	--	--	--
658	SUEZ O	1 x 17	17	15	1976	--	--	--
753	EL MAX	2 x 14	28	24	1966	--	--	--

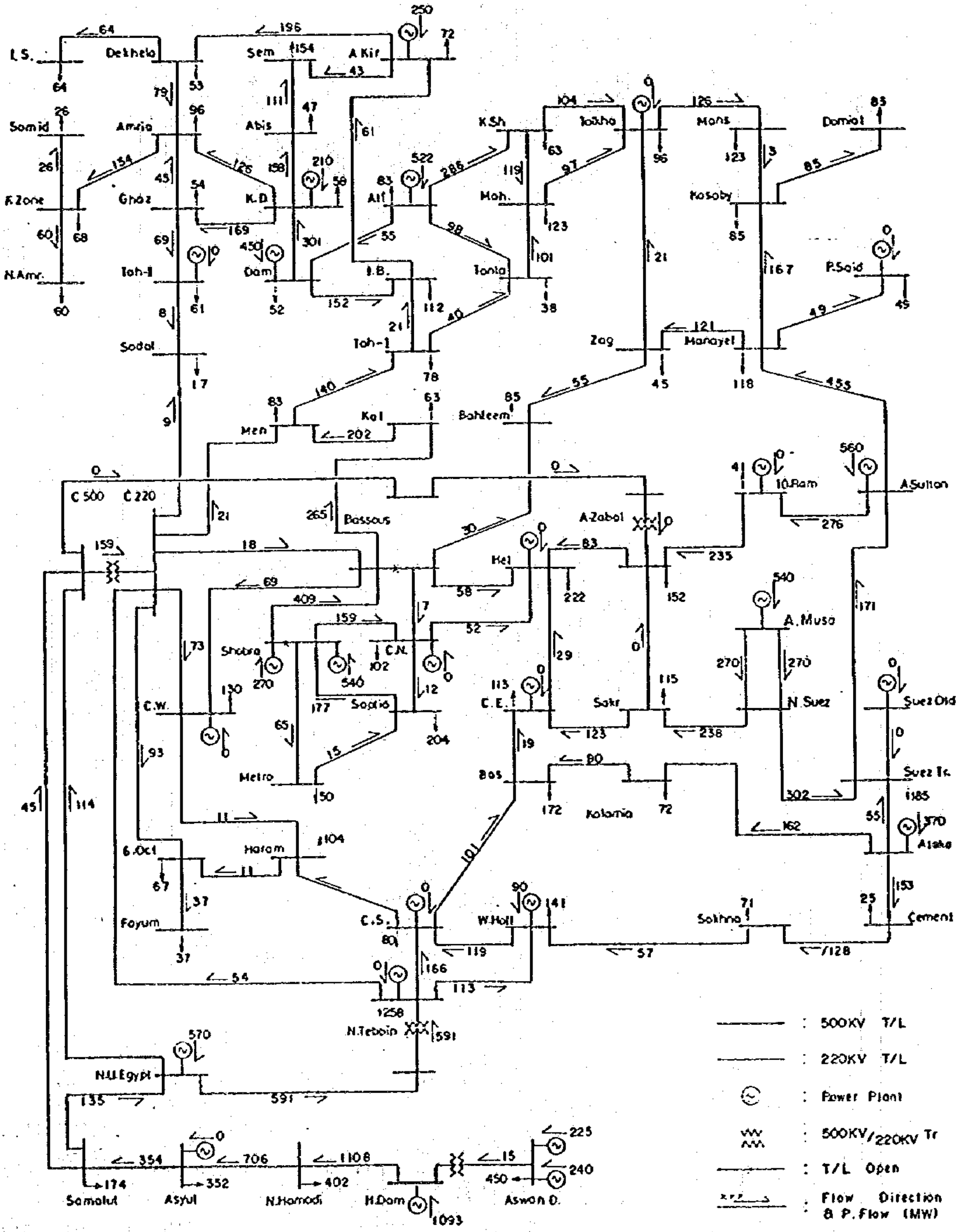
HYHDORO POWER						P	O.P	N
851	ASWAN DAM	7 x 46	322	322	1960	199	199	199
852	ASWAN II	4 x 75	300	300	1983	205	205	155
853	ASWAN HIGHDAM	(1.) 10 x 175	1750	1750	1967 ~1970	1616	650	354

TOTAL OUT PUT (A)	8764	6691	5595
POSSIBLE OUT PUT CAPACITY (B)	9305	8117	7944
SPINING RESERVE CAPACITY (B)-(A)	541	1426	2349
%	6.1	21.3	42.0

1989 Flow NO.3

Load Flow in 1989 (Day Time) Case L-89-2

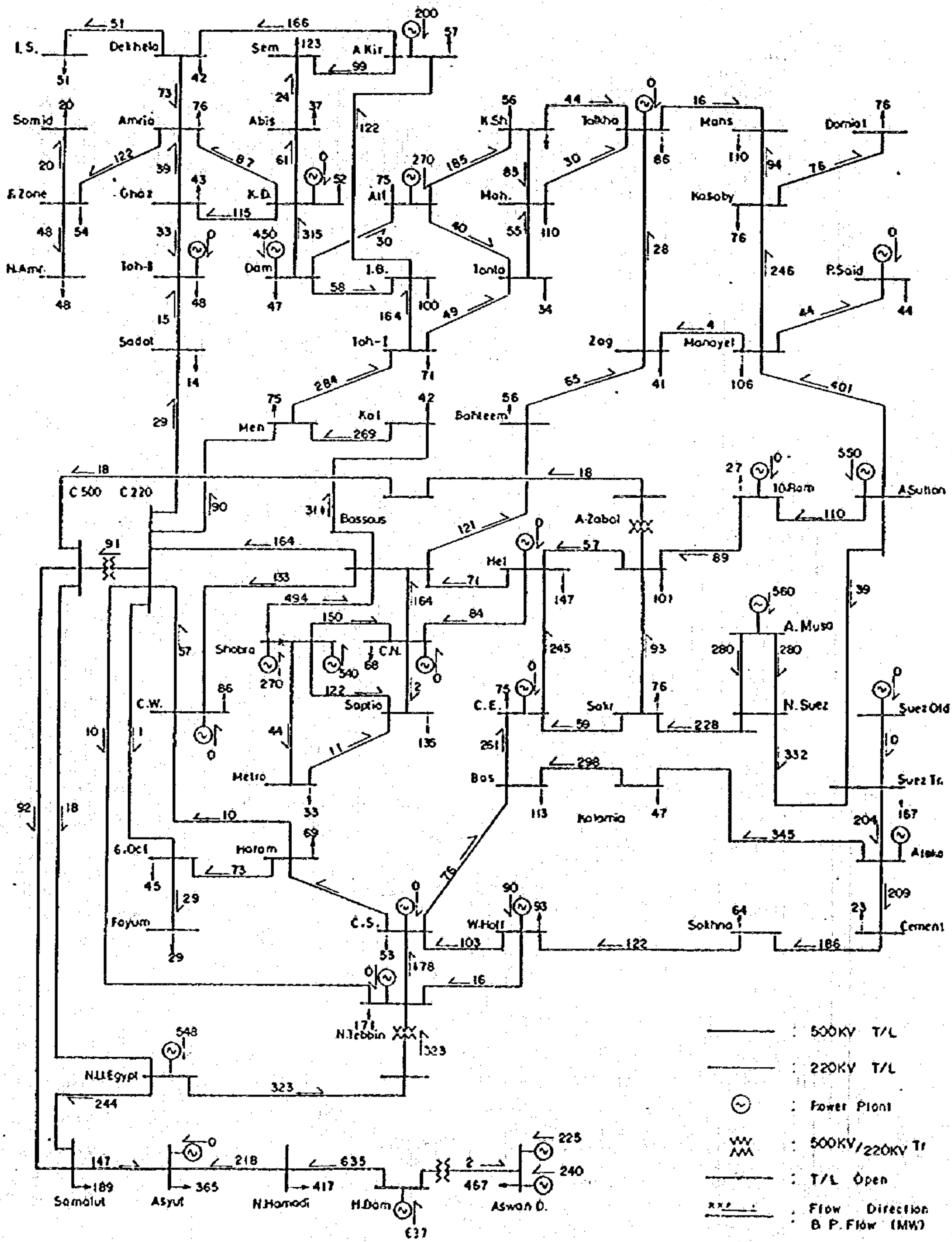
Conditions : 1) All Loop



1989 Flow NO4

Load Flow in 1989 (Mid Night) Case L-89-3

Conditions : 1) All Loop



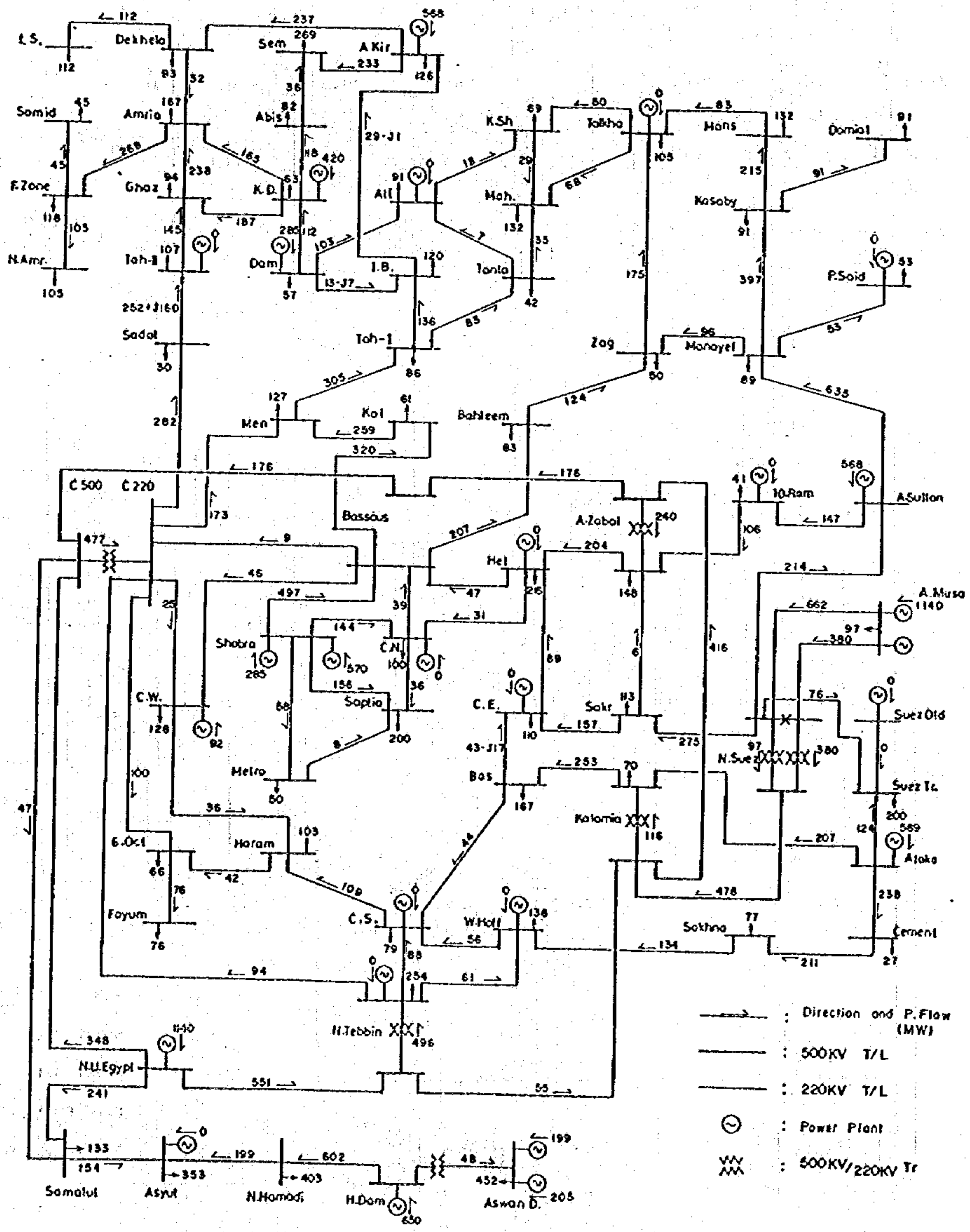
1990 Flow NO.6

Load Flow in 1990 (Day Time) Case L-90-2

Conditions : I) All Loop

II) N.Suez 220KV Bus Separate

III) Reference Bus is C.500



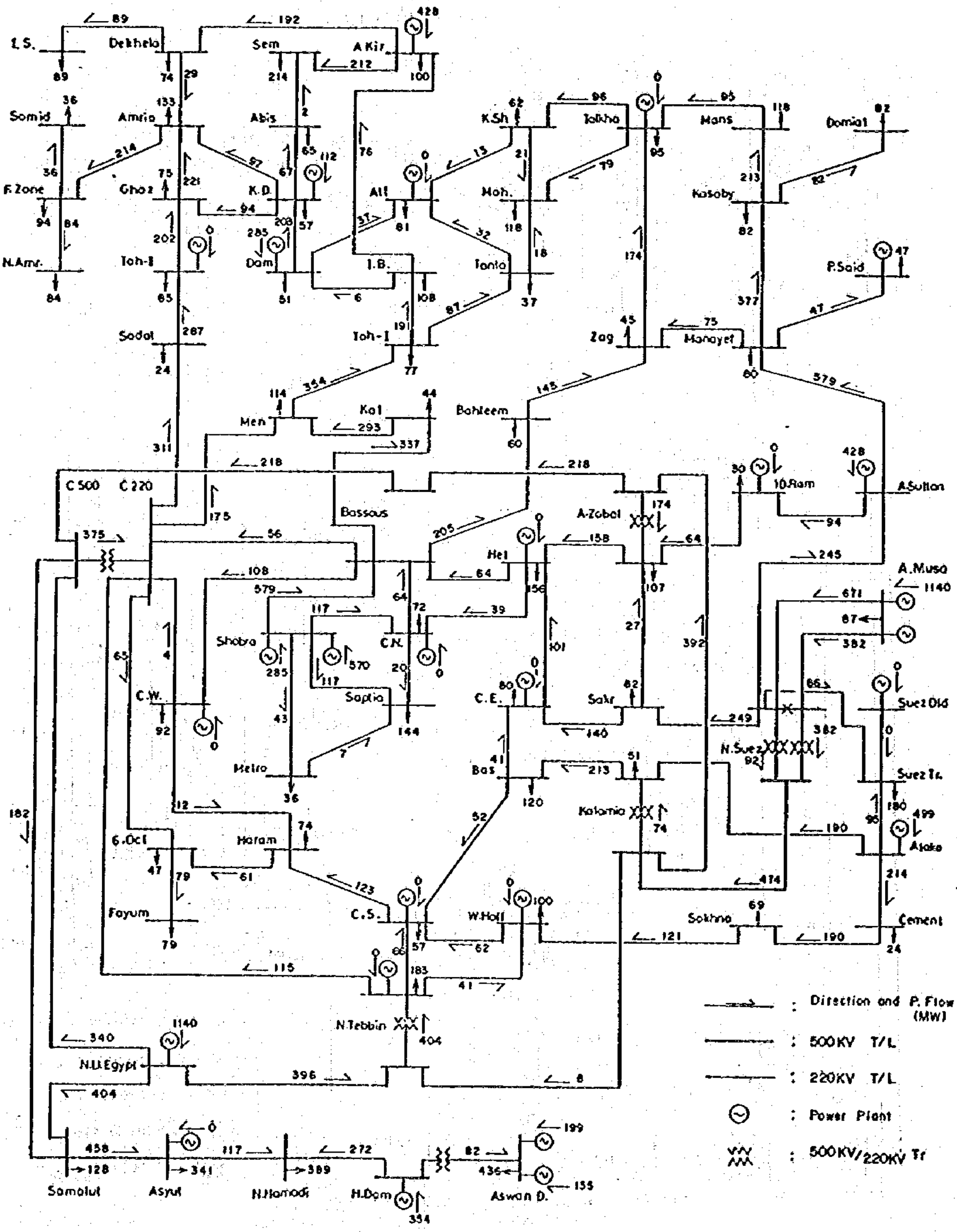
1990 Flow NO.7

Load Flow in 1990 (Mid Night) Case L-90-3

Conditions : I) All Loop

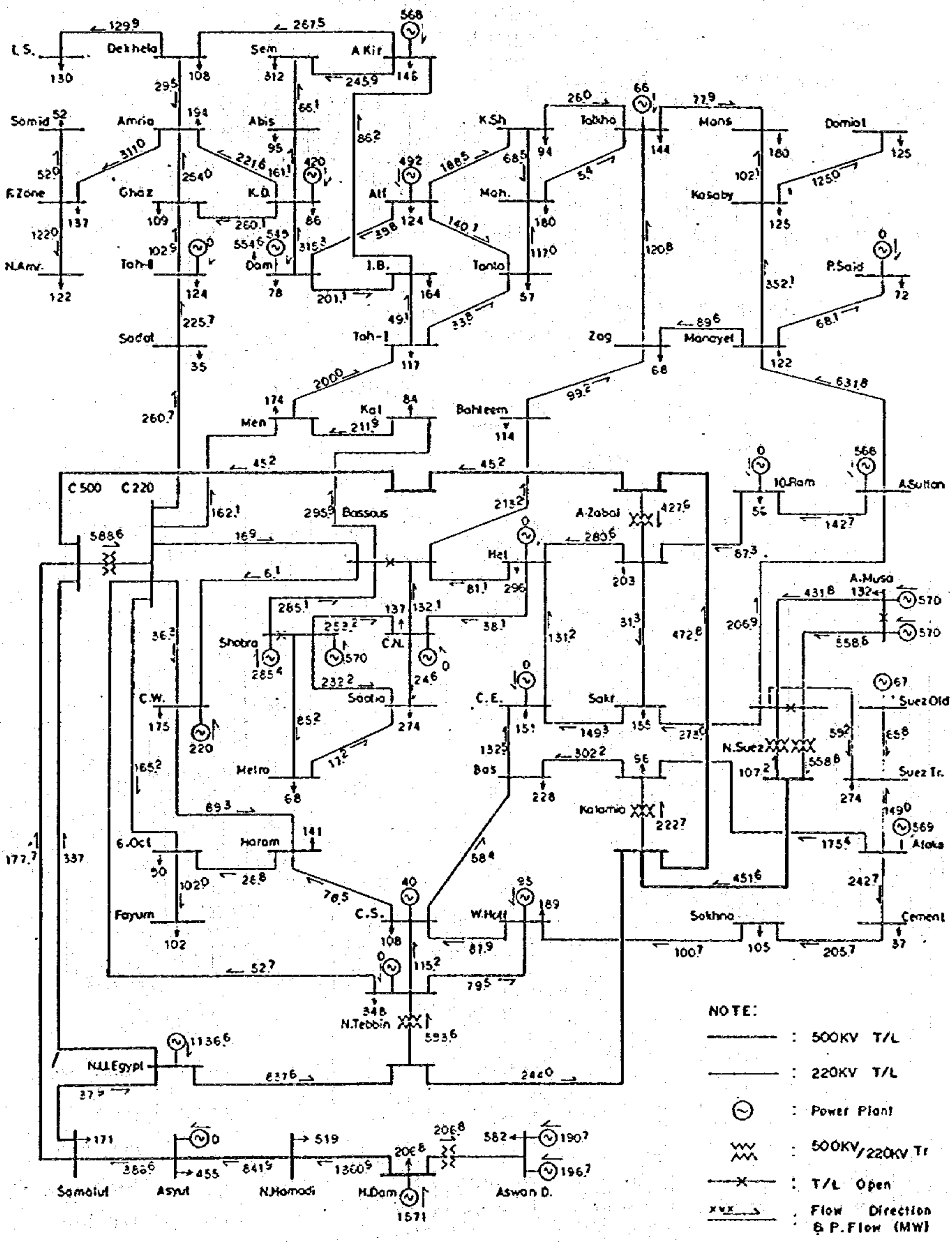
II) N.Suez 220KV Bus Separate

III) Reference Bus is C.500



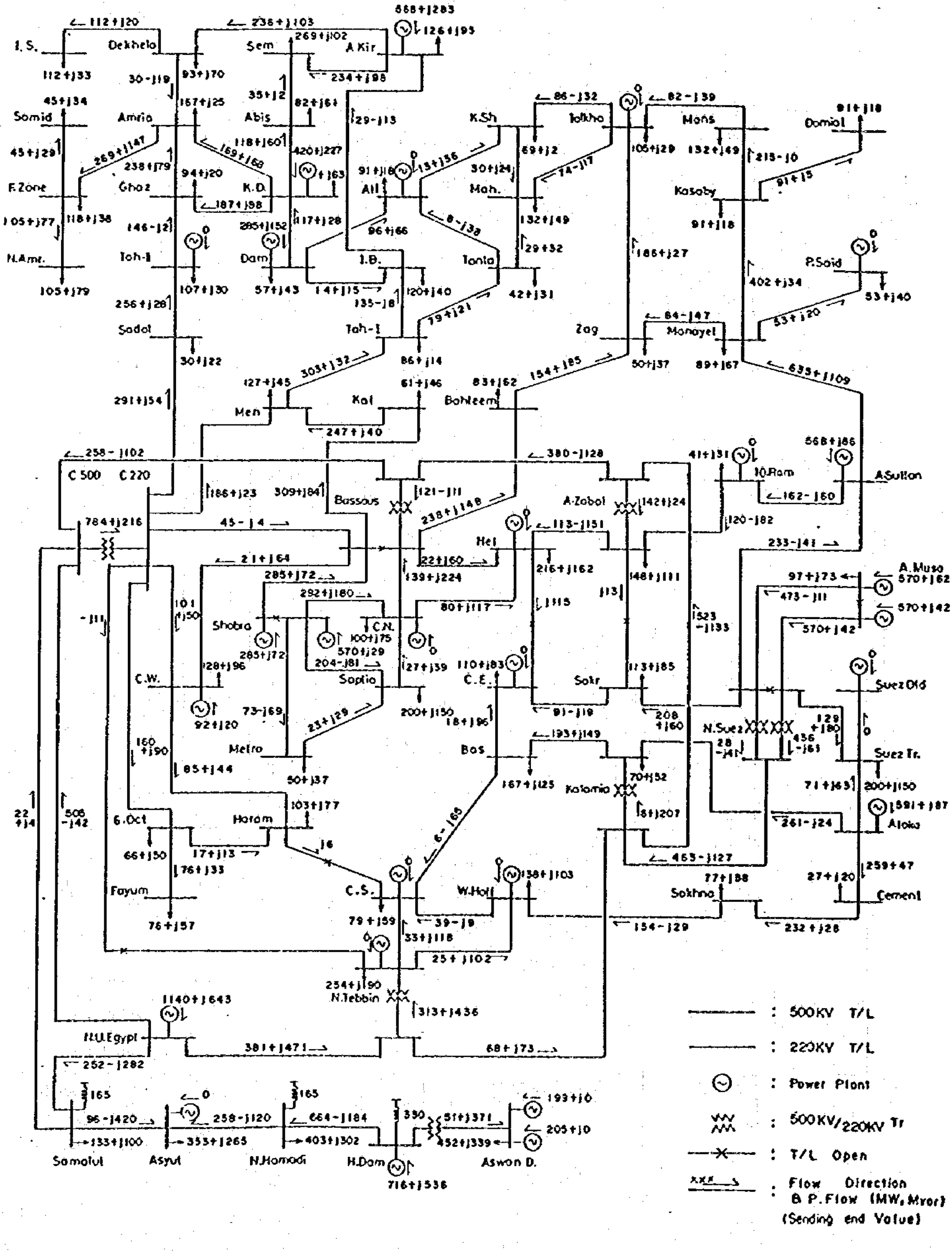
Load Flow 1990 (Peak) case L-90-3

Conditoins: i) Bassous, Shobra Bus Separate
ii) New Suez 220 kv Bus Separate



Load Flow in 1990 (Day Time) Case L-90-6

Conditions
- I) Bassous, Shobra Bus Separate.
- II) C200-N.Tebbin, Haram-C.S, Hel-C.E, A.Zabol-Sakr Lines Open
- III) Bassous 500/220KV Step Down Tr. Is Installed.
- IV) N.Suez 220KV Bus Separate.



Load Flow in 1990 (Mid Night) Case L-90-7

Conditions
I) Bossous, Shobra Bus Separate.
II) C200-N.Tebbin, Horam-C.S, Hel-C.E, A.Zabal-Sakr Lines Open
III) Bossous 500/220KV Step Down Tr. Is Installed.
IV) N.Suez 220KV Bus Separate.