promoted after securing the work space by retaining the ground through use of steel sheet piles. Prior to the retaining work, shore struts should be tentatively provided.

(3) Drainage work

Because of the high ground water level at this site, drainage work is essential during the excavation and dismantling work. Normally, although drainage by using drainage pumps is sufficient in cases whese the excavation area is small, the site area required that drainage be executed by means of wells, particularly during excavation of foundations for the main powerhouse building, boiler structure, chimney, etc., in case the excavation area is large.

(4) Piling work

For the main powerhouse building, boiler structure, chimney and other heavy structures, 600 mm diameter steel pipe piles should be used, and 400 mm diameter concrete piles adopted for other structures. Piles having a length of about 30 m will be driven in so as to firm the consolidated clay stratum.

(5) Foundation concreting work

All materials for concreting work can be procured in Pakistan. However, since a space sufficient for installing the concrete batcher plant is not available within the site, this plant should be installed outside the plant site. As a result, it will be necessary to procure ready-mix concrete trucks, no doubt from an outside country. As for the concrete batcher plant, it would be most effective if a part of the KSY site could be leased for installation of this plant.

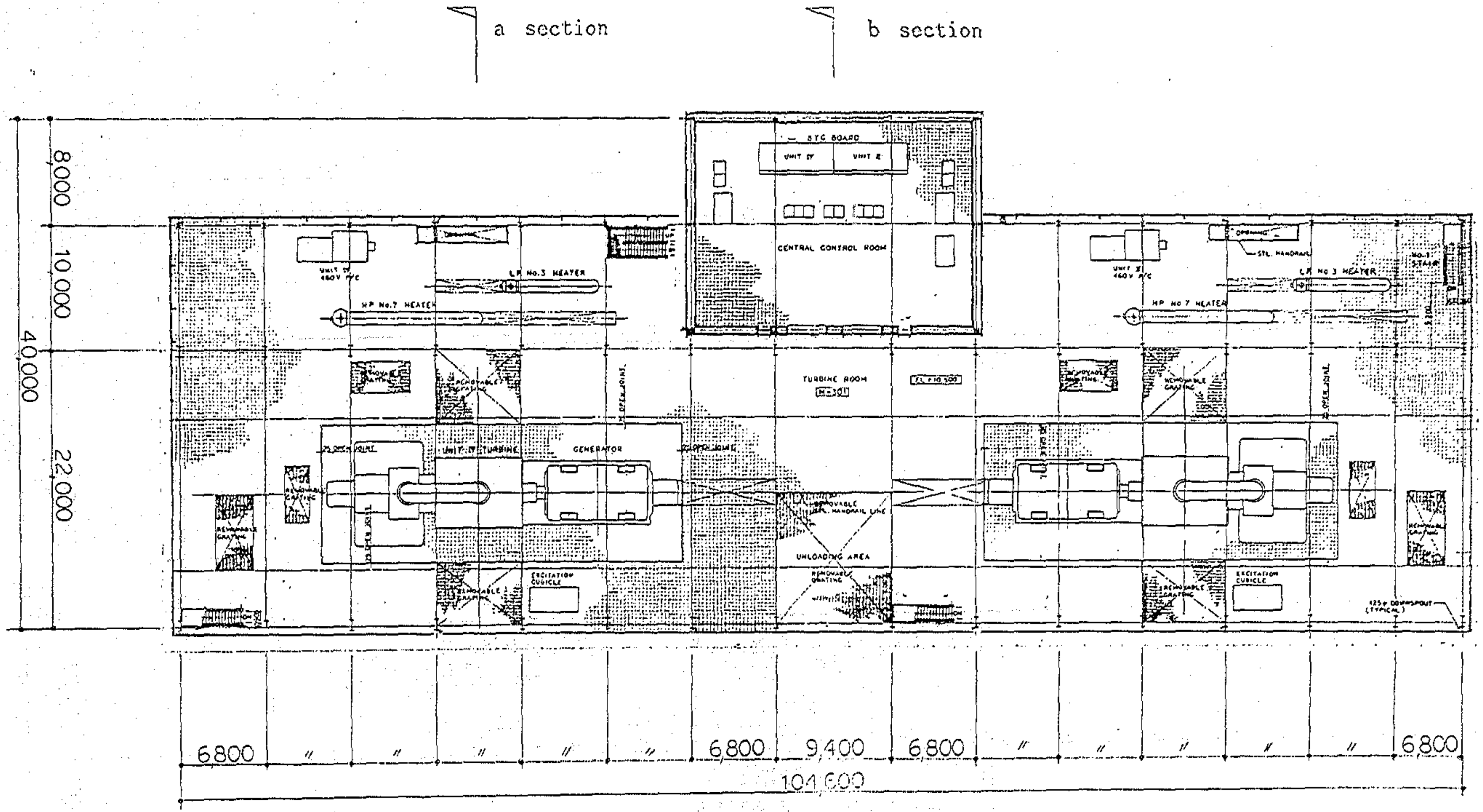


Fig.6.7-1(a) 3rd Floor Plan

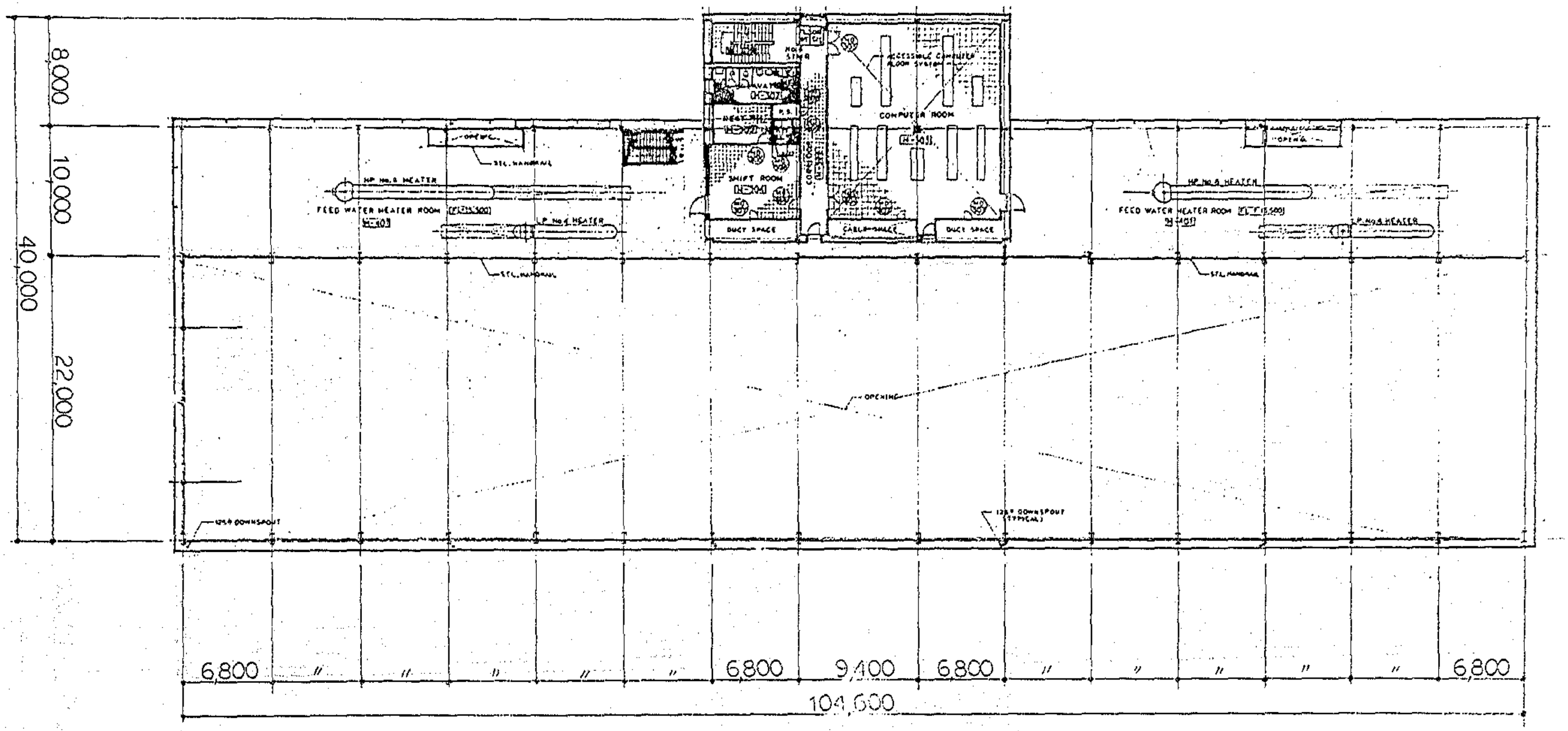
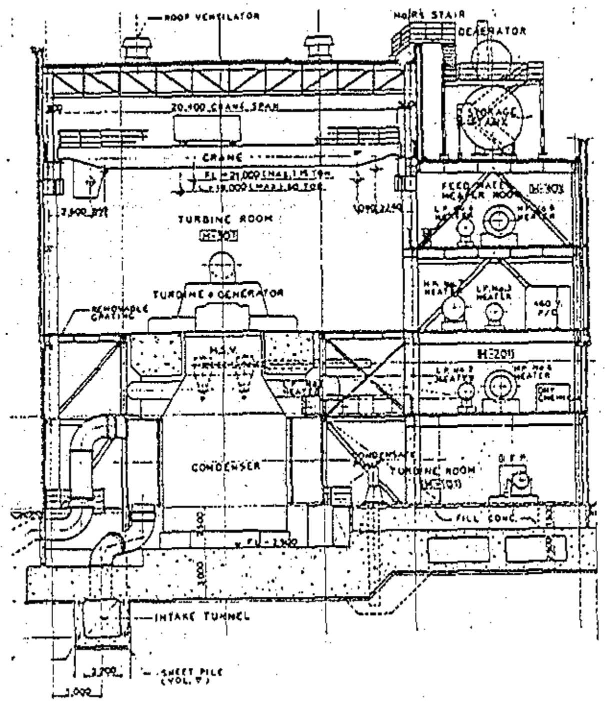
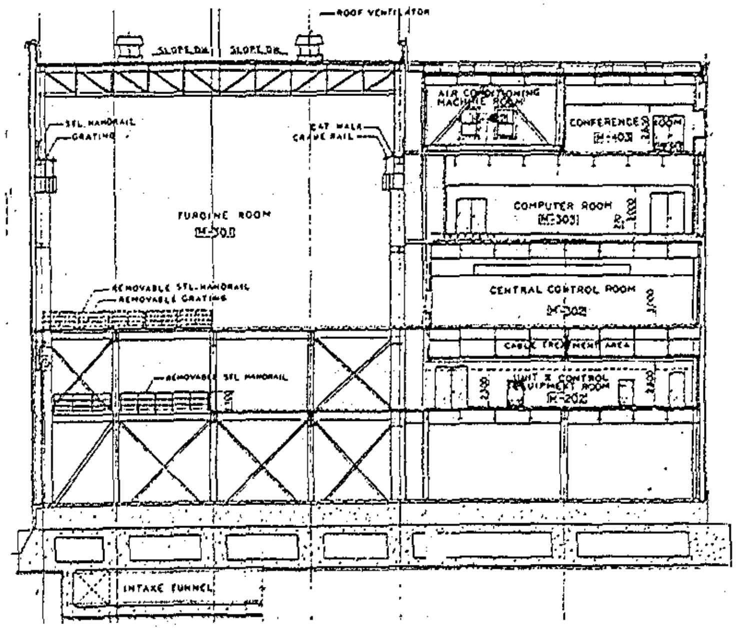


Fig.6.7-1(b) 4th Floor Plan



a section



b section

Fig.6.7-1(c) Section

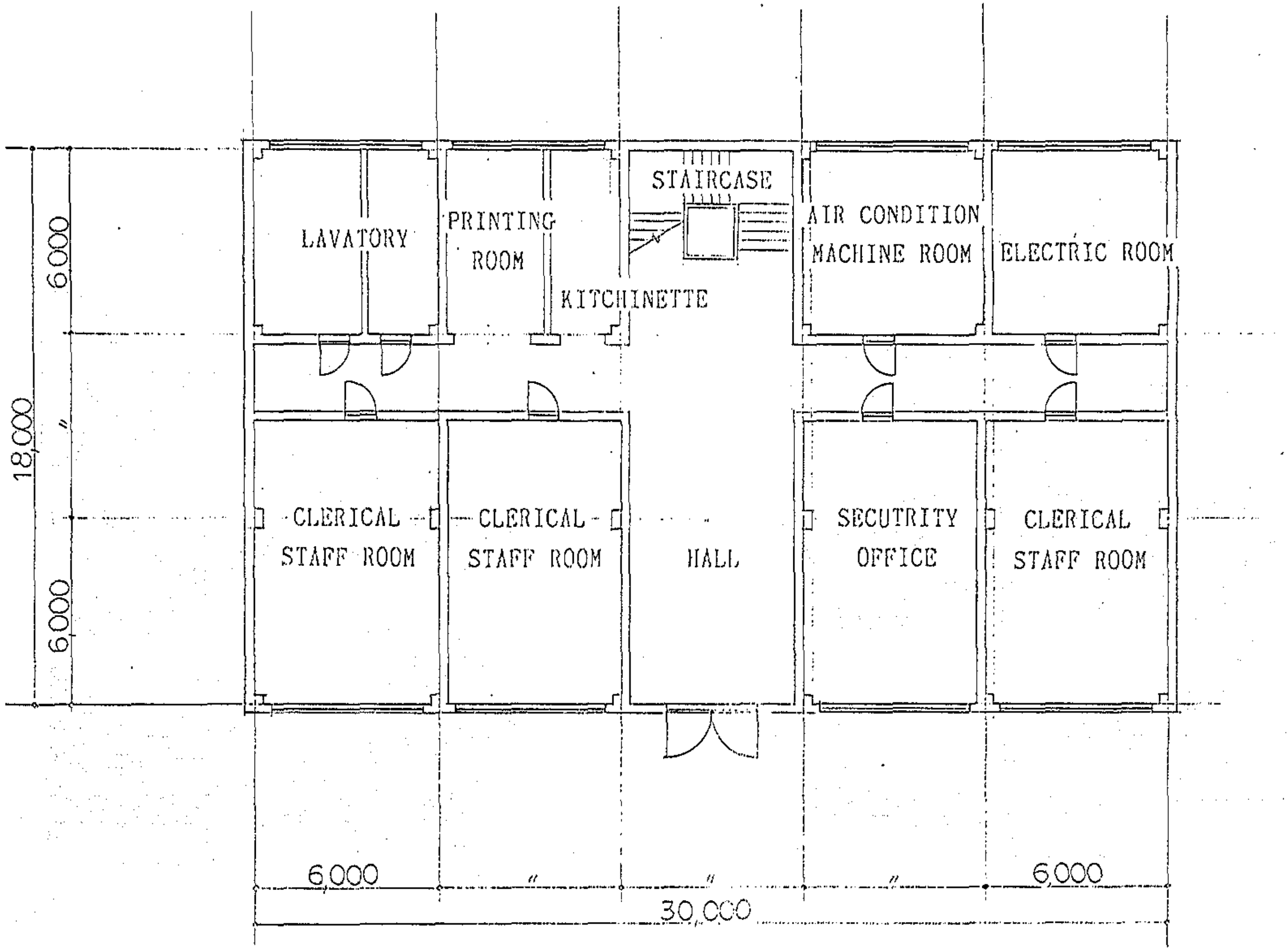


Fig.6.7-2 1st Floor Plan of ADMINISTRATION BUILDING

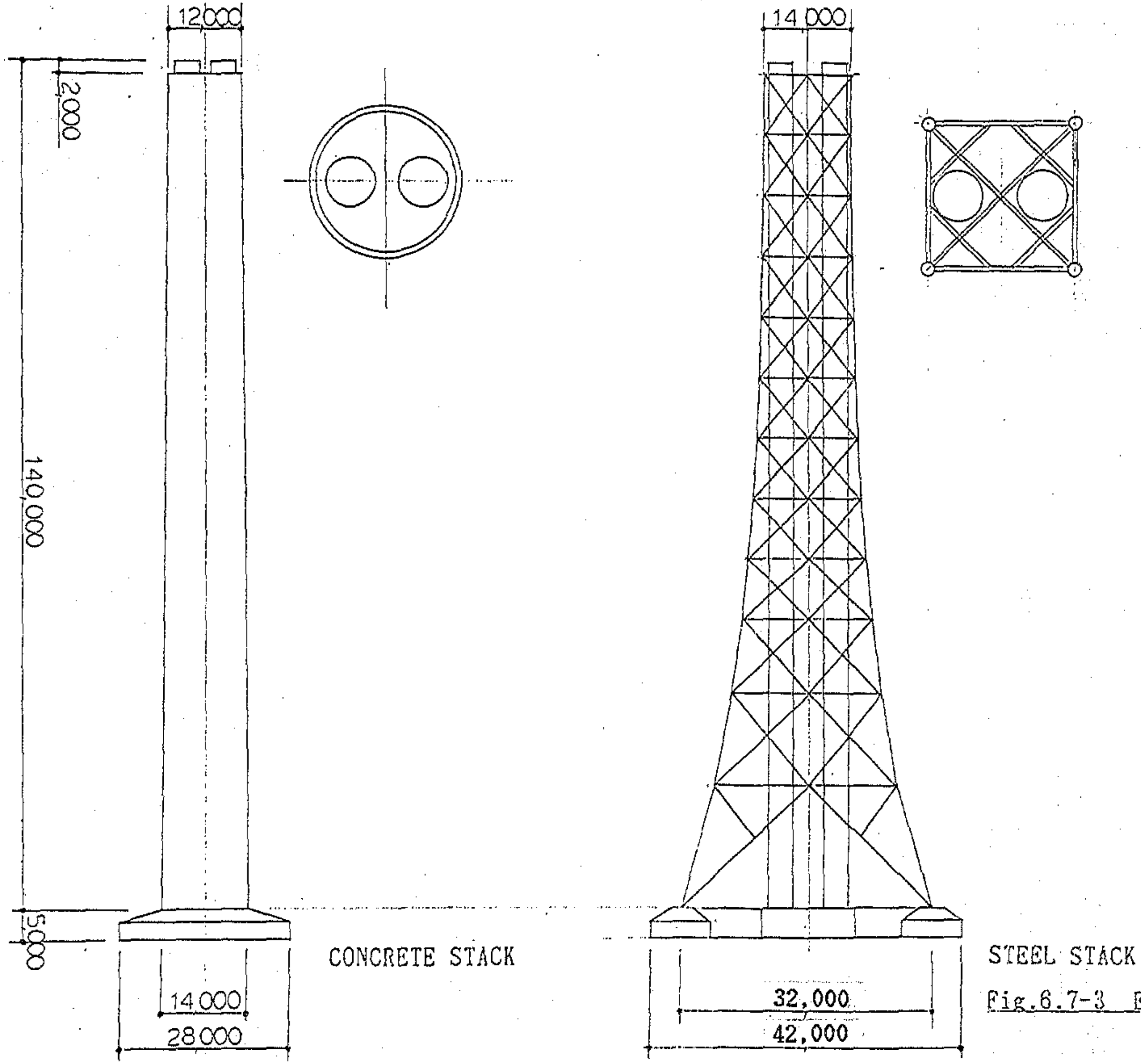


Fig.6.7-3 Elevation of Stacks

Table 6.7-1 COMPARATIVE EVALUATION ON STACK

	CONCRETE STACK	STEEL STACK
COST of work	100 (Normarised)	120 (Normarised)
TERM of work	140 days	160 days
AREA of work	28m x 28m	42m x 42m
EVALUATION	BETTER	GOOD

Chapter 7. COST ESTIMATION

The optimum development plan of the West Wharf Thermal Power Plant Project envisages to construct two (2) sets of 200 MW oil fired thermal power generating unit.

The construction cost is estimated based upon the optimum development plan by assuming reconstruction of the existing West Wharf Power Plant and according to the equipment specifications cited in Chapter 6 of this report.

The construction cost listed below contains the equipment cost, erection cost, engineering fee, contingency, etc., while the equipment cost for two (2) sets of 200 MW thermal power generating unit and 220 kV transmission facilities is as listed in Table 7-1 and 7-2.

These costs have been estimated, based on the average costs in Japan, with reference of tender prices of the similar equipment in Pakistan, local material acost, local labour costs, etc., furthermore, considering the additional costs due to reconstruction of the existing power stations, such as dismantling of the "B" and "BX" power station, removal and rebuilding of the existing facilities, etc.

The estimated construction costs are summerized as follows.

(1) West Wahrf Thermal Power Plant

200 MW oil fired thermal power generating unit

Units No.1 and No.2 construction cost x 10^6 ¥
(x 10^6 Rs. 1Rs = 7.4074¥)

	No.1 Units	No.2 Unit	Nos.1 and 2
Foreign currency	22,386.75 (3,022.21)	15,686.03 (2,117.62)	38,072.78 x 10^6¥ (5,139.83 x 10^6Rs)
Items			
200MW power equipment	15,002.10	12,897.90	27,900.00
Civil works	2,574.06	1,718.94	4,293.00
Substation	2,520.00		2,520.00
Consultant fee & contingency	2,290.59	1,069.19	3,359.78

	No.1 Units	No.2 Unit	Nos.1 and 2
Local currency	4,184.39 (564.89)	3,345.48 (451.64)	7,529.87 x 10^6¥ (1,016.53 x 10^6Rs)
Items			
200MW power plant erection fee	1,376.35	1,188.65	2,565.00
Civil works	1,663.23	1,451.27	3,114.50
Substation erection fee	68.00		68.00
Consultant fee & contingency	1,076.81	705.56	1,782.37

(2) 220 kV transmissio and substation facilities, construction cost (Baldia G/S - West Wharf Power Plant) (1Rs = 7.4074¥)

Foreign currency (equipment, material)	$2{,}203.0 \times 10^6$¥	(297.4×10^6Rs)
Local currency (erection)	585.9×10^6¥	(79.1×10^6Rs)

(3) Total construction cost

Foreign currency	$40{,}275.78 \times 10^6$¥	($5{,}437.24 \times 10^6$Rs)
Local currency	$8{,}115.77 \times 10^6$¥	($1{,}095.63 \times 10^6$Rs)

Table 7-1

WEST WHARF THERMAL POWER PLANT PROJECT

FEASIBILITY STUDY

EQUIPMENT & ERECTION COST

YEN EQUIVALENT COST (x10^6 YEN)

	UNIT 1			UNIT 2			TOTAL		
	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL
CIVIL WORK	2574.06	1663.23	4237.29	1718.94	1451.27	3170.21	4293.00	3114.50	7407.50
BOILER	5184.60	637.90	5822.50	4690.80	577.10	5267.90	9875.40	1215.00	11090.40
TURBINE	5855.00	433.35	6288.35	5089.00	376.65	5465.65	10944.00	810.00	11754.00
ELECTRICAL	3212.40	305.10	3517.50	2473.30	234.90	2708.20	5685.70	540.00	6225.70
SUBSTATION	2520.00	68.00	2588.00			0.00	2520.00	68.00	2588.00
SPARE PART	750.10		750.10	644.80		644.80	1394.90	0.00	1394.90
TOTAL	20096.16	3107.58	23203.74	14616.84	2639.92	17256.76	34713.00	5747.50	40460.50

RUPEE EQUIVALENT COST (x10^6 Rs)   1 Rs= 7.4074¥

	UNIT 1			UNIT 2			TOTAL		
	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL
CIVIL WORK	347.50	224.54	572.03	232.06	195.92	427.98	579.56	420.46	1000.01
BOILER	699.92	86.12	786.04	633.26	77.91	711.17	1333.18	164.03	1497.21
TURBINE	790.43	58.50	848.93	687.02	50.85	737.86	1477.44	109.35	1586.79
ELECTRICAL	433.67	41.19	474.86	333.90	31.71	365.61	767.57	72.90	840.47
SUBSTATION	340.20	9.18	349.38	0.00	0.00	0.00	340.20	9.18	349.38
SPARE PART	101.26	0.00	101.26	87.05	0.00	87.05	188.31	0.00	188.31
TOTAL	2712.98	419.52	3132.51	1973.28	356.39	2329.66	4686.26	775.91	5462.17

DOLLAR EQUIVALENT COST (x10^6 $)   1 $=125 ¥

	UNIT 1			UNIT 2			TOTAL		
	F/C	L/C	TOTAL	F/C	L/C	TOTAL	F/C	L/C	TOTAL
CIVIL WORK	20.59	13.31	33.90	13.75	11.61	25.36	34.34	24.92	59.26
BOILER	41.48	5.10	46.58	37.53	4.62	42.14	79.00	9.72	88.72
TURBINE	46.84	3.47	50.31	40.71	3.01	43.73	87.55	6.48	94.03
ELECTRICAL	25.70	2.44	28.14	19.79	1.88	21.67	45.49	4.32	49.81
SUBSTATION	20.16	0.54	20.70	0.00	0.00	0.00	20.16	0.54	20.70
SPARE PART	6.00	0.00	6.00	5.16	0.00	5.16	11.16	0.00	11.16
TOTAL	160.77	24.86	185.63	116.93	21.12	138.05	277.70	45.98	323.68

Table 7-2

WEST WHARF P.P. UNITS 1 & 2 CONSTRUCTION COST
220 kV Transmission Line

	Foreign Currency	Local Currency	Total
220 kV Transmission Line	2,203.0	585.9	$\times 10^6$ ¥ 2,788.9
	297.4	79.1	$\times 10^6$ Rs 376.5

(1 Rs = 7.4074¥)

Chapter 8. IMPLEMENTATION SCHEDULES

The implementation schedule for the optimum development plan described in Chapter 5 is as attached in Fig. 8-1.

In this schedule, the first unit of 200 MW termal power plant is envisaged to be completed at the end of 1992, and the second unit at the end of 1994, which is two years after completion of the first unit.

This schedule is based upon Development Plan A, which means that construction work of the first unit should start with the "BX" station in operation.

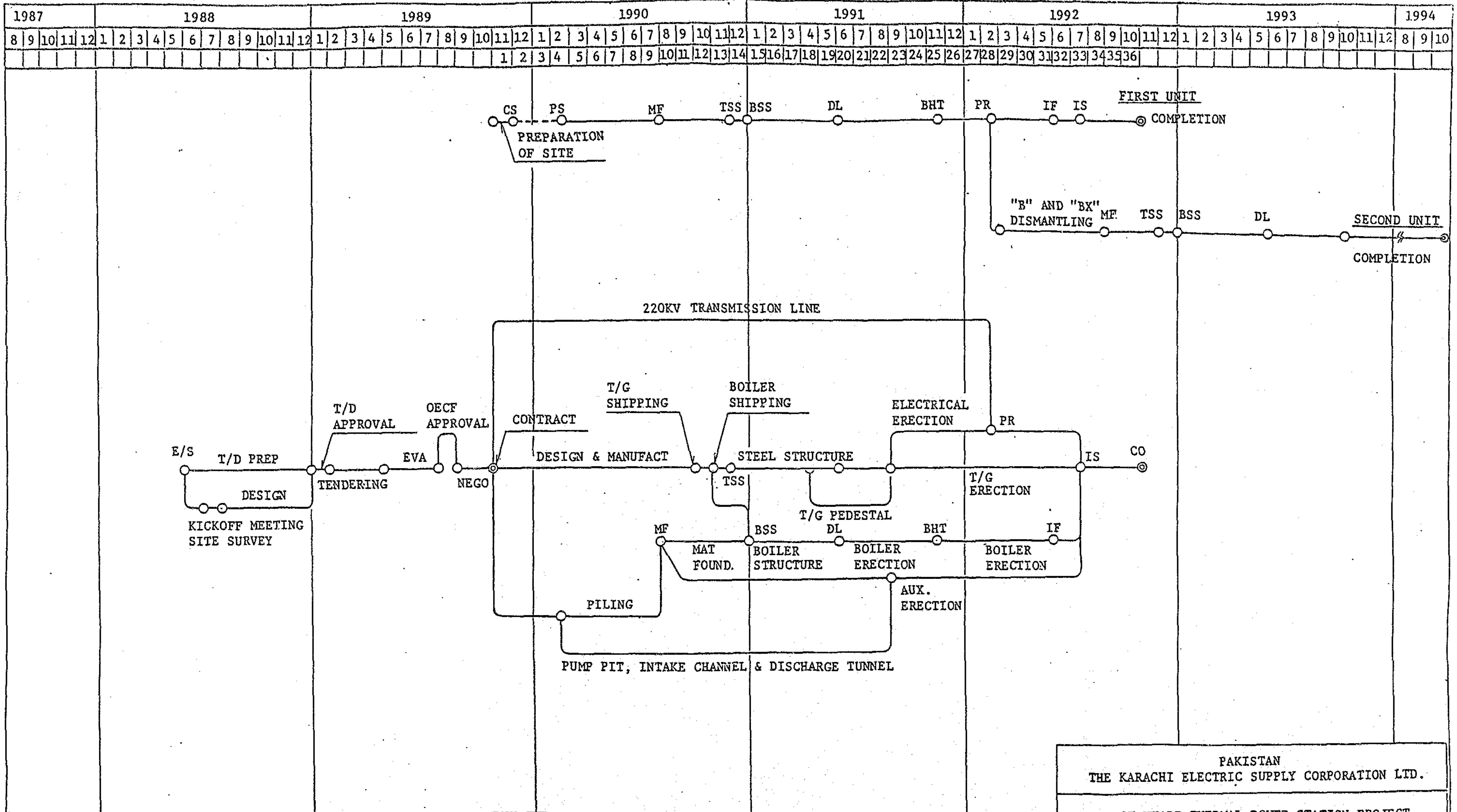
Decommissioning and dismantling of the "BX" station will be commenced after the 220 kV transmission line will have been connected from the Balodia G/S to West Wharf P.P.

In order to realize completion of the second unit within two (2) years after the first unit, the construction work should be carried out by the same contractor. Moreover, the loan agreement should be arranged in the same package with the first unit, so as to save time for selection of a new contractor, to prepare another loan agreement, to carry out equipment design and manufacturing as well as to enable shortening of the dismantling time of the "BX" station.

Construction Schedule Key Dates:

(1)	Detailed Design Completion	Jan., 1989
(2)	Contract with Erector	Oct., 1989
(3)	Construction Start	Nov., 1989

(4)	220 kV Transmission Line Completion	Jan., 1992
(5)	Start of Dismantling Work of "B" and "BX" Stations	Feb., 1992
(6)	First Unit Commissioning	Oct., 1992
(7)	Second Unit Commissioning	Oct., 1994



Notes;

CS	: CONSTRUCTION START	IS	: INITIAL STEAMING
PS	: PILING START	CO	: COMMERCIAL OPERATION
MF	: MAT FOUNDATION	ES	: ENGINEERING SERVICES
TSS	: TURBINE ROOM STEEL STRUCTURE	T/D	: TENDER DOCUMENTS
BSS	: BOILER STEEL STRUCTURE	PREP	: PREPARATION
DL	: DRUM LIFTING	EVA	: EVALUATION
BHT	: BOILER HYDRO. TEST	NEGO	: CONTRACT NEGOTIATION
PR	: POWER RECEIVING	T/G	: TURBINE-GENERATOR
IF	: INITIAL FIRING	FOUND	: FOUNDATION
		AUX.	: AUXILIARY EQUIPMENT

PAKISTAN
THE KARACHI ELECTRIC SUPPLY CORPORATION LTD.

WEST WHARF THERMAL POWER STATION PROJECT

Fig. 8-1

OVERALL CONSTRUCTION SCHEDULE

TOKYO ELECTRIC POWER SERVICES CO., LTD.
TOKYO JAPAN

APPROVED BY DATE	REVIEWED BY	CHECKED BY	DRAWN BY
			SCALE

Chapter 9. FINANCIAL AND ECONOMIC ANALYSIS

The purpose of this chapter is to prepare the financial projections and to apply benefit cost methodology in order to evaluate the financial and economic viabilities of the proposed project. The criterion used in this appraisal is the Internal Rate of Return for the power benefits expressed in terms of sales value of energy.

9-1 Financial Projections

Financial projections are made in line with the KESC's formula appeared in "PC-1 PROFORMA FOR EXTENSION OF BIN QASIM THERMAL POWER STATION 200 MW UNIT-5, September - 1985" as required by the KESC. Assumptions and basis of the financial projections are presented in Table 9-1.

With respect to the selling rate of the energy, the present fuel adjustment charges of Paisa 76.7/KWH are assumed to continue throughout the project life; whereas the base rate assumptions were elaborated to attain the financial situation where the sales revenue accrual to the project can finance the costs involved and give rise to an appropriate amount of net profit. The amount of internal funds for financing the project was assumed at about 25% of the total project costs, which was suggested by the Asian Development Bank.

Escalation rates during construction are assumed as follows:

Year	Escalation rate L.C.
1988-89	7.0
1989-90	10.7
1990-91	18.5
1992-92	26.8
1992-93	35.7
1993-94	45.2
1994-95	55.3

Cost estimation and distribution schedules, amortization schedules for foreign and local loans, and the forecast profit and loss account for the service lifes of UNIT-1 and UNIT-2 are presented in Tables 9-2 to 9-9.

9-2 Financial Analysis

Financial Internal Rate of Return of the project from the viewpoint of all the financing agents (foreign and local loans and self-financing) was calculated for the combined financial benefits and costs streams of Units 1 and 2 on the cash flow basis. The cash flows of financial costs and benefits for Units 1 and 2 are presented in Tables 9-2, 9-5, 9-6 and 9-9, and summarized in Table 9-10. Table 9-11 shows the combined financial benefit cost streams for the entire project life and calculated NPV of Rs.2,934.46 million at the discount rate of 11% and the FIRR of about 17.3%, based on the assumptions of selling rate of energy presented in Table 9-1.

Tables 9-12 and 9-13 are for the case where the base rate of the tariff is assumed to be fixed at Paisa 113.65 of 1992/93 throughout the service life, and the FIRR of about 14.0% is obtained.

9-3 Economic Analysis

Economic Internal Rate of Return of the project from the viewpoint of the Pakistan's national economy was calculated by applying economic costs instead of the financial costs used in the financial analysis. The economic costs of the project were prepared by deducting the transfere component within the economy; namely Import Duty and Agency Commission & W.P Fund (see tables 9-2 and 9-5). It should be noted that the tax component of the expenditure item of "Insurance, Repaires & Maintenance, Rents, Rates and Taxes and other expenses" was ignored because of the technical difficulty and its negligible importance.

In theory, economic benefits of a power generation project is to be measured by the identified social costs of not meeting the amount of power demand attributable to the project. In practice, however, these social costs are not objectively identifiable, and therefore, the revenue from sales of the energy is used as the proxy for the economic benefits. In the present economic analysis, economic benefits are thus measured by the revenue of energy sales; same as the financial benefits. It should be understood, however, that the actual economic benefits would certainly be far greater than the amount of the sales revenue.

Tables 9-14 presents the economic benefit cost streams of Units 1 and 2 and table 9-15 shows the combined benefit cost streams with the calculated NPV of Rs.4,850.48 and EIRR of about 24.1%. Tables 9-16 and 9-17 are for the case where the base rate of the tariff is assumed to be fixed at Paisa 113.65 of 1992/93 throughout the service life. The obtained EIRR of about 19.9%, which should be understood as a minimum figure, and still exceeding the country's opportunity cost of capital of 11%, safely leads to the conclusion that the present project is economically feasible.

Table 9-1

400 MW WEST WHARF THERMAL POWER STATION

ASSUMPTION BASIS

1.	Name of the Project	West Wharf Thermal Power Station			
2.	Plant Capacity	400 MW (200MWx2)			
3.	Prime movers	Steam Turbines			
4.	Service life	20 years (both Unit-1 and Unit-2)			
5.	Available capacity	85% (Stoppage for maintenance 15%)			
6.	Annual plant factor	60%			
7.	Auxiliary consumption	6%			
8.	Trans. & dist. losses	16%			
9.	Thermal efficiency	37%			
10.	Specific fuel consumption	226 gram/kwh			
11.	Type of fuel	Heavy oil (furnace oil)			
12.	Cost of project:				
			(Unit-1)	(Unit-2)	(Total)
	Foreign (Million Rs)		3,032.60	2,119.91	5,152.51
	Local (Million Rs)		3,116.62	2,432.64	5,549.26
	Total (Million Rs)		6,149.22	4,552.55	10,701.77

13. Financing

		(Unit-1)	(Unit-2)	(Total)
Foreign loans/credits	(M.Rs.)	3,032.60	2,119.91	5,152.51
Consortium Bank Loans	(M.Rs.)	1,564.55	1,288.56	2,853.11
Self-financing	(M.Rs.)	1,552.07	1,144.08	2,696.15
Total	(M.Rs.)	6,149.22	4,552.55	10,701.77

14. Repayment of loans:

Foreign loans (Unit-1)	24.5 years including 4.5 years grace period
" (Unit-2)	23.5 years including 3.5 years grace period
Local loans	15 years including 4 years grace period

15. Rate of interest — On Foreign Loans 11.0%
On Local Loans 11.351%

16. Selling rate:

Base rate	1992-93 Paisa 113.65/KWH
	1993-94 Paisa 136.38/KWH 20% increase
	1994-95 Paisa 150.02/KWH 10% increase
	1995-96 & onwards Paisa 150.02/KWH
Fuel adjustment charges	Fixed at Paisa 76.7/KWH

17. Cost of fuel:
Residual oil (Furnace oil) — @ Rs.1,643/- per M.Ton (No escalation)

18. Salaries & wages — As assumed in PC-1 PROFORMA for Extension of BIN QASIM Thermal Power Station 200 MW-5, September - 1985. (15% escalation each year)

19. Other benefits — 35% of salaries & wages

20.	Insurance, repair & maintenance, rents, rates & taxes and other expenses	As assumed in PC-1 PROFORMA for Extension of BIN QASIM Thermal Power Station 200 MW-5, September - 1985.
21.	Transport	(15% escalation each year)
22.	Provision for fire & machinery breakdown fund	
23.	Depreciation	5% on 90% (scrap value 10%) or (4.5% on total cost)
24.	Additional depreciation	1st year Nil 2nd year 10% of normal depreciation 3rd year 20% " 4th year 30% " 5th year & onwards 40% "
25.	Administration & general and Billing expenses	5% of Revenue from base rate
26.	Transmission and distribution expenses	25% of Revenue from base rate

Table 9-2 200MW WEST WHARF THERMAL POWER STATION UNIT-1

COST ESTIMATION AND DISBURSEMENT SCHEDULE

Description	Material & Services Foreign	Material & Services Local	Total	1988-89			1989-90			1990-91			1991-92		
				F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
1. Civil Works	347.50	224.54	572.03				69.50	44.91	114.41	139.00	89.81	228.81	104.25	67.36	171.61
2. Boiler Plant	699.92	86.12	786.04				69.99		69.99	279.97	34.45	314.42	244.97	30.14	275.11
3. Turbine Plant	790.43	58.50	848.93				79.04		79.04	316.17	23.40	339.57	276.65	20.48	297.12
4. Electrical Equipment	433.67	41.19	474.86				43.37		43.37	173.47	16.48	189.95	151.79	14.42	166.20
5. Sub-station	340.20	9.18	349.38				34.02		34.02	136.08	3.67	139.75	119.07	3.21	122.28
6. Spare Parts	101.26		101.26							45.57		45.57	45.57		45.57
7. Ocean Freight @6.4%	Included in above items		0.00												
8. Import Duty @55%		1,492.14	1,492.14								671.46	671.46		671.46	671.46
9. Consultants Eng. Services	164.97	32.67	197.64	32.99	6.53	39.53	24.75	4.90	29.65	49.49	9.80	59.29	41.24	8.17	49.41
10. Training	7.16	4.05	11.21							3.58	2.03	5.60	3.58	2.03	5.60
11. Escalation(on item 1 to 10)		305.69	305.69			0.00		3.49	3.49		91.07	91.07		151.19	151.19
12. I. D. C. 11% F. 11.315% L		733.64	733.64		3.24	3.24		36.55	36.55		186.52	186.52		384.41	384.41
13. Departmental Expenses	3.24	16.20	19.44		0.81	0.81		4.05	4.05	1.62	4.86	6.48	1.62	4.86	6.48
14. Contingency(5% on 1 to 11)	144.26	112.70	256.96	1.65	0.33	1.98	16.03	2.66	18.70	57.17	47.11	104.27	49.36	48.42	97.78
Total	3,032.60	3,116.62	6,149.22	34.64	10.91	45.56	336.70	96.56	433.26	1,202.11	1,180.66	2,382.77	1,038.09	1,406.15	2,444.24

Table 9-2 200MW WEST WHARF THERMAL POWER STATION UNIT-1

COST ESTIMATION AND DISBURSEMENT SCHEDULE

(Unit : Million Rs.)

	Material & Services Foreign	Material & Services Local	Total	1988-89			1989-90			1990-91			1991-92			1992-93		
				F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
	347.50	224.54	572.03				69.50	44.91	114.41	139.00	89.81	228.81	104.25	67.36	171.61	34.75	22.45	57.20
	699.92	86.12	786.04				69.99		69.99	279.97	34.45	314.42	244.97	30.14	275.11	104.99	21.53	126.52
	790.43	58.50	848.93				79.04		79.04	316.17	23.40	339.57	276.65	20.48	297.12	118.56	14.63	133.19
	433.67	41.19	474.86				43.37		43.37	173.47	16.48	189.95	151.79	14.42	166.20	65.05	10.30	75.35
	340.20	9.18	349.38				34.02		34.02	136.08	3.67	139.75	119.07	3.21	122.28	51.03	2.30	53.33
	101.26		101.26							45.57		45.57	45.57		45.57	10.13		10.13
Included in above items			0.00															
		1,492.14	1,492.14								671.46	671.46		671.46	671.46		149.21	149.21
es	164.97	32.67	197.64	32.99	6.53	39.53	24.75	4.90	29.65	49.49	9.80	59.29	41.24	8.17	49.41	16.50	3.27	19.76
	7.16	4.05	11.21							3.58	2.03	5.60	3.58	2.03	5.60			
10)		305.69	305.69			0.00		3.49	3.49		91.07	91.07		151.19	151.19		59.95	59.95
L		733.64	733.64		3.24	3.24		36.55	36.55		186.52	186.52		384.41	384.41		122.92	122.92
	3.24	16.20	19.44		0.81	0.81		4.05	4.05	1.62	4.86	6.48	1.62	4.86	6.48		1.62	1.62
11)	144.26	112.70	256.96	1.65	0.33	1.98	16.03	2.66	18.70	57.17	47.11	104.27	49.36	48.42	97.78	20.05	14.18	34.23
	3,032.60	3,116.62	6,149.22	34.64	10.91	45.56	336.70	96.56	433.26	1,202.11	1,180.66	2,382.77	1,038.09	1,406.15	2,444.24	421.06	422.35	843.41

Table 9-3 AMORTISATION SCHEDULE (UNIT I)

Amount of Loan Rs. 3,032.60
Interest Rate 11.00%
Payable Over 24.5 years including 4.5 years grace period from 30. 6. 1993. to 31. 12. 2012
(EXPRESSED IN MILLION Rs.)

Year		Amount of Loan Out-Standing	Princepal Repayment	Interest	Total
1988 - 1989	I	17.32		0.95	0.95
	II	34.64		1.91	1.91
1989 - 1990	I	202.99		11.16	11.16
	II	371.34		20.42	20.42
1990 - 1991	I	972.40		53.48	53.48
	II	1,573.45		86.54	86.54
1991 - 1992	I	2,092.50		115.09	115.09
	II	2,611.55		143.64	143.64
1992 - 1993	I	2,822.07		155.21	155.21
	II	3,032.60	22.20	166.79	188.99
1993 - 1994	I	3,010.40	23.42	165.57	188.99
	II	2,986.98	24.71	164.28	188.99
1994 - 1995	I	2,962.27	26.07	162.93	188.99
	II	2,936.20	27.50	161.49	188.99
1995 - 1996	I	2,908.70	29.01	159.98	188.99
	II	2,879.69	30.61	158.38	188.99
1996 - 1997	I	2,849.08	32.29	156.70	188.99
	II	2,816.79	34.07	154.92	188.99
1997 - 1998	I	2,782.72	35.94	153.05	188.99
	II	2,746.77	37.92	151.07	188.99
1998 - 1999	I	2,708.85	40.01	148.99	188.99
	II	2,668.85	42.21	146.79	188.99
1999 - 2000	I	2,626.64	44.53	144.47	188.99
	II	2,582.11	46.98	142.02	188.99
2000 - 2001	I	2,535.14	49.56	139.43	188.99
	II	2,485.58	52.29	136.71	188.99
2001 - 2002	I	2,433.29	55.16	133.83	188.99
	II	2,378.13	58.20	130.80	188.99
2002 - 2003	I	2,319.93	61.40	127.60	188.99
	II	2,258.54	64.77	124.22	188.99
2003 - 2004	I	2,193.76	68.34	120.66	188.99
	II	2,125.43	72.09	116.90	188.99
2004 - 2005	I	2,053.33	76.06	112.93	188.99
	II	1,977.27	80.24	108.75	188.99
2005 - 2006	I	1,897.03	84.66	104.34	188.99
	II	1,812.37	89.31	99.68	188.99
2006 - 2007	I	1,723.06	94.22	94.77	188.99
	II	1,628.84	99.41	89.59	188.99
2007 - 2008	I	1,529.43	104.87	84.12	188.99
	II	1,424.56	110.64	78.35	188.99
2008 - 2009	I	1,313.91	116.73	72.27	188.99
	II	1,197.19	123.15	65.85	188.99
2009 - 2010	I	1,074.04	129.92	59.07	188.99
	II	944.12	137.07	51.93	188.99
2010 - 2011	I	807.05	144.60	44.39	188.99
	II	662.45	152.56	36.43	188.99
2011 - 2012	I	509.89	160.95	28.04	188.99
	II	348.94	169.80	19.19	188.99
2012 - 2013	I	179.14	179.14	9.85	188.99

Table 9-4 AMORTISATION SCHEDULE (UNIT I)

Local Currency Loan 1,564.55
Interest Rate 11.315%
Payable in 15 years including 4 years grace period

(EXPRESSED IN MILLION Rs.)

Year		Opening Balance	With-drawals	Repayment	Closing Balance	Interest
1988 - 1989	I		2.26		2.26	0.13
	II	2.26	2.26		4.51	0.26
1989 - 1990	I	4.51	26.21		30.72	1.74
	II	30.72	26.21		56.93	3.22
1990 - 1991	I	56.93	236.02		292.94	16.57
	II	292.94	236.02		528.96	29.93
1991 - 1992	I	528.96	387.89		916.85	51.87
	II	916.85	387.89		1,304.73	73.82
1992 - 1993	I	1,304.73	129.91		1,434.64	81.16
	II	1,434.64	129.91	0.05	1,564.49	88.51
1993 - 1994	I	1,564.49		0.11	1,564.38	88.51
	II	1,564.38		0.75	1,563.64	88.50
1994 - 1995	I	1,563.64		1.42	1,562.22	88.46
	II	1,562.22		7.17	1,555.05	88.38
1995 - 1996	I	1,555.05		13.24	1,541.81	87.98
	II	1,541.81		23.30	1,518.51	87.23
1996 - 1997	I	1,518.51		33.94	1,484.57	85.91
	II	1,484.57		38.98	1,445.59	83.99
1997 - 1998	I	1,445.59		44.30	1,401.29	81.78
	II	1,401.29		46.81	1,354.48	79.28
1998 - 1999	I	1,354.48		49.46	1,305.03	76.63
	II	1,305.03		52.25	1,252.77	73.83
1999 - 2000	I	1,252.77		55.21	1,197.56	70.88
	II	1,197.56		58.33	1,139.23	67.75
2000 - 2001	I	1,139.23		61.63	1,077.60	64.45
	II	1,077.60		65.12	1,012.47	60.96
2001 - 2002	I	1,012.47		68.81	943.67	57.28
	II	943.67		72.70	870.97	53.39
2002 - 2003	I	870.97		76.81	794.16	49.28
	II	794.16		81.16	713.01	44.93
2003 - 2004	I	713.01		85.75	627.26	40.34
	II	627.26		90.42	536.84	35.49
2004 - 2005	I	536.84		95.35	441.49	30.37
	II	441.49		98.63	342.86	24.98
2005 - 2006	I	342.86		102.10	240.76	19.40
	II	240.76		88.86	151.90	13.62
2006 - 2007	I	151.90		74.86	77.03	8.59
	II	77.03		47.84	29.20	4.36
2007 - 2008	I	29.20		19.29	9.91	1.65
	II	9.91		9.91	0.00	0.56

Table 9-5 200MW WEST WHARF THERMAL POWER STATION UNIT-1

PROFIT & LOSS ACCOUNT
1992/93 - 2012/13

Description		1992-93 (9 Months)	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-2003	2003-04	2004-05
Units Generated	MWH	788,400	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200
Units Sentout	MWH	741,096	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128
Units Sold	MWH	622,521	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028
Average Selling Rate:														
a) Base Rate	Ps/KWH	113.65	136.38	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02
b) Fuel Adjustment	Ps/KWH	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7
c) Total Selling Rate	Ps/KWH	190.35	213.08	226.718	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72
Revenue from Sale of Energy:														
a) By Base Rate	Million Rs	707.49	1,131.99	1,245.19	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21
b) By Fuel Adjustment	Million Rs	477.47	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63
c) Total Revenue	Million Rs	1,184.97	1,768.62	1,881.82	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84
EXPENDITURE														
- Fuel - Quantity	M.Ton	178,178.40	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20
- Amount	Million Rs	292.75	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33
- Salaries & Wages	Million Rs	4.28	6.55	7.53	8.66	9.96	11.46	13.17	15.15	17.42	20.04	23.04	26.50	30.47
- Other benefits	Million Rs	1.50	2.29	2.64	3.03	3.49	4.01	4.61	5.30	6.10	7.01	8.06	9.27	10.67
- Insurance, Repaires & Maintenance, Rents, Rates & Taxes and other expences	Million Rs	11.90	18.25	20.99	24.14	27.76	31.92	36.71	42.21	48.55	55.83	64.20	73.83	84.91
- Transport expenses	Million Rs	4.76	7.30	8.40	9.65	11.10	12.77	14.68	16.89	19.42	22.33	25.68	29.53	33.96
- Provision for fire & Machinary breakdown fund	Million Rs	3.90	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20
- Depreciation	Million Rs	207.54	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71
- Additional depreciation	Million Rs		27.67	55.34	83.01	110.69	110.69	110.69	110.69	110.69	110.69	110.69	110.69	110.69
- Interest on foreign loans	Million Rs	241.51	329.86	324.42	318.36	311.62	304.12	295.77	286.48	276.14	264.63	251.82	237.56	221.68
- Interest on local loans	Million Rs	127.26	177.02	176.85	175.20	169.90	161.06	150.46	138.63	125.42	110.67	94.20	75.83	55.35
- Administrative overhead	Million Rs	35.37	56.60	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26
- Transmission and distribution expenses	Million Rs	132.66	283.00	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30
- Agency commission & W.P. Fund	Million Rs	12.16	18.78	23.99	21.40	19.15	20.00	20.99	22.07	23.23	24.48	25.83	27.28	28.83
TOTAL EXPENDITURE		1,075.57	1,599.56	1,665.94	1,689.27	1,709.47	1,701.83	1,692.90	1,683.22	1,672.76	1,661.48	1,649.34	1,636.29	1,622.36
NET PROFIT/(LOSS)		109.40	169.06	215.88	192.57	172.37	180.01	188.94	198.62	209.07	220.36	232.50	245.55	259.48

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1997-98	1998-99	1999-2000	2000-01	2001-02	2002-2003	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13 (3 Months)	TOTAL 20years
1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	262,800	21,024,000
988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	247,032	19,762,560
830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	207,507	16,600,550
150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	147.64
76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.70
226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	224.34
1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	311.30	24,564.50
636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	159.16	12,732.62
1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	470.46	37,297.12
237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	59,392.80	4,751,424.00
390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	97.58	7,806.59
11.46	13.17	15.15	17.42	20.04	23.04	26.50	30.47	35.04	40.30	46.35	53.30	61.29	70.49	81.06	23.30	605.37
4.01	4.61	5.30	6.10	7.01	8.06	9.27	10.67	12.27	14.11	16.22	18.65	21.45	24.67	28.37	8.16	211.88
31.92	36.71	42.21	48.55	55.83	64.20	73.83	84.91	97.64	112.29	129.13	148.50	170.78	196.39	225.85	64.93	1,686.70
12.77	14.68	16.89	19.42	22.33	25.68	29.53	33.96	39.06	44.92	51.65	59.40	68.31	78.56	90.34	25.97	674.68
5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	1.30	104.00
276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	276.71	69.18	5,534.30
110.69	110.69	110.69	110.69	110.69	110.69	110.69	110.69	110.69	110.69	110.69	110.69	110.69	110.69	110.69	27.67	1,964.68
304.12	295.77	286.48	276.14	264.63	251.82	237.56	221.68	204.02	184.35	162.47	138.11	111.00	80.82	47.24	9.85	4,601.82
161.06	150.46	138.63	125.42	110.67	94.20	75.83	55.35	33.02	12.95	2.21						1,786.02
62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	3.89	1,216.55
311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	19.46	6,038.54
20.00	20.99	22.07	23.23	24.48	25.83	27.28	28.83	30.43	31.64	31.73	30.74	29.25	27.44	25.25	11.92	506.60
1,701.83	1,692.90	1,683.22	1,672.76	1,661.48	1,649.34	1,636.29	1,622.36	1,607.97	1,597.05	1,596.26	1,605.20	1,618.57	1,634.86	1,654.60	363.22	32,737.73
180.01	188.94	198.62	209.07	220.36	232.50	245.55	259.48	273.87	284.79	285.58	276.64	263.26	246.97	227.24	107.24	4,559.40

Table 9-6 200MW WEST WHARF THERMAL POWER STATION UNIT-2

COST ESTIMATION AND DISBURSEMENT SCHEDULE

(Unit : Mill. Rs.)

Description	Material & Services Foreing	Material & Services Local	Total	1991-92			1992-93			1993-94			1994-95		
				F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
1. Civil Works	232.06	195.92	427.98	46.41	39.18	85.60	92.82	78.37	171.19	69.62	58.78	128.39	23.21	19.59	42.
2. Boiler Plant	633.26	77.91	711.17	63.33		63.33	253.30	31.16	284.47	221.64	27.27	248.91	94.99	19.48	114.
3. Turbine Plant	687.02	50.85	737.86	68.70		68.70	274.81	20.34	295.15	240.46	17.80	258.25	103.05	12.71	115.
4. Electrical Equipment	333.90	31.71	365.61	33.39		33.39	133.56	12.68	146.24	116.86	11.10	127.96	50.08	7.93	58.
5. Spare Parts	87.05	0.00	87.05				39.17		39.17	39.17		39.17	8.70		8.
6. Ocean Freight @6.4%	Included in above items		0.00												
7. Import Duty @55%		1,085.30	1,085.30					488.39	488.39		488.39	488.39		108.53	108.
8. Consultants Eng. Services	43.47	5.67	49.14	15.21	1.98	17.20	13.04	1.70	14.74	10.87	1.42	12.29	4.35	0.57	4.
9. Training	0.68	0.41	1.08				0.34	0.20	0.54	0.34	0.20	0.54			
10. Escalation(on item 1 to 9)		343.87	343.87		4.41	4.41		117.08	117.08		162.13	162.13		60.26	60.
11. I. D. C. 11% F, 11.315% L		543.32	543.32		23.10	23.10		140.50	140.50		288.33	288.33		91.40	91.
12. Departmental Expenses	1.62	8.10	9.72		2.43	2.43	0.81	2.43	3.24	0.81	2.43	3.24		0.81	0.
13. Contingency(5% on 1 to 10)	100.87	89.58	190.45	11.35	2.28	13.63	40.35	37.50	77.85	34.95	38.35	73.30	14.22	11.45	25.
Total	2,119.91	2,432.64	4,552.55	238.39	73.38	311.77	848.20	930.34	1,778.55	734.71	1,096.18	1,830.89	298.60	332.73	631.

Table 9-6 200MW WEST WHARF THERMAL POWER STATION UNIT-2

COST ESTIMATION AND DISBURSEMENT SCHEDULE

(Unit : Mill. Rs.)

Description	Material & Services Foreing	Material & Services Local	Total	1991-92			1992-93			1993-94			1994-95		
				F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
1. Civil Works	232.06	195.92	427.98	46.41	39.18	85.60	92.82	78.37	171.19	69.62	58.78	128.39	23.21	19.59	42.80
2. Boiler Plant	633.26	77.91	711.17	63.33		63.33	253.30	31.16	284.47	221.64	27.27	248.91	94.99	19.48	114.47
3. Turbine Plant	687.02	50.85	737.86	68.70		68.70	274.81	20.34	295.15	240.46	17.80	258.25	103.05	12.71	115.76
4. Electrical Equipment	333.90	31.71	365.61	33.39		33.39	133.56	12.68	146.24	116.86	11.10	127.96	50.08	7.93	58.01
5. Spare Parts	87.05	0.00	87.05				39.17		39.17	39.17		39.17	8.70		8.70
6. Ocean Freight @6.4%	Included in above items		0.00												
7. Import Duty @55%		1,085.30	1,085.30					488.39	488.39		488.39	488.39		108.53	108.53
8. Consultants Eng. Services	43.47	5.67	49.14	15.21	1.98	17.20	13.04	1.70	14.74	10.87	1.42	12.29	4.35	0.57	4.91
9. Training	0.68	0.41	1.08				0.34	0.20	0.54	0.34	0.20	0.54			
10. Escalation(on item 1 to 9)		343.87	343.87		4.41	4.41		117.08	117.08		162.13	162.13		60.26	60.26
11. I. D. C. 11% F, 11.315% L		543.32	543.32		23.10	23.10		140.50	140.50		288.33	288.33		91.40	91.40
12. Departmental Expenses	1.62	8.10	9.72		2.43	2.43	0.81	2.43	3.24	0.81	2.43	3.24		0.81	0.81
13. Contingency(5% on 1 to 10)	100.87	89.58	190.45	11.35	2.28	13.63	40.35	37.50	77.85	34.95	38.35	73.30	14.22	11.45	25.67
Total	2,119.91	2,432.64	4,552.55	238.39	73.38	311.77	848.20	930.34	1,778.55	734.71	1,096.18	1,830.89	298.60	332.73	631.33

Table 9-7 AMORTISATION SCHEDULE (UNIT II)

Amount of Loan Rs. 2,119.91
Interest Rate 11.00%
Payable Over 23.5 years including 3.5 years grace period from 30. 6. 1994 to 31. 12. 2014
(EXPRESSED IN MILLION Rs.)

Year		Amount of Loan Out-Standing	Princepal Repayment	Interest	Total
1991 - 1992	I	119.20		6.56	6.56
	II	238.39		13.11	13.11
1992 - 1993	I	662.50		36.44	36.44
	II	1,086.60		59.76	59.76
1993 - 1994	I	1,453.95		79.97	79.97
	II	1,821.31		100.17	100.17
1994 - 1995	I	1,970.61		108.38	108.38
	II	2,119.91	15.52	116.60	132.11
1995 - 1996	I	2,104.39	16.37	115.74	132.11
	II	2,088.02	17.27	114.84	132.11
1996 - 1997	I	2,070.75	18.22	113.89	132.11
	II	2,052.52	19.22	112.89	132.11
1997 - 1998	I	2,033.30	20.28	111.83	132.11
	II	2,013.02	21.40	110.72	132.11
1998 - 1999	I	1,991.62	22.57	109.54	132.11
	II	1,969.05	23.82	108.30	132.11
1999 - 2000	I	1,945.23	25.13	106.99	132.11
	II	1,920.10	26.51	105.61	132.11
2000 - 2001	I	1,893.60	27.97	104.15	132.11
	II	1,865.63	29.50	102.61	132.11
2001 - 2002	I	1,836.13	31.13	100.99	132.11
	II	1,805.00	32.84	99.27	132.11
2002 - 2003	I	1,772.16	34.64	97.47	132.11
	II	1,737.52	36.55	95.56	132.11
2003 - 2004	I	1,700.97	38.56	93.55	132.11
	II	1,662.41	40.68	91.43	132.11
2004 - 2005	I	1,621.73	42.92	89.19	132.11
	II	1,578.81	45.28	86.83	132.11
2005 - 2006	I	1,533.53	47.77	84.34	132.11
	II	1,485.76	50.40	81.72	132.11
2006 - 2007	I	1,435.36	53.17	78.94	132.11
	II	1,382.19	56.09	76.02	132.11
2007 - 2008	I	1,326.10	59.18	72.94	132.11
	II	1,266.92	62.43	69.68	132.11
2008 - 2009	I	1,204.49	65.87	66.25	132.11
	II	1,138.62	69.49	62.62	132.11
2009 - 2010	I	1,069.13	73.31	58.80	132.11
	II	995.82	77.34	54.77	132.11
2010 - 2011	I	918.48	81.60	50.52	132.11
	II	836.88	86.08	46.03	132.11
2011 - 2012	I	750.80	90.82	41.29	132.11
	II	659.98	95.81	36.30	132.11
2012 - 2013	I	564.16	101.08	31.03	132.11
	II	463.08	106.64	25.47	132.11
2013 - 2014	I	356.43	112.51	19.60	132.11
	II	243.92	118.70	13.42	132.11
2014 - 2015	I	125.23	125.23	6.89	132.11

Table 9-8 AMORTISATION SCHEDULE (UNIT II)

Local Currency Loan 1,288.56
Interest Rate 11.315%
Payable in 15 years including 4 years grace period

(EXPRESSED IN MILLION Rs.)

Year		Opening Balance	With-drawals	Repayment	Closing Balance	Interest
1991 - 1992	I		20.21		20.21	1.14
	II	20.21	20.21		40.42	2.29
1992 - 1993	I	40.42	234.05		274.47	15.53
	II	274.47	234.05		508.53	28.77
1993 - 1994	I	508.53	298.42		806.95	45.65
	II	806.95	298.42		1,105.37	62.54
1994 - 1995	I	1,105.37	91.59		1,196.96	67.72
	II	1,196.96	91.59		1,288.56	72.90
1995 - 1996	I	1,288.56			1,288.56	72.90
	II	1,288.56		0.49	1,288.07	72.90
1996 - 1997	I	1,288.07		1.00	1,287.07	72.87
	II	1,287.07		6.68	1,280.40	72.82
1997 - 1998	I	1,280.40		12.67	1,267.72	72.44
	II	1,267.72		20.56	1,247.17	71.72
1998 - 1999	I	1,247.17		28.89	1,218.28	70.56
	II	1,218.28		32.72	1,185.56	68.92
1999 - 2000	I	1,185.56		36.77	1,148.79	67.07
	II	1,148.79		38.85	1,109.94	64.99
2000 - 2001	I	1,109.94		41.05	1,068.89	62.79
	II	1,068.89		43.37	1,025.52	60.47
2001 - 2002	I	1,025.52		45.83	979.69	58.02
	II	979.69		48.42	931.28	55.43
2002 - 2003	I	931.28		51.16	880.12	52.69
	II	880.12		54.05	826.07	49.79
2003 - 2004	I	826.07		57.11	768.96	46.73
	II	768.96		60.34	708.62	43.50
2004 - 2005	I	708.62		63.75	644.86	40.09
	II	644.86		67.36	577.50	36.48
2005 - 2006	I	577.50		71.17	506.33	32.67
	II	506.33		75.20	431.13	28.65
2006 - 2007	I	431.13		79.45	351.68	24.39
	II	351.68		82.32	269.36	19.90
2007 - 2008	I	269.36		85.35	184.02	15.24
	II	184.02		71.31	112.70	10.41
2008 - 2009	I	112.70		56.49	56.22	6.38
	II	56.22		35.63	20.58	3.18
2009 - 2010	I	20.58		13.60	6.99	1.16
	II	6.99		6.99	0.00	0.40

Table 9-9 200MW WEST WHARF THERMAL POWER STATION UNIT-2

PROFIT & LOSS ACCOUNT
1994/95 - 2014/15

Description		1994-95 (9 Months)	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-2002	2002-03	2003-04	2004-2005	2005-06	2006-07
Units Generated	MWH	788,400	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200
Units Sentout	MWH	741,096	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128
Units Sold	MWH	622,521	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028
Average Selling Rate:														
a) Base Rate	Ps/KWH	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02
b) Fuel Adjustment	Ps/KWH	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7
c) Total Selling Rate	Ps/KWH	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72
Revenue from Sale of Energy:														
a) By Base Rate	Million Rs	933.91	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21
b) By Fuel Adjustment	Million Rs	477.47	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63
c) Total Revenue	Million Rs	1,411.38	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84
EXPENDITURE														
- Fuel - Quantity	M.Ton	178,178.40	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20 2
- Amount	Million Rs	292.75	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33
- Salaries & Wages	Million Rs	5.66	8.67	9.97	11.47	13.19	15.16	17.44	20.05	23.06	26.52	30.50	35.07	40.34
- Other benefits	Million Rs	1.98	3.03	3.49	4.01	4.62	5.31	6.10	7.02	8.07	9.28	10.67	12.28	14.12
- Insurance, Repaires & Maintenance, Rents, Rates & Taxes and other expences	Million Rs	15.74	24.14	27.76	31.93	36.71	42.22	48.55	55.84	64.21	73.84	84.92	97.66	112.31
- Transport expenses	Million Rs	6.30	9.65	11.10	12.76	14.68	16.88	19.41	22.32	25.67	29.52	33.95	39.04	44.90
- Provision for fire & Machinary breakdown fund	Million Rs	3.90	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20
- Depreciation	Million Rs	153.65	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86
- Additional depreciation	Million Rs		20.49	40.97	61.46	81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95
- Interest on foreign loans	Million Rs	168.73	230.58	226.78	222.55	217.84	212.59	206.76	200.26	193.03	184.99	176.03	166.06	154.97
- Interest on local loans	Million Rs	105.46	145.80	145.69	144.16	139.48	132.07	123.27	113.44	102.48	90.24	76.57	61.32	44.29
- Administrative overhead	Million Rs	46.70	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26
- Transmission and distribution expenses	Million Rs	233.48	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30
- Agency commission & W.P. Fund	Million Rs	37.70	46.55	44.21	41.95	39.94	40.17	40.44	40.70	40.94	41.15	41.33	41.45	41.50
TOTAL EXPENDITURE		1,072.05	1,462.87	1,483.93	1,504.24	1,522.36	1,520.30	1,517.87	1,515.54	1,513.37	1,511.45	1,509.88	1,508.78	1,508.32
NET PROFIT/(LOSS)		339.33	418.97	397.91	377.59	359.48	361.54	363.97	366.30	368.47	370.39	371.96	373.06	373.52

ON UNIT-2

998-99	1999-00	2000-01	2001-2002	2002-03	2003-04	2004-2005	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15 (3 Months)	TOTAL 20years
051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	1,051,200	262,800	21,024,000
988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	988,128	247,032	19,762,560
830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	830,028	207,507	16,600,550
150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02	150.02
76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.7	76.70
226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	226.72	140.23	222.60
,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	1,245.21	311.30	24,904.15
636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	636.63	159.16	12,732.62
,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	1,881.84	470.46	37,636.77
,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	237,571.20	59,392.80	4,751,424.00
390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	390.33	97.58	7,806.59
13.19	15.16	17.44	20.05	23.06	26.52	30.50	35.07	40.34	46.39	53.34	61.35	70.55	81.13	93.30	107.30	30.85	801.30
4.62	5.31	6.10	7.02	8.07	9.28	10.67	12.28	14.12	16.24	18.67	21.47	24.69	28.40	32.66	37.55	10.80	280.45
36.71	42.22	48.55	55.84	64.21	73.84	84.92	97.66	112.31	129.16	148.53	170.81	196.43	225.89	259.78	298.74	85.89	2,231.06
14.68	16.88	19.41	22.32	25.67	29.52	33.95	39.04	44.90	51.63	59.37	68.28	78.52	90.30	103.85	119.42	34.33	891.88
5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	1.30	104.00
204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	204.86	51.22	4,097.29
81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95	81.95	20.49	1,454.54
217.84	212.59	206.76	200.26	193.03	184.99	176.03	166.06	154.97	142.62	128.87	113.57	96.54	77.59	56.50	33.02	6.89	3,216.77
139.48	132.07	123.27	113.44	102.48	90.24	76.57	61.32	44.29	25.65	9.56	1.56						1,461.04
62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	62.26	3.89	1,233.53
311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	311.30	19.46	6,167.67
39.94	40.17	40.44	40.70	40.94	41.15	41.33	41.45	41.50	41.43	40.76	38.89	35.92	32.26	27.99	22.99	10.78	789.06
522.36	1,520.30	1,517.87	1,515.54	1,513.37	1,511.45	1,509.88	1,508.78	1,508.32	1,509.00	1,515.01	1,531.83	1,558.56	1,591.48	1,629.96	1,674.93	373.46	30,535.19
359.48	361.54	363.97	366.30	368.47	370.39	371.96	373.06	373.52	372.84	366.83	350.01	323.28	290.36	251.87	206.91	97.00	7,101.58

Table 9-10 Financial Benefit and Cost Stream on Cash Flow Basis

(Unit : Mill. Rs.)

Year	UNIT I				UNIT II			
	Benefit	Cost			Benefit	Cost		
		Con. Cost	O/M	Total		Con. Cost	O/M	Total
88/89		42.31		42.31				
89/90		396.71		396.71				
90/91		2,196.24		2,196.24				
91/92		2,059.83		2,059.83		288.68		288.68
92/93	1,184.97	720.49	499.27	1,219.75		1,638.05		1,638.05
93/94	1,768.62		788.30	788.30		1,542.56		1,542.56
94/95	1,881.82		832.62	832.62	1,411.38	539.94	644.20	1,184.13
95/96	1,881.84		835.97	835.97	1,881.84		861.14	861.14
96/97	1,881.84		840.55	840.55	1,881.84		865.62	865.62
97/98	1,881.84		849.25	849.25	1,881.84		871.21	871.21
98/99	1,881.84		859.26	859.26	1,881.84		878.23	878.23
99/00	1,881.84		870.71	870.71	1,881.84		888.83	888.83
00/01	1,881.84		883.81	883.81	1,881.84		901.04	901.04
01/02	1,881.84		898.78	898.78	1,881.84		915.02	915.02
02/03	1,881.84		915.91	915.91	1,881.84		931.05	931.05
03/04	1,881.84		935.51	935.51	1,881.84		949.41	949.41
04/05	1,881.84		957.93	957.93	1,881.84		970.46	970.46
05/06	1,881.84		983.53	983.53	1,881.84		994.59	994.59
06/07	1,881.84		1,012.34	1,012.34	1,881.84		1,022.25	1,022.25
07/08	1,881.84		1,044.17	1,044.17	1,881.84		1,053.92	1,053.92
08/09	1,881.84		1,079.68	1,079.68	1,881.84		1,089.77	1,089.77
09/10	1,881.84		1,120.18	1,120.18	1,881.84		1,129.89	1,129.89
10/11	1,881.84		1,166.64	1,166.64	1,881.84		1,175.20	1,175.20
11/12	1,881.84		1,219.96	1,219.96	1,881.84		1,227.07	1,227.07
12/13	470.46		256.51	256.51	1,881.84		1,286.66	1,286.66
13/14					1,881.84		1,355.10	1,355.10
14/15					470.46		294.87	294.87
Res. Value	614.92				455.25			
Note:	1.	2.	3.		4.	5.	6.	

Note:

1. Table 9-5
   Total Revenue
2. Table 9-2
   Annual Disbursement
   Excluding:
   I.D.C.
3. Table 9-5
   Annual Expenditure
   Excluding:
   . Depreciation
   . Additional Depreciation
   . Interest on Foreign Loans
   . Interest on Local Loans
4. Table 9-9
   Same as 1
5. Table 9-6
   Same as 2
6. Table 9-9
   Same as 3

Table 9-11 Financial Internal Rate of Return

(Unit : Mill. Rs)

Year	Financial Benefit	Financial Cost	Net Benefit	Discount Rate = 11%		Discount Rate = 17.34%		
				Present Value (11%)	Net Present Value	Present Value	Net Present Value	FIRR 17.34263%
88/89	0.00	42.31	-42.31	-38.12	2,934.46	-36.06	-0.00129	
89/90	0.00	396.71	-396.71	-321.98		-288.11		
90/91	0.00	2,196.24	-2,196.24	-1,605.88		-1,359.29		
91/92	0.00	2,348.51	-2,348.51	-1,547.03		-1,238.71		
92/93	1,184.97	2,857.80	-1,672.84	-992.75		-751.92		
93/94	1,768.62	2,330.87	-562.25	-300.60		-215.37		
94/95	3,293.20	2,016.76	1,276.44	614.81		416.69		
95/96	3,763.68	1,697.11	2,066.57	896.74		574.91		
96/97	3,763.68	1,706.17	2,057.50	804.33		487.80		
97/98	3,763.68	1,720.46	2,043.22	719.59		412.82		
98/99	3,763.68	1,737.49	2,026.19	642.88		348.87		
99/00	3,763.68	1,759.54	2,004.13	572.86		294.07		
00/01	3,763.68	1,784.84	1,978.83	509.58		247.45		
01/02	3,763.68	1,813.81	1,949.87	452.36		207.79		
02/03	3,763.68	1,846.96	1,916.71	400.60		174.07		
03/04	3,763.68	1,884.93	1,878.75	353.75		145.40		
04/05	3,763.68	1,928.39	1,835.28	311.32		121.05		
05/06	3,763.68	1,978.12	1,785.55	272.87		100.36		
06/07	3,763.68	2,034.60	1,729.08	238.06		82.82		
07/08	3,763.68	2,098.10	1,665.58	206.59		67.99		
08/09	3,763.68	2,169.45	1,594.22	178.14		55.46		
09/10	3,763.68	2,250.06	1,513.61	152.37		44.87		
10/11	3,763.68	2,341.84	1,421.83	128.95		35.92		
11/12	3,763.68	2,447.04	1,316.64	107.58		28.35		
12/13	2,967.22	1,543.17	1,424.05	104.82		26.13		
13/14	1,881.84	1,355.10	526.74	34.93		8.24		
14/15	925.71	294.87	630.84	37.69		8.41		

Calculation formula is as follows:

Benefit (Present Valve) = $\sum_{i=1}^{n} \frac{B_i}{(1+r)^i}$

Cost (present Valve) = $\sum_{i=1}^{n} \frac{C_i}{(1+r)^i}$

Where, B_i : Benefit in "i" th year

C_i : Cost in "i" th year

i : "i" th year

n : Project life

Net present Valve (NPV) = $\sum_{i=1}^{n} \frac{B_i - C_i}{(1+r)^i}$

IRR : Discount Rate = r_0

$$NPV = \sum_{i=1}^{n} \frac{B_i - C_i}{(1+r_0)^i} = 0$$

Table 9-12 Financial Benefit and Cost Stream on Cash Flow Basis (Base Rate = Ps.113.65)

(Unit : Mill. Rs.)

Year	UNIT I				UNIT II			
	Benefit	Cost			Benefit	Cost		
		Con. Cost	O/M	Total		Con. Cost	O/M	Total
88/89		42.31		42.31				
89/90		396.71		396.71				
90/91		2,196.24		2,196.24				
91/92		2,059.83		2,059.83		288.68		288.68
92/93	1,184.97	720.49	499.27	1,219.75		1,638.05		1,638.05
93/94	1,579.96		718.50	718.50		1,542.56		1,542.56
94/95	1,579.96		720.93	720.93	1,184.97	539.94	560.43	1,100.36
95/96	1,579.96		724.28	724.28	1,579.96		749.44	749.44
96/97	1,579.96		730.83	730.83	1,579.96		753.93	753.93
97/98	1,579.96		738.68	738.68	1,579.96		759.52	759.52
98/99	1,579.96		747.70	747.70	1,579.96		766.53	766.53
99/00	1,579.96		759.02	759.02	1,579.96		777.14	777.14
00/01	1,579.96		772.11	772.11	1,579.96		789.34	789.34
01/02	1,579.96		787.09	787.09	1,579.96		803.33	803.33
02/03	1,579.96		804.22	804.22	1,579.96		819.35	819.35
03/04	1,579.96		823.82	823.82	1,579.96		837.72	837.72
04/05	1,579.96		846.23	846.23	1,579.96		858.77	858.77
05/06	1,579.96		871.83	871.83	1,579.96		882.90	882.90
06/07	1,579.96		900.65	900.65	1,579.96		910.56	910.56
07/08	1,579.96		932.48	932.48	1,579.96		942.23	942.23
08/09	1,579.96		967.99	967.99	1,579.96		978.07	978.07
09/10	1,579.96		1,008.48	1,008.48	1,579.96		1,018.19	1,018.19
10/11	1,579.96		1,054.94	1,054.94	1,579.96		1,063.51	1,063.51
11/12	1,579.96		1,108.27	1,108.27	1,579.96		1,115.38	1,115.38
12/13	394.99		243.87	243.87	1,579.96		1,174.96	1,174.96
13/14					1,579.96		1,243.40	1,243.40
14/15					394.99		282.23	282.23
Res. Value	614.92				455.25			

Table 9-13 Financial Internal Rate of Return (Base Rate = Ps.113.65)

(Unit : Mill. Rs.)

Year	Financial Benefit	Financial Cost	Net Benefit	Present Value (11%)	Net Present Value	Present Value	Net Present Value	FIRR 14.01252%
88/89	0.00	42.31	-42.31	-38.12	1,291.41	-37.11	-0.00003	
89/90	0.00	396.71	-396.71	-321.98		-305.19		
90/91	0.00	2,196.24	-2,196.24	-1,605.88		-1,481.91		
91/92	0.00	2,348.51	-2,348.51	-1,547.03		-1,389.89		
92/93	1,184.97	2,857.80	-1,672.84	-992.75		-868.34		
93/94	1,579.96	2,261.06	-681.10	-364.15		-310.10		
94/95	2,764.93	1,821.30	943.63	454.51		376.82		
95/96	3,159.91	1,473.72	1,686.20	731.69		590.59		
96/97	3,159.91	1,484.76	1,675.15	654.86		514.61		
97/98	3,159.91	1,498.20	1,661.72	585.23		447.75		
98/99	3,159.91	1,514.23	1,645.68	522.15		388.93		
99/00	3,159.91	1,536.15	1,623.76	464.14		336.58		
00/01	3,159.91	1,561.45	1,598.46	411.63		290.62		
01/02	3,159.91	1,590.41	1,569.50	364.12		250.28		
02/03	3,159.91	1,623.57	1,536.34	321.10		214.88		
03/04	3,159.91	1,661.53	1,498.38	282.13		183.82		
04/05	3,159.91	1,705.00	1,454.91	246.80		156.55		
05/06	3,159.91	1,754.73	1,405.18	214.74		132.61		
06/07	3,159.91	1,811.20	1,348.71	185.69		111.64		
07/08	3,159.91	1,874.71	1,285.21	159.41		93.31		
08/09	3,159.91	1,946.06	1,213.85	135.64		77.30		
09/10	3,159.91	2,026.67	1,133.24	114.08		63.29		
10/11	3,159.91	2,118.45	1,041.46	94.45		51.02		
11/12	3,159.91	2,223.65	936.27	76.50		40.23		
12/13	2,589.87	1,418.83	1,171.04	86.20		44.13		
13/14	1,579.96	1,243.40	336.56	22.32		11.12		
14/15	850.24	282.23	568.01	33.93		16.47		

Table 9-14. Economic Benefit and Cost on Cash Flow Basis

(Unit : Mill. Rs.)

Year	UNIT I				UNIT II			
	Benefit	Cost			Benefit	Cost		
		Con. Cost	O/M	Total		Con. Cost	O/M	Total
88/89		42.31		42.31				
89/90		396.71		396.71				
90/91		1,524.78		1,524.78				
91/92		1,388.37		1,388.37		288.68		288.68
92/93	1,184.97	571.27	487.11	1,058.39		1,149.66		1,149.66
93/94	1,768.62		769.52	769.52		1,054.18		1,054.18
94/95	1,881.82		808.64	808.64	1,411.38	431.41	606.50	1,037.90
95/96	1,881.84		814.58	814.58	1,881.84		814.59	814.59
96/97	1,881.84		821.40	821.40	1,881.84		821.41	821.41
97/98	1,881.84		829.24	829.24	1,881.84		829.26	829.26
98/99	1,881.84		838.27	838.27	1,881.84		838.28	838.28
99/00	1,881.84		848.64	848.64	1,881.84		848.66	848.66
00/01	1,881.84		860.58	860.58	1,881.84		860.60	860.60
01/02	1,881.84		874.30	874.30	1,881.84		874.32	874.32
02/03	1,881.84		890.08	890.08	1,881.84		890.11	890.11
03/04	1,881.84		908.23	908.23	1,881.84		908.26	908.26
04/05	1,881.84		929.10	929.10	1,881.84		929.14	929.14
05/06	1,881.84		953.10	953.10	1,881.84		953.14	953.14
06/07	1,881.84		980.70	980.70	1,881.84		980.75	980.75
07/08	1,881.84		1,012.44	1,012.44	1,881.84		1,012.50	1,012.50
08/09	1,881.84		1,048.95	1,048.95	1,881.84		1,049.01	1,049.01
09/10	1,881.84		1,090.92	1,090.92	1,881.84		1,091.00	1,091.00
10/11	1,881.84		1,139.20	1,139.20	1,881.84		1,139.28	1,139.28
11/12	1,881.84		1,194.71	1,194.71	1,881.84		1,194.81	1,194.81
12/13	470.46		244.60	244.60	1,881.84		1,258.67	1,258.67
13/14					1,881.84		1,332.11	1,332.11
14/15					470.46		284.10	284.10
Res. Value	614.92				455.25			
Note:	1.	2.	3.		4.	5.	6.	

Note:

1. Table 9-5
   Total Revenue
2. Table 9-2
   Annual Disbursement
   Excluding:
   . Import Duty
   . I.D.C.
3. Table 9-5
   Annual Expenditure
   Excluding:
   . Depreciation
   . Additional Depreciation
   . Interest on Foreign Loans
   . Interest on Local Loans
   . Agency Commission & W.P. Fund
4. Table 9-9
   Same as 1
5. Table 9-6
   Same as 2
6. Table 9-9
   Same as 3

Table 9-15 Economic Internal Rate of Return

(Unit : Mill. Rs.)

Year	Economic Benefit	Economic Cost	Net Benefit	Present Value (11%)	Net Present Value	Present Value (EIRR)	Net Present Value	EIRR
88/89	0.00	42.31	-42.31	-38.12	4,850.48	-34.11	-0.00018	24.06516%
89/90	0.00	396.71	-396.71	-321.98		-257.73		
90/91	0.00	1,524.78	-1,524.78	-1,114.91		-798.47		
91/92	0.00	1,677.04	-1,677.04	-1,104.72		-707.86		
92/93	1,184.97	2,208.05	-1,023.08	-607.15		-348.07		
93/94	1,768.62	1,823.70	-55.08	-29.45		-15.10		
94/95	3,293.20	1,846.54	1,446.66	696.80		319.76		
95/96	3,763.68	1,629.16	2,134.51	926.22		380.28		
96/97	3,763.68	1,642.81	2,120.87	829.10		304.55		
97/98	3,763.68	1,658.50	2,105.17	741.41		243.66		
98/99	3,763.68	1,676.55	2,087.13	662.21		194.72		
99/00	3,763.68	1,697.31	2,066.37	590.65		155.39		
00/01	3,763.68	1,721.17	2,042.50	525.97		123.80		
01/02	3,763.68	1,748.62	2,015.05	467.48		98.44		
02/03	3,763.68	1,780.19	1,983.49	414.56		78.11		
03/04	3,763.68	1,816.49	1,947.19	366.64		61.80		
04/05	3,763.68	1,858.23	1,905.44	323.23		48.75		
05/06	3,763.68	1,906.24	1,857.43	283.86		38.30		
06/07	3,763.68	1,961.45	1,802.23	248.13		29.95		
07/08	3,763.68	2,024.94	1,738.74	215.66		23.29		
08/09	3,763.68	2,097.96	1,665.72	186.13		17.99		
09/10	3,763.68	2,181.92	1,581.76	159.23		13.77		
10/11	3,763.68	2,278.48	1,485.20	134.70		10.42		
11/12	3,763.68	2,389.53	1,374.15	112.27		7.77		
12/13	2,967.22	1,503.27	1,463.95	107.76		6.67		
13/14	1,881.84	1,332.11	549.73	36.45		2.02		
14/15	925.71	284.10	641.62	38.33		1.90		

Table 9-16 Economic Benefit and Cost on Cash Flow Basis (Base Rate = 113.65 Ps/KWh)

(Unit : Mill. Rs.)

Year	UNIT I				UNIT II			
	Benefit	Cost			Benefit	Cost		
		Con. Cost	O/M	Total		Con. Cost	O/M	Total
88/89		42.31		42.31				
89/90		396.71		396.71				
90/91		1,524.78		1,524.78				
91/92		1,388.37		1,388.37		288.68		288.68
92/93	1,184.97	571.27	487.11	1,058.39		1,149.66		1,149.66
93/94	1,579.96		712.92	712.92		1,054.18		1,054.18
94/95	1,579.96		718.08	718.08	1,184.97	431.41	538.57	969.98
95/96	1,579.96		724.01	724.01	1,579.96		724.02	724.02
96/97	1,579.96		730.83	730.83	1,579.96		730.85	730.85
97/98	1,579.96		738.68	738.68	1,579.96		738.69	738.69
98/99	1,579.96		747.70	747.70	1,579.96		747.72	747.72
99/00	1,579.96		758.08	758.08	1,579.96		758.10	758.10
00/01	1,579.96		770.01	770.01	1,579.96		770.03	770.03
01/02	1,579.96		783.73	783.73	1,579.96		783.76	783.76
02/03	1,579.96		799.52	799.52	1,579.96		799.54	799.54
03/04	1,579.96		817.66	817.66	1,579.96		817.70	817.70
04/05	1,579.96		838.53	838.53	1,579.96		838.57	838.57
05/06	1,579.96		862.54	862.54	1,579.96		862.58	862.58
06/07	1,579.96		890.14	890.14	1,579.96		890.19	890.19
07/08	1,579.96		921.88	921.88	1,579.96		921.93	921.93
08/09	1,579.96		958.38	958.38	1,579.96		958.45	958.45
09/10	1,579.96		1,000.36	1,000.36	1,579.96		1,000.43	1,000.43
10/11	1,579.96		1,048.63	1,048.63	1,579.96		1,048.72	1,048.72
11/12	1,579.96		1,104.15	1,104.15	1,579.96		1,104.25	1,104.25
12/13	394.99		238.94	238.94	1,579.96		1,168.11	1,168.11
13/14					1,579.96		1,241.54	1,241.54
14/15					394.99		278.44	278.44
Res. Value	614.92				455.25			

Table 9-17 Economic Internal Rate of Return (Base Rate = 113.65 Ps/KW)

(Unit : Mill. Rs.)

Year	Economic Benefit	Economic Cost	Net Benefit	Present Value (11%)	Net Present Value	Present Value (EIRR)	Net Present Value	EIRR 19.90728%
88/89	0.00	42.31	-42.31	-38.12	3,026.21	-35.29	-0.00016	
89/90	0.00	396.71	-396.71	-321.98		-275.92		
90/91	0.00	1,524.78	-1,524.78	-1,114.91		-884.45		
91/92	0.00	1,677.04	-1,677.04	-1,104.72		-811.26		
92/93	1,184.97	2,208.05	-1,023.08	-607.15		-412.75		
93/94	1,579.96	1,767.10	-187.14	-100.05		-62.96		
94/95	2,764.93	1,688.06	1,076.87	518.68		302.16		
95/96	3,159.91	1,448.03	1,711.88	742.83		400.60		
96/97	3,159.91	1,461.68	1,698.23	663.88		331.43		
97/98	3,159.91	1,477.37	1,682.54	592.56		273.85		
98/99	3,159.91	1,495.42	1,664.49	528.12		225.93		
99/00	3,159.91	1,516.18	1,643.74	469.85		186.07		
00/01	3,159.91	1,540.05	1,619.87	417.14		152.93		
01/02	3,159.91	1,567.49	1,592.42	369.43		125.38		
02/03	3,159.91	1,599.06	1,560.86	326.23		102.49		
03/04	3,159.91	1,635.36	1,524.55	287.06		83.49		
04/05	3,159.91	1,677.11	1,482.81	251.53		67.72		
05/06	3,159.91	1,725.11	1,434.80	219.27		54.65		
06/07	3,159.91	1,780.32	1,379.59	189.94		43.82		
07/08	3,159.91	1,843.81	1,316.10	163.24		34.86		
08/09	3,159.91	1,916.83	1,243.09	138.91		27.46		
09/10	3,159.91	2,000.79	1,159.12	116.69		21.36		
10/11	3,159.91	2,097.35	1,062.56	96.37		16.33		
11/12	3,159.91	2,208.40	951.52	77.74		12.19		
12/13	2,589.87	1,407.04	1,182.83	87.07		12.64		
13/14	1,579.96	1,241.54	338.41	22.44		3.02		
14/15	850.24	278.44	571.81	34.16		4.25		

Chapter 10. ASSESSMENT OF ENVIRONMENTAL IMPACTS

10.1 Study on Environmental Impact of West Wharf Thermal Power Plant

The JICA study Team has carried out study on environmental impact resulting from modernization of the West Wharf Thermal Power Plant.

Along with the growth of industries in any country, environmental protection becomes a subject of major concern. It is therefor essential to work out an eivironmental protection plan for the specified industrial area on the basis of the long term industrial development program. Particularly, the high density of SO_2 in flue gas poses a harmful threat to the environment.

With this in mind, JICA has made a special study of SOx emission as the first phase, because, with respect to emission of other air pollution substances such as airborn dust and NOx due to fuel combustion, the power plant is expected to generate much less than SO_2.

10.2 Results of Study (Preliminary Bases)

In this study, the environmental impact of the West Wharf Thermal Power Plant modanization, particularly with respect to SO_2 pollution, was investigated.

Results of investigation point out the necessity of a 120 m height of the chimney so as to satisfy the on ground concentration of 0.04 ppm of SO_2 in the case of a 200 MW x 1 unit only.

In the case of 200 MW x 2 units, a 140 m height of chimney is recommended for controlling environmental impact.

Adoption of a 140 m height of chimney will greatly help to improve the present pollution condition around the West Wharf area.

10.3 Data Collection

10.3.1 General

The following input data were required in order to proceed with the study on environmental impact of West Wharf Thermal Power Plant Project.

Meteorological data
(1) Wind speed and directions
(2) Precipitation and humidity
(3) Temperatures

For a preliminary study, the necessary data are quoted from "KARACHI ELECTRIC SUPPLY CORPORATION, POWER DEVELOPMENT AND TARIFF STUDY", Volume III "GENERATION DEVELOPMENT", Electrowatt, Fichtner, Jafri, ASIAN DEVELOPMENT BANK T.A. NO. 411-PAKISTAN, Nov. 1982.

10.3.2 Meteorological data

The project areas is characterized by hot and humid weather conditions with long summers (May - October), and comparatively short and mild winters (November - February). The summers are characterized by high humidity and frequent cloud coverage with southwesterly monsoon winds. During the winters, the wind direction changes to northeast, while the humidity and temperatures are moderate.

10.3.3 Winds

As stated above, winds in the area are predominantly in the direction of southwest and west and strongest during the summer monsoon season of May to October. The data for the past ten years, i.e. 1975 - 84, was studied, and typical wind rises for summer and winter are presented in Fig. 10-1. From these wind rises, it is obvious that the areas most frequently influenced by the pollution originating from the power plant are in the east and northeast direction from the plant.

This area is not affected by the cyclones and thunder storms originating from the east coast of Africa or Bay of Bengal, because they normally follow a route which is several hundred kilometres south of the Karachi coast.

10.3.4 Precipitation and humidity data

Humidity and the precipitation data (in mm) for the years 1975 - 84 was studied, and the monthly average figures are given in Table 10-1. The table and a reference to the other pertinent records showed that the frequency of fog is maximum at the outset of the northeast monsoons in the months of October to January, with April to September free from fog. On the average, however, there are 10 occasions of fog in a one year period. The visibility in the area is generally fair and limited to a small amount of haze.

The table (Table 10-1) shows that the relative humidity is maximum from May to August (75% - 85%) corresponding to the onset of the southwest monsoons and is minimum (60% - 70%) in December and January. Since the area is generally humid as a result of the influence of the Arabian Sea, the variation in the annual average relative humidities is not large and is of the order of 30% only. The average diurnal maximum for relative humidity in July and

January are recorded as 59% - 75%, respectively.

Table 10-1

(Average figures for 1975 - 1984)

Month	Average Precipitation (in mm)	Average Relative Humidity
Jan.	12.1	62%
Feb.	20.6	69%
Mar.	13.1	72%
Apr.	1.1	75%
May	-	75%
June	9.8	76%
July	74.6	80%
Aug.	100.1	85%
Sept.	20.0	80%
Oct.	3.1	75%
Nov.	2.0	62%
Dec.	8.7	65%

10.3.5 Temperatures

The average mean, maximum and minimum monthly temperatures of the area for the period 1975 - 84 are shown in Table 10-2. It is seen from the data that the maximum temperatures during the year range between 28°C to 43°C and the minimum between 6°C to 27°C. It is also observed from the available data that the hottest period of the year is May - June and the coldest is in January.

Table 10-2

(Average Temperatures for the period 1975 - 1987)

Month	Max.	Min.	Mean
	Temperature °C		
Jan.	28.7	6.1	18.2
Feb.	32.3	7.9	20.3
Mar.	35.4	11.5	24.1
Apr.	40.1	18.2	28.4
May	41.2	21.9	30.6
June	42.7	26.2	31.7
July	37.1	25.4	30.4
Aug.	35.5	24.2	28.7
Sept.	37.5	23.0	29.1
Oct.	38.8	15.9	27.2
Nov.	36.2	11.1	23.3
Dec.	30.8	8.3	19.6

10.4 Estimation of Present Suitiation

At present, there are 2 units of 33 MW each installed and operated at the West Wharf Thermal Power Plant.

In this area, there are no major sources of pollution other than the West Wharf Thermal Power Plant and vehicle transportation systems.

Regarding the existing pollution condition, no existing data was available or newly collected.

Therefore, at first, the JICA Team has calculated the present pollution condition according to Satton's formula based on fuel oil ingredient.

10.4.1 Formulas

(1) Simplified formula of flue gas amount

$$HL = Hr - 600\ (9h + w)\ (Kcal/kg) \quad \text{---------------} \quad (1.1)$$

$$GO = \frac{0.85\ HL}{1.000}\ (Nm^3/kg) \quad \text{---------------} \quad (1.2)$$

$$AO = \frac{0.85}{1.000} + 2.0\ (Nm^3/kg) \quad \text{---------------} \quad (1.3)$$

$$G' = GO + (m - 1)\ AO\ (Nm^3/kg) \quad \text{---------------} \quad (1.4)$$

$$G = G' + 11.2\ h + 1.24\ W\ (Nm^3/kg) \quad \text{------------} \quad (1.5)$$

$$Q'G = G \times W\ (Nm^3/H) \quad \text{---------------} \quad (1.6)$$

$$QG = G \times W\ \frac{to + 273}{273}\ (m^3/H) \quad \text{---------------} \quad (1.7)$$

Where:

HL : Low heat calorific value (Kcal/kg)

Hh : High heat calorific value (Kcal/kg)

h : Hydrogen kg formed per 1 kg of fuel

w : Water kg formed per 1 kg of fuel

GO : Theoretical flue gas generated by the combustion of fuel (Nm^3/kg)

AO : Theoretical air required for the combustion of fuel (Nm^3/kg)

G' : Actual flue gas generated by the combustion of fuel (Dry gas) (Nm^3/kg)

m : Ratio of excess air

G : Actual flue gas generated by the combustion of fuel (Wet gas) (Nm^3/kg)

QG': Flue gas amount per hour (Nm^3/H)

W : Fuel oil consumption per hour (kg/H)

QG : Flue gas amount per hour at ambient temperature (m^3/h)

TO : Ambient temperature (°C)

(2) Formula of the SO_2 gas amount

$$S + O_2 = SO_2 \qquad \text{---------------} \quad (2.1)$$

32 kg 32 kg 64 kg

224 Nm^3 22.4 Vm^3

It is easily understood that 0.7 Nm^3 of SO_2 gas will be generated by combustion of 1 kg of sulfur in fuel.

Therefore,

$$Qs' = 0.7S \times W \ (Nm^3/H) \qquad \text{---------------} \quad (2.2)$$

$$Qs = 0.7S \times W \times \frac{To + 273}{273} \qquad \text{---------------} \quad (2.3)$$

Where:

S : Sulfur kg formed per 1 kg of fuel

Qs': SO_2 gas amount per hours (Nm^3/H)

Qs : SO_2 gas amount per hours at ambient temperature (m^3/H)

To : Ambient temperature (°C)

$$\text{The density in flue gas} = \frac{Qs\times10^6}{QG} = \frac{Qs\times10^6}{QG'} \ (ppm) \qquad \text{------} \quad (2.4)$$

(3) Formula of effective height of stack (chimney)

$$He = Ho + \alpha\,(Hm + Ht) \qquad \text{---------------} \quad (3.1)$$

$$Hm = \frac{4.77}{1+0.43\,\frac{U}{VS}} \cdot \frac{\sqrt{QG.VS}}{U} \qquad \text{---------------} \quad (3.2)$$

$$Ht = 6.37\,g \cdot \frac{QG}{U^3} \cdot \frac{Ts-TO}{TO} \cdot Z \qquad \text{---------------} \quad (3.3)$$

$$Z = \ln J^2 + \frac{2}{J} - 2 \qquad \text{---------------} \quad (3.4)$$

$$J = \frac{U^2}{\sqrt{QG.VS}} (0.43) \sqrt{\frac{To}{g.Qa}} - 0.28 \cdot \frac{Vs}{g} \cdot \frac{To}{TS-TO} + 1) \quad \text{------} \quad (3.5)$$

Where:

He : Effective height (m)

Ho : Actual stack height (m)

α : Current coefficient ($\alpha = 0.65$)

Hm : Rising height by momentum (m)

Ht : Buoyant height by temperature (m)

U : Average wind velocity (m/s)

VS : Leaving velocity of flue gas (m/s)

QG : Amount of flue gas at ambient temperature (m^3/s)

Ts : Temperature of flue gas (°K) (Ts = 408°K)

To : Ambient temperature (°K)

g : Acceleration of gravity (m/s^2) ($g = 9.8\ m/s^2$)

Ga : Temperature gradient of atmosphere (°C/m)

Ga = 0.0033 (°C/m)

To : Ambient temperature (°C)

(4) Formula of maximum density of ground level

$$Cmax = 2.35 \frac{Qs\times10^5}{U \cdot He^2} \cdot \frac{Cz}{Cy} \cdot kt \quad \text{----------------} \quad (4.1)$$

Where:

Cmax : Maximum density at ground level (ppm)

U : Average wind velocity (m/s)

Qs : SO_2 gas amount of stack discharge at ambient temperature (m^3/s)

He : Effective height of stack (m)

Cz : Dispersion variable (Horizontal)

Cy : Dispersion variable (Vertical)

Kt : Correct coefficient (Kt = 0.15)

(5) Formula for the distance of maximum density

$$Xmax = 27.75\ He^{\frac{8}{7}} \quad \text{--------------------------} \quad (5.1)$$

Where:

Xmax : The distance of maximum density (m)

He : Effective height for stack (m)

10.4.2 Calculation of present situation (Trial estimation)

The JICA Team has calculated the SO_2 maximum density at ground level and its distance using the following figures. These are assumed figures of the present condition at the West Wharf Thermal Power Plant.

Stack height	:	Ho = 50 m
Sulfur content	:	S = 3.5%
Leaving velocity of flue gas	:	Vs = 13 m/s
Average wind velocity	:	U = 6 m/s
Temperature of flue gas	:	TS = 273° + 135° = 408°K
Ambient temperature	:	To = 33°C
High heat caloric value	:	Hh = 10,000 Kcal/kg (KESC's Data)
Hydrogen kg formed per kg of fuel	:	h = 0.113 kg
Water kg formed per kg of fuel	:	w = 0.010 kg
Ratio of excess air	:	m = 1.2
Fuel oil consumption	:	W = 10,775 kg/H 33 MW, Efficiency = 25%

(1) Calculation of flue gas amount

By formula (1.1) through (1.7)

HL = 9,383.8 Kcal/kg

GO = 10.42 Nm^3/kg

AO = 9.98 Nm^3/kg

G' = 12.41 Nm^3/kg

G = 13.69 Nm^3/kg

G'G = 147.5×10^3 Nm^3/H

QG at 33°C = 165.2×10^3 m^3/H

(2) Calculation of SO_2 gas amount leaving from stack

By formula (2.2) and (2.3)
QS' = 263.9 Nm^3/H
QS at 33°C = 295.6 m /H

The SO_2 density in flue gas leaving the stack is calculated by formula (2.4) : 1,789 ppm

The results of calculation with the effective stack height, that is the maximum concentration of SO_2 at ground level and its distance are shown below.

Maximum concentration of SO_2	:	0.2 ppm
Distance from the emission source	:	2.5 km

The results can not be considered as representative figures, and it is very difficult at present to estimate the pollution condition with surrounding area of the West Wharf P.P., because, there are no existing data concerning the environmental pollution for Karachi City and environs.

For estimating the pollution condition to obtain background information, it is necessary to obtain more representative figures. Also, the measurement for air pollution should be made at various intervals during the year.

However, it can be said that the West Wharf Thermal Power Plant is one of pollution sources, at present.

10.5 Calculation of Air Pollution

The operation of combustion plants causes air polluting substances to be discharged into the atomosphere together with the flue gases generated by the combustion processes.

In the atmosphere, these emissions are diluted with clean air and carried by the wind.

In their passage through the atmosphere they undergo futher physical and chemical changes to some extent. Ultimately, they reach the ground or the vicinity of the ground directly or indirectly, and there exert an influence on animate and inamimate objects.

For the above reason, the JICA Team carried out a computerized study on ground level concentration of SO for some cases. The computer program, utilization on IBM 5550 Work Station, was developed by TEPSCO, and is based on the "Manual for Emission Dispersion issued by the Ministry of Environmental Authorities of Japan".

10.5.1 Calculation method

(1) Effective source height (ΔH).

The effective source height, ΔH, is the sum of the chimney construction height and the flue gas rise due to thermal density effect.

To calculate the effective source height, some formulas have been suggested - these are Bosanquet, Moses & Carson and Brigges.

The Bosanquet formula is applied to a constant wind velocity of 6 m/sec.

The Moses & Carson formula is applied to a wind velocity of more than 1 m/sec of range, and the Briggs formula is also applied to a non wind or one less than 1 m/sec of ranges.

For this report, Moses & Carson formula was applied for calculating the effective source height.

The calculation formulas is as follows.

$$H = (C_1 \ Vs \ D + C_2 \ QH^{1/2}) \ U^{-1}$$

Where:

Pay time $d\theta/dz$ = (Neutral) ; $C_1 = 0.35$, $C_2 = 0.171$

Night time $d\theta/dz$ = (Stable) ; $C_1 = -1.04$, $C_2 = 0.145$

(2) Dispersion formula

The Plume formula was applied to calculate dispersion. This formula is as follows.

$$C\ (x,\ y) = \frac{Q}{\pi \sigma y \cdot \sigma z \cdot U}\ e\ x\ p\ (-\frac{y^2}{2\sigma y^2})\ e\ x\ p\ (-\frac{He}{2\sigma z^2}) + C_B$$

The dispersion parameters of σy and σz have been suggested, but Sutton and Pasquill-Gifford formulas are used in many cases for calculating as dispension parameters.

In the case of the Sutton formula, σy, σz are given in variable distance (Constant direction) from the emission source to down wind.

Namely,

$$\sigma_y = \frac{1}{\overline{2}} \cdot C_y \cdot x^{(1 - \frac{n}{2})}$$

$$\sigma_z = \frac{1}{\overline{2}} \cdot C_z \cdot x^{(1 - \frac{n}{2})}$$

Here, the followings are given as typical values.

$cy = Cz = 0.07$
$n = 0.25$

On other hand, in the case of the Pasquill-Gifford dispersion parameter, σy, σz are given in variable distance for each direction and atmospheric condition (wind velocity, wind direction, etc.).

σy = (Atmospheric condition and distance)
σz = (Atmospheric condition and distance)

At this time, for the evaluation of ground level concentrations, the Pasquill-Gifford formular was used, with the Satton formula used for calculation of maximum concentration point and maximum on ground level.

The calculations of the yearly average ground level concentrations require the relative frequency of weather conditions as an input.

According to Pasquill-Gifford, all weather conditions can be divided into six weather categories.

A : Strongly unstable
B : Unstable
C : Slightly unstable
D : Neutral
E : Slightly stable
F : Stable

10.5.2 Study condition

(1) Atmospheric condition and stability

The following conditions were used as input data for computer in order to obtain environmental impact level surrounding Karachi City and the West Wharf area. This data was used for studing the follow cases (Table 8-5).

Table 8-5 Atmospheric Condition and Stability

Atmospheric condition and stability	Atmospheric conditions dθ/dz	Atmospheric stability Wind velocity 3 - 4 m/sec	Wind velocity 4 - 6 m/sec
Sunshine amount ordinary/weak	= 0 (Pay time)	C	D

(2) Study condition (for each condition of the following items)

i) Unit number
200 MW x 1
200 MW x 2

ii) Chemney height
100 m
120 m
140 m

iii) Wind direction

West

Southwesternly

West south

South

(3) Calculation data

i) Unit

Output power	:	200 MW x 2
Efficiency	:	37%
Fuel	:	Furnace oil (Equivalent to Bunker C)

ii) Fuel imgredents

High calorific value	:	10,000 Kcal/kg
Sulfur content	:	Max. 3.5% wt
Hydrogen	:	11.3% wt
Water content	:	1.0% wt

iii) Flue gas ingredients

Flue gas amount	:	336 m^3/sec at 140°C
Flue gas temperature	:	140°C
Flue gas density	:	1.225 g/m^3 at 15°C
Flue gas specific gravity	:	0.24 Cal/°k.g

(Note): Theoretical flue gas amount was calculated by Rosin formula based on the heat calorific value.

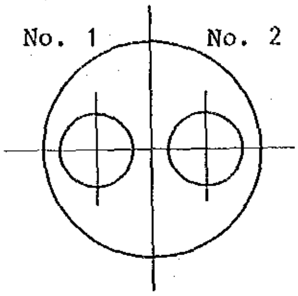
iv) Chimney

Inside diameter of chimney : 3.78 m

Exhaust velocity at chimney : 30 m/sec

Structure of chimney comprises concrete shield and two inner flues, that is, one stack having two chimneys constructed inside of stack.

See diagram below



v) Atmospheric condition

Temperature : 30°C

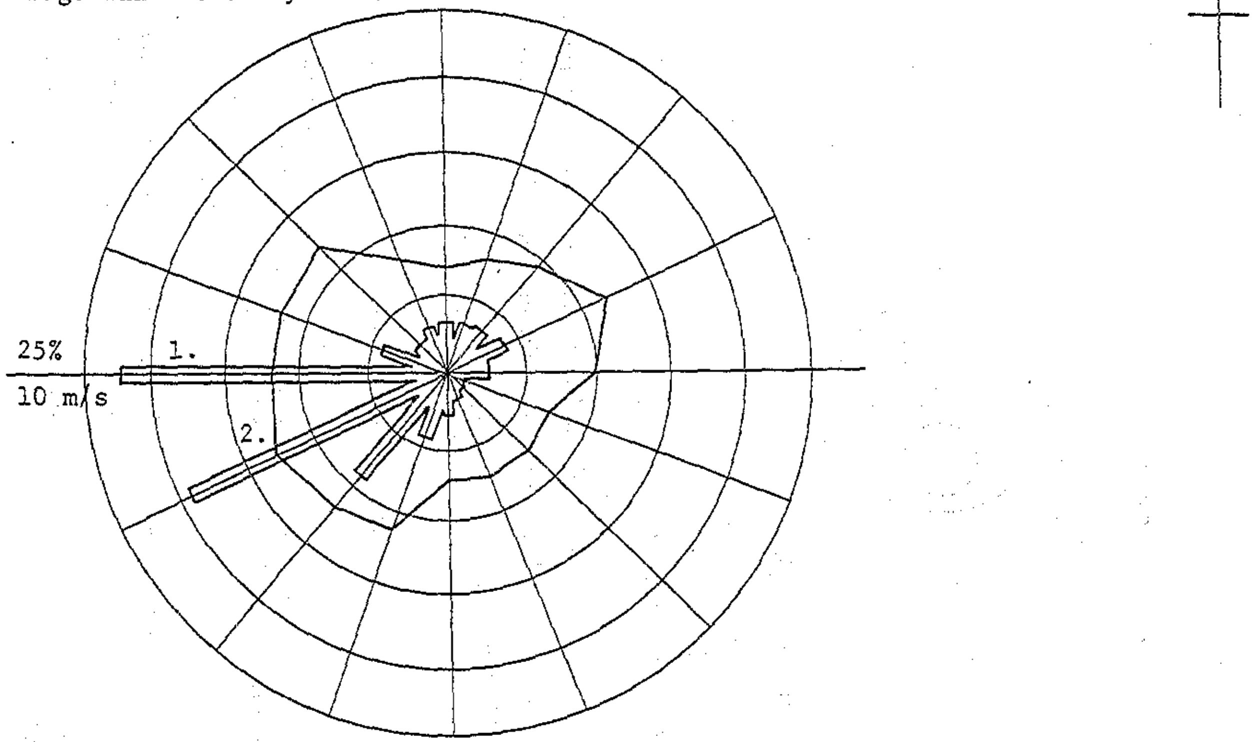
10.5.3 Calculation Results

The results of output data by computer shows the maximum concentration and its distance for 140m chimney height with two (2) units of 200MW operation as follows.

Wind direction	Maximum Atmosphere condition	Maximum Atmospheric stability	Appearance Condition		
			Maximum Concentration		Distance
			Sulfer 3.0 %	Sulfer 3.5 %	
West	Day Time	Ordinary	0.03 (ppm)	0.03 (ppm)	10,850 (m)
South-Westerly	Day Time	Ordinary	0.02	0.03	10,070 (m)

Fig. 10-1 Wind Rose of Karachi-Airport

Note: Figure shows average wind velocity in m/s



1. Frequency in %
One division shows 5%
2. Wind velocity m/s
One division shows 2 m/s

Chapter 11. EXECUTION OF THE FEASIBILITY STUDY AND SCOPE OF WORK (S/W)

11.1 Feasibility Study Execution

In response to the request from the Islamic Republic of Pakistan (hereinafter referred to as "Pakistan"), the Government of Japan has decided to implement the Feasibility Study for the West Wharf Thermal Power Plant Project (hereinafter referred to as "Study"), in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for implementation of technical cooperation programs of the Government of Japan, sent a preliminary mission comprised of Mr. M. Enomoto, the team leader, and four (4) other members to Pakistan from August 10 to August 22, 1987 for the first site survey and settlement of the agreement regarding the feasibility study on the West Wharf Thermal Power Plant Project.

The main items agreed upon as a result of discussions on the Scope of Works (S/W) are as follows;

1. Since any alternative site other than the existing thermal power station site (approximate site area: 37,000 m2) is not available, the new thermal power plant shall be constructed within the existing power plant site.

2. In consideration of the existing power plant site area mentioned above, study and investigation shall be carried out so as to enable construction of a new 200 MW - 400 MW output thermal power plant.

3. In light of the fact that cooling water is discharged into the sea through an underground discharge tunnel provided in ground under the Karachi Shipyard site, KESC is requested to obtain permission to enter the shipyard site during site survey by the study Team.

4. Although the power transmission system of KESC is comprised of the three voltage systems, 66 kV, 132 kV and 220 kV, the improvement plan, including cost calculation, of the existing power transmission system will also constitute one of the study items under this feasibility study to be carried out on the basis of the output of the new West Wharf Thermal Power Plant.

5. The core boring and topographic survey, and survey of the existing facilities will be carried out by KESC based upon the specifications to be prepared by the Japanese study team.

6. Other details are as described in the Scope of Work (S/W) and Minutes of the Meeting agreed upon between the relevant party of Pakistan and JICA Preliminary Study Team.

Succeeding to the preliminary mission, JICA dispatched a survey team comprised of Mr. K. Takasawa, the team leader, and seven (7) other members to Pakistan from Nov. 23rd to Dec. 21st, 1987 and performed a full scale site survey for advancing the study.

Field topographic survey, sounding and structural survey, together with core boring and penetration test were conducted by KESC during a period from Nov. 15th, 1987 to Jan. 17th, 1988 and necessary data and drawings have been presented to JICA for advancing the study.

11.2 Scope of Work (S/W)

This study has been carried out in accordance with the major intentions given in the agreement titled "Scope of Work for Feasibility Study on West Wharf Thermal Power Plant" agreed upon between KESC and JICA Preliminary Study Team. The items pertaining to the objectives of study, scope of work and contents thereof are described below for reference:

Outline of the Project

A new power plant construction plan will be worked out by utilizing the land of the West Wharf Thermal Power Plant and existing infrastructure.

Objectives of the study

This study is intended to work out a technically, economically and financially optimum development plan pertaining to the West Wharf Thermal Power Development Project and prepare a feasibility study report. Moreover, transfer of technical knowledge to Pakistani counterpart will be provided during execution of this study.

Relevant study area

The West Wharf Thermal Power Plant (including port, water intake and discharge facilities, ship navigation route, etc.) and power transmission networks of KESC in the Islamic Republic of Pakistan.

Contents of study

1. Collection and review of all existing data, reports and other relevant information concerning the project

2. Field survey

   (1) Existing land availability
   (2) Accessibility to the site
   (3) Weather and marine conditions
   (4) Existing plant including ancillary facilities
   (5) Operation and maintenance
   (6) Transmission lines
   (7) Environmental aspects

3. Preparation of execution plan and specifications for field topographic survey, sounding and structural survey, and technical guidance for survey work to be carried out by KESC

4. Preparation of execution plan and specification for core boring and penetration tests, and technical guidance for execution of work by KESC

5. Setting of design values for foundation bed of structures based on the results of geologic survey.

6. Review of electric power demand and supply plan

7. Working-out and comparative study of alternative plans for determining an optimum development plan

   (1) Cooling water (Water intake and discharge system)
   (2) Fuel transportation/storage
   (3) Auxiliary power source
   (4) New power plant installed capacity

(5) Existing transmission system for transmitting power generated at proposed plant and propose most economical solution with respect to transmission voltages, i.e., 66 kV or 132 kV or 220 kV

8. Feasibility design based on optimum development plan

(1) Power plant equipment (boiler, turbine/generator)
(2) Boiler water and general service water
(3) Electric control system, pollution control equipment, communication equipment and environmental pollution preventive equipment, if necessary
(4) Cooling water system (Intake and discharge facilities)
(5) Fuel transportation and storage facilities
(6) Civil works of the proposed power plant
(7) Buildings necessary for the plants, facilities and for operation and maintenance
(8) Transmission line and interconnections necessary for feeding the generated power into systems to KESC

9. Cost estimate (by foreign currency and local currency) and preparation of yearly budget appropriation schedule

(1) Cost of new plant
(2) Cost for modification/demolition of existing plant including transmission system
(3) Cost for design and engineering
(4) Contingencies
(5) Disbursement program

10. Formulation of the implementation schedule based on time-oriented bar chart

11. Economic and financial analysis of the project

12. Assessment of environmental impacts (Relevant items: Air-borne emissions, cooling water intake/discharge, oil storage, power transmission, soil quality, noise and vibration, effect upon animal and vegetable)

(1) Evaluation of present situations based on existing data and information

(2) Prediction of and countermeasures against the effect of increasing the power plant capacity

Annex A1 Interconnection of Power System and Its Reliability for Supplying Generated Output to The Transmission System of KESC

A1.1 Desirable connection between West Wharf Power Plant and 132 kV power system

(1) Conditions of power flow and voltage study

In order to study the power flow conditions in 1992 and 1994 after the first and second 200 MW units are to be installed, respectively, the total loads have been distributed to the respective grid stations based upon the 6th and 7th Five Year Programs* of KESC. Moreover, voltage regulation will be ensured by dispersedly distributing capacitors to the grid stations having big loads where the load factor is assumed to be 82%. In addition, consideration has been given for maintaining the 11 kV system voltage of major grid station within 98% and the 11 kV system voltage of the surrounding grid stations within 95%.

(2) System configuration considered in view of power flow (Study of Power System Configuration in 1994)

a. Studies cases

Case A: A basic case where the systems indicated in the 7th Five Year Program of KESC; namely, the following equipment and facilities have been commissioned:

i) Construction of 132 kV cable x 2 cct lines between West Wharf Power Plant and Queens Road

ii) Construction of one cct cable line between the West Wharf Power Plant and Garden East through Elander Road

iii) Installation of 132/66 kV bank/s at West Wharf

* 6th Five Year Program:
1983/84 - 1987/88

7th Five Year Program:
1988/89 - 1992/93

Case B: A case where there is no transmission line between the West Wharf Power Plant and Queens Road among those in Case A.

Case C: A case where there is no transmission line between West Wharf and Elander Road in item (2) of Case A

Case D: In case two circuit lines are added between West Wharf and SITE to Case A but there is no transmission line between West Wharf and Elander Road

Case E: There is no 132/66 kV bank at West Wharf among those in Case A

b. Results of study

i) Summary

A power flow diagram in Case A, that is, a basic case, is indicated in Fig. A-1-1.

As can be seen from the diagram, roughly 85% of the total output of the West Wharf Power Plant is transmitted to the surrounding areas of the power station and city center through 220/132 kV banks during peak load hours. The total capacity in case the generated output of 1,580 MW in the 220 kV system including the Bin Qasim Power Station is passing through the 220/132 kV banks at the respective grid stations, is roughly 460 MW at Pipuri West, 400 MW at

KDA-33, 390 MW at Baldia and 320 MW at West Wharf. From these values, two (2) 220/132 kV 250 MVA banks are deemed to be necessary at the West Wharf Power Plant.

Furthermore, the transmission line (one circuit) between the Korangi Power Station and Korangi West Grid Station has exceeded the transmission capacity of 165 MVA. On the other hand, the power flow between Baldia and Valika will not become so large as to require reinforcement of the transmission line between this section. Thus, it is deemed necessary to take countermeasures while observing the trend in region-wise growth of the load in the future.

ii) Comparison of Cases A, B, C and D

Presented in Fig. A-1-2 is a simplified power flow diagram summarized to readily recognize the difference between the respective Cases A, B, C and D.

(i) In Case B, the section between West Wharf and Elander Road is subjected to overload, while the section between Queens Road and Gizri is also subjected to overload in Case C. In both cases, the power flow change is limited to a local one, and does not cause any substantial change in the surrounding system. Therefore, the transmission loss does not change markedly. The transmission line connecting West Wharf and Queens Road and that between West Wharf and Garden East through Elander Road are seen to play an important role.

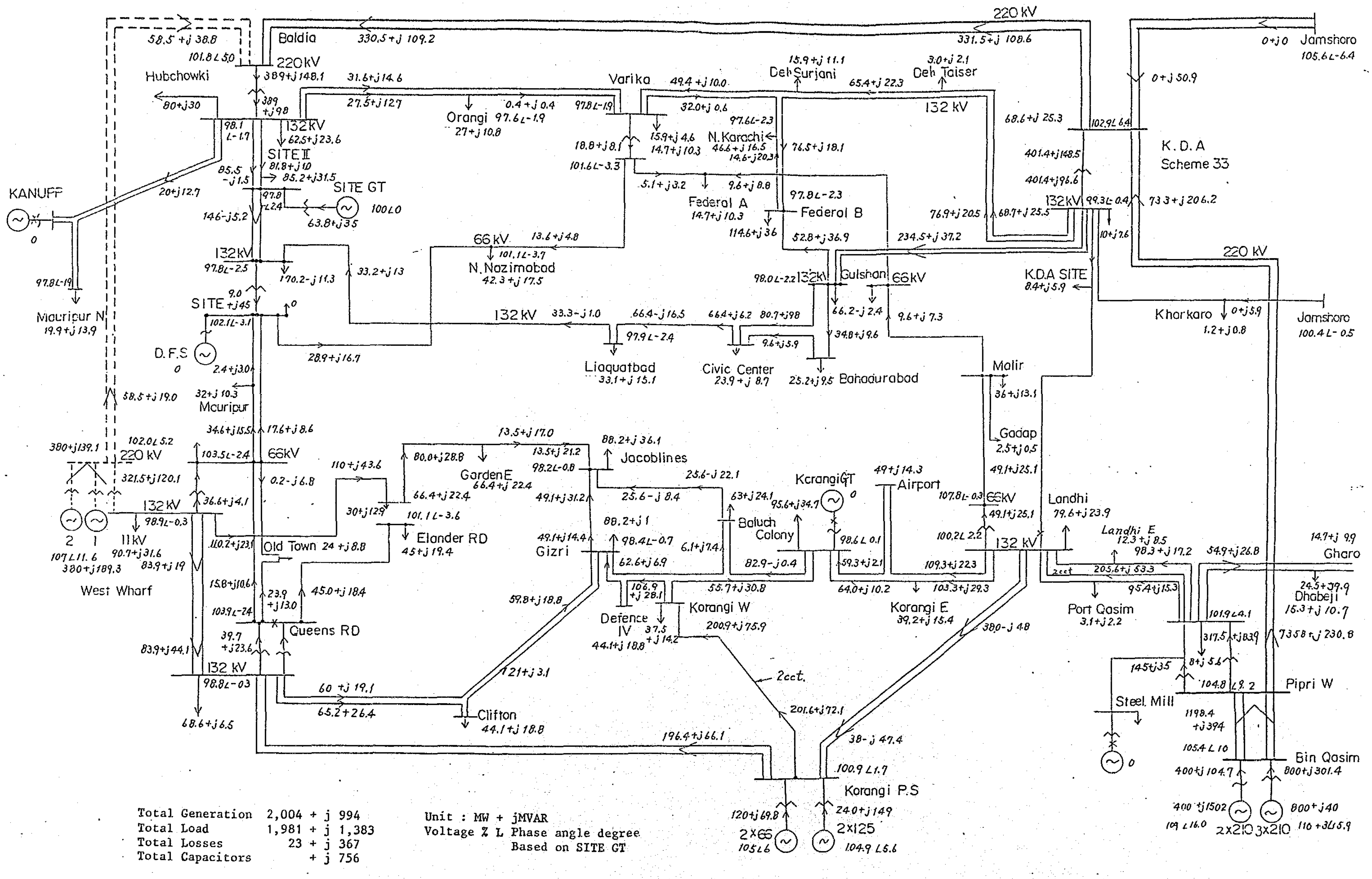
(ii) The West Wharf and S.I.T.E. connecting plan in

Case D cause a decrease in 220 kV power flow at West Wharf, resulting in further increases in the incoming power flow to the 132 kV system from Pipuri West on the east side. The transmission loss indicates little change.

(iii) The results of calculating short circuit power in both Cases A and D are as indicated in Fig. A-1-3.

As is clear from the results, if West Wharf and S.I.T.E. are connected through a 132 kV system, the short circuit power will increase at the respective grid stations and exceed 5,000 MVA at Queens Road, Korangi Power Stations, etc., in the old facilities.

(iv) Judging from the above, it is considered preferable that interconnection between West Wharf and S.I.T.E. be studied further in the future without constructing the system under this project.



Total Generation 2,004 + j 994
Total Load 1,981 + j 1,383
Total Losses 23 + j 367
Total Capacitors + j 756

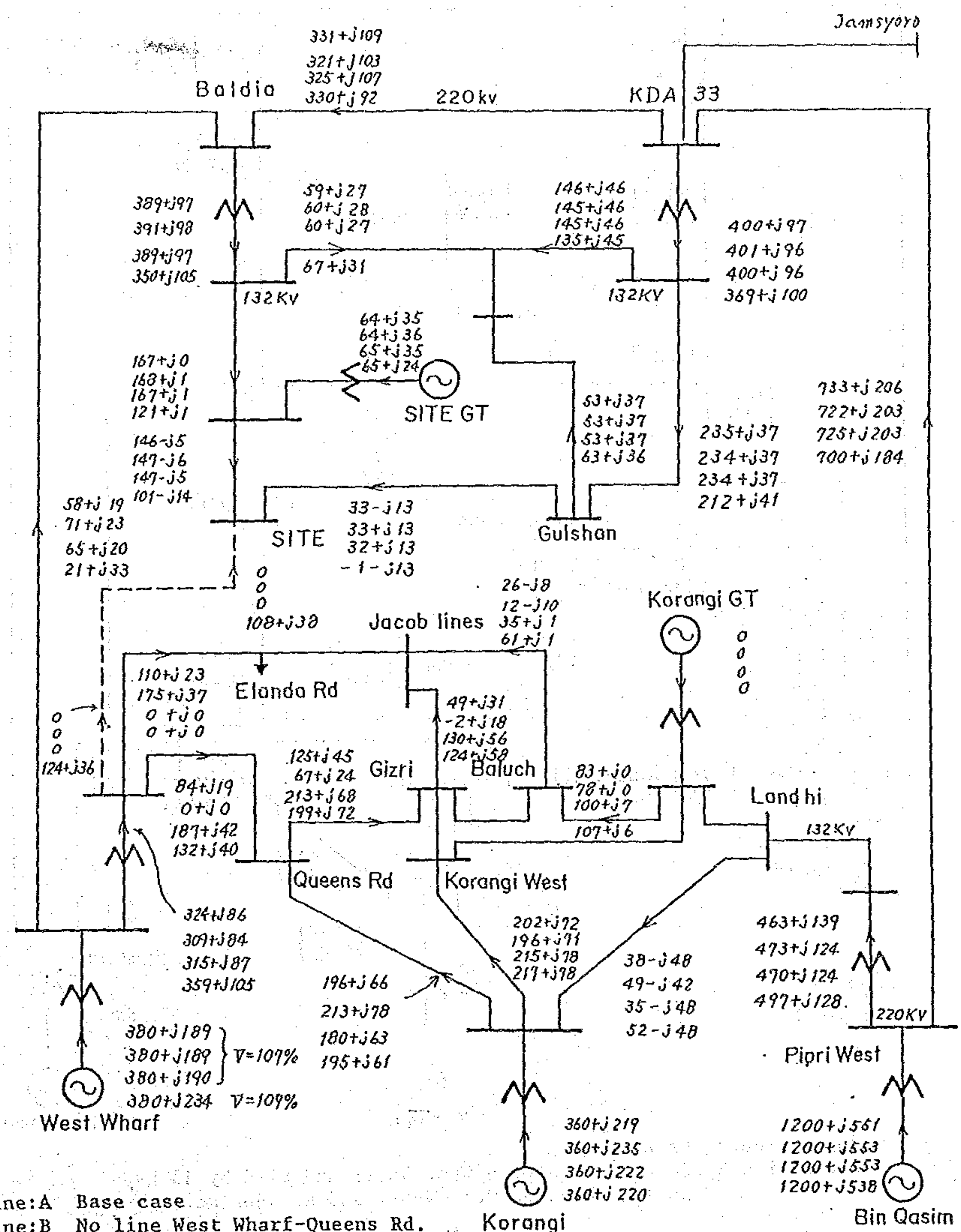
Unit : MW + jMVAR
Voltage % ∠ Phase angle degree
Based on SITE GT

Fig. A-1-1 Power Flow Study Diagram in 1994
Case A

Fig. A-1-2 Simplified Power Flow Study Diagram in 1994 case A, B, C, D

Unit:MW+jMVAR

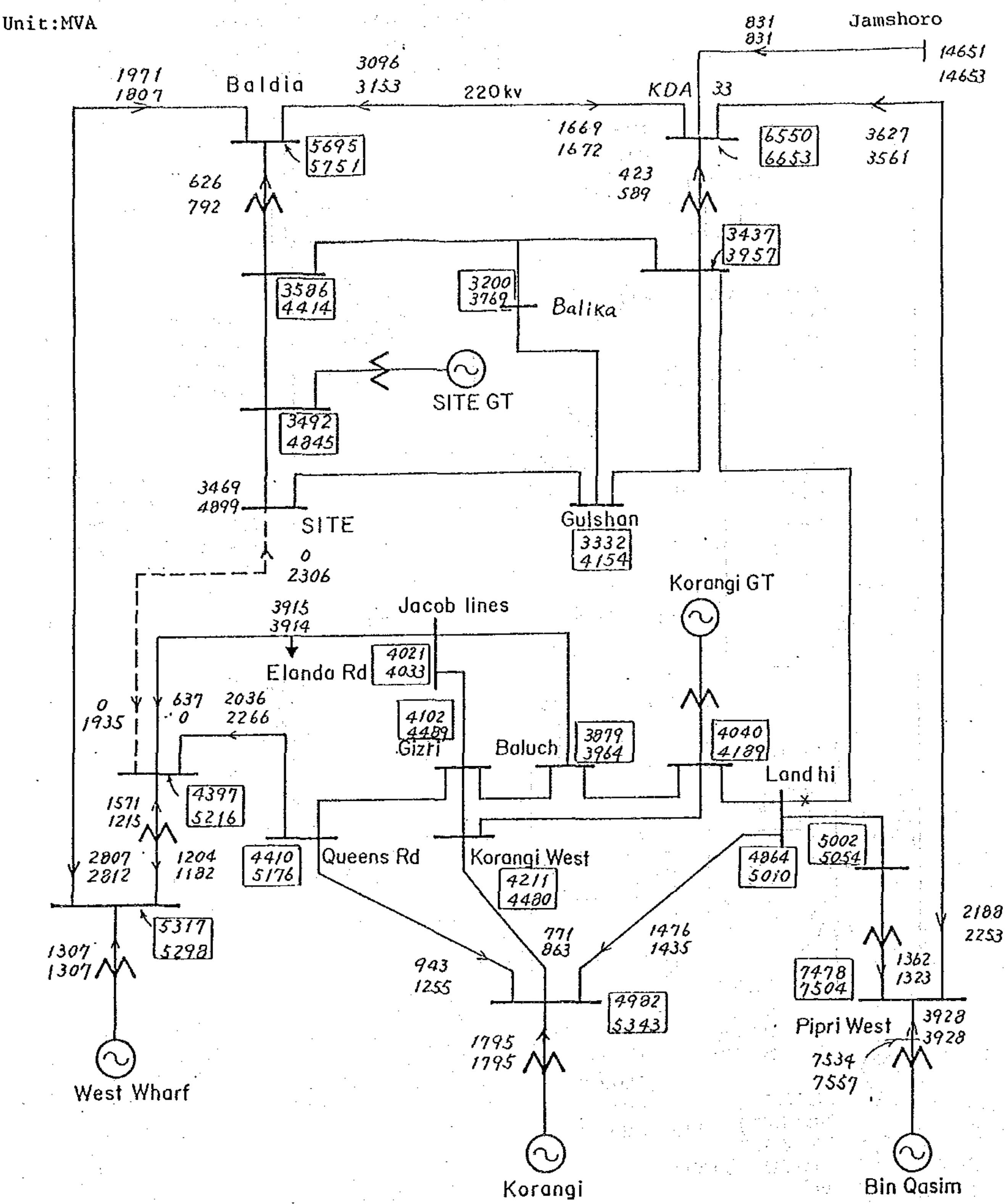
Generating power	Total losses	Capacitors
2,004+j 994	22.6+j367	j756
2,004+j1,003	23.2+j396	j775
2,005+j1,001	23.9+j394	j775
2,005+j1,017	23.7+j377	j743



1st line:A Base case
2nd line:B No line West Wharf-Queens Rd.
3rd line:C No line West Wharf-Elander Rd.
4th line:D Ditto and there is a new line West Wharf-SITE

Fig. A-1-3 Simplified Short Circuit Power Diagram in 1994
case A, D

Unit:MVA



Upper line:A Base case
Lower line:B Connected between West Wharf and SITE by 132kV, no line between West Wharf and Elander Rd.

A1.2 Study in case 132/66 kV banks are not installed in the West Wharf Power Plant (Case E in Clause A1.1)

This power system study has been carried out on the assumption that changeover of 66/11 kV banks to 132/11 kV banks at the S.I.T.E. Grid Station (G/S) and Gulshan G/S, which have been incorporated in the 6th and 7th Five Year Programs of KESC, are completed, and that the Mauripur G/S is completed and the load increased as a result of completion is absorbed by the above grid stations.

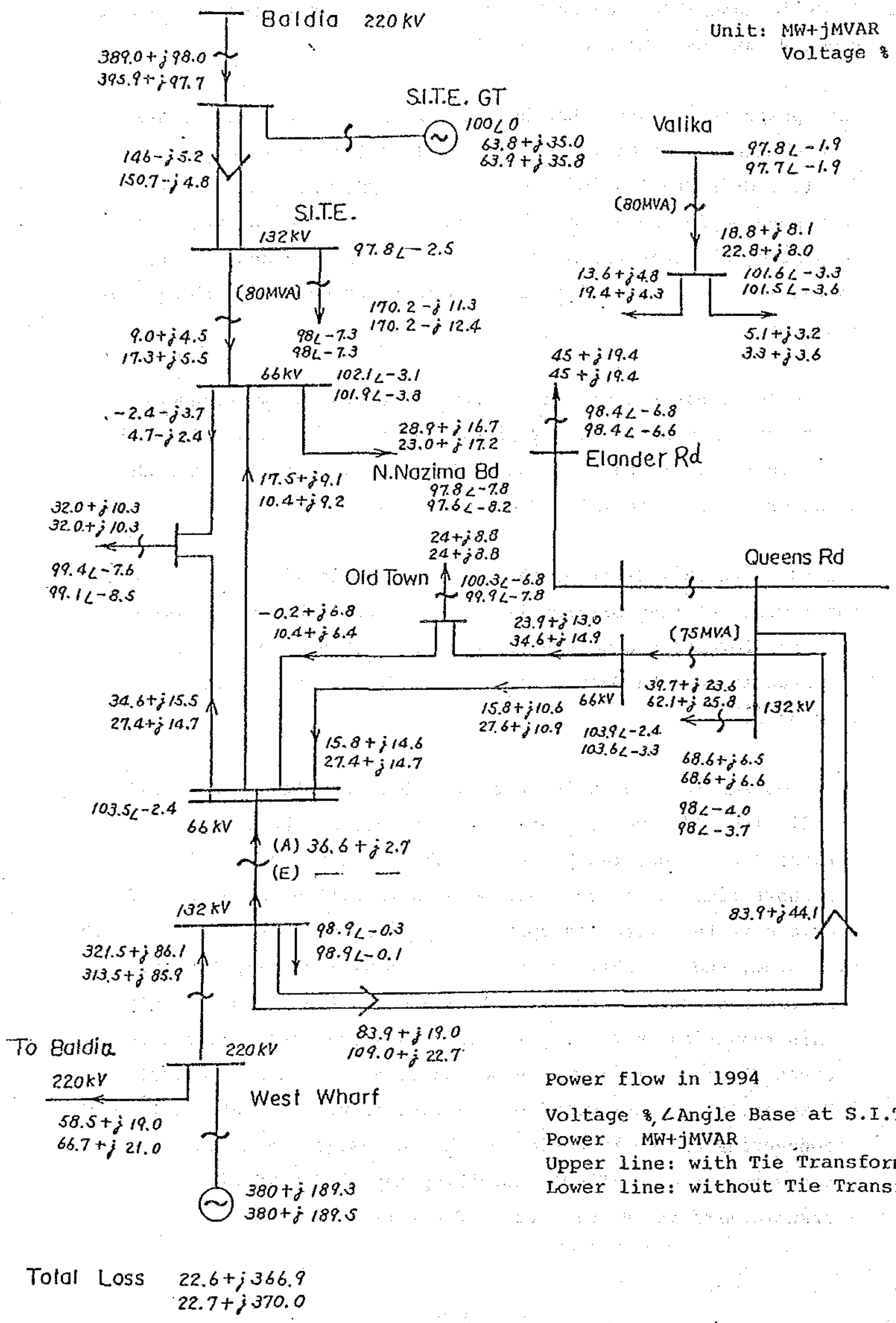
Fig. A-1-4 indicates changes in power flow in the surrounding power system in case the 132/66 kV tie transformers are assumed to be installed in the West Wharf Power Plant and in case such tie transformers are not installed in the power plant.

According to this diagram, the voltage drop is within 1% and the total value of transmission loss makes little change in case the tie transformers are not installed, although the load to the tie transformers at the Queens Road, S.I.T.E. and Valika G/S increases.

The problematical point is that the cables between Queens Road and Old Town G/S are subjected to overload, as the load is estimated to almost reach the allowable capacity value of 350 A for short time operation. Although there will be no danger of overload if the system is operated by disconnecting the loop of 66 kV system, the reliability of the system will be slightly lowered in cases of the transmission line and tie transformers fault. This reduction in reliability is within the extent allowable since the power failure can be restored by switching operation. However, it is considered more advantageous to adopt a method of connecting the 66 kV cables on the Queens Road and S.I.T.E. sides separately without installing any 132/66 kV tie transformers at the West Wharf Power Plant.

Fig.A-1-4 Influence of Tie Transformer in West Wharf Power Plant
Case A/E

Unit: MW+jMVAR
Voltage % ∠degree



Power flow in 1994

Voltage %,∠Angle Base at S.I.T.E.G.T.
Power MW+jMVAR
Upper line: with Tie Transformer(A)
Lower line: without Tie Transformer(E)

A1.3 Study of System Stability

From the power flow diagram in Fig. A-1-1, the mutual differential phase angles are as indicated below.

Assuming that the differential phase angle at S.I.T.E. G/S is zero (0) (S.I.T.E. G/T $\angle 0°$).

West Wharf Power Plant	$\angle$ 11.6°
Korangi Power Station	$\angle$ 6°
Bin Qasim Power Station	$\angle$ 16°

In light of the fact that the difference is roughly within 10° with reference to the differential phase angle at the Korangi Power Station located at a center position of the power system, the power system can be said to be highly stable.

Therefore, it has been evaluated that no problem will arise regarding system stability as far as operation of the West Wharf Power Station is concerned.

Annex A2 Site Survey on 220 kV T/L from Baldia G/S to West Wharf P.P.

Results of the route survey on the captioned T/L in relation with the West Wharf Project are as follows: (Refer to Fig. A2-1)

1. Existing 66 kV T/L Route Between West Wharf P.P. and SITE G/S.

(1) Underground cable is laid about 1.2 km from West Wharf P.P. to a point near the entrance of Fishery Harbour, and the cable is interconnected to the overhead T/L at Tower No. 1.

(2) Up to Tower No. 5, about 1.0 km from Tower No. 1, the T/L is installed along the paved road parallel with the railway, then turn left (separating from the road).

(3) Under/around the T/L from the above turning to the mouth of the Layari River, many small houses are crowded together, and no reinforcement of the T/L seems possible.

(4) Beyond the mouth of Layari River, the T/L comes to Mauripur G/S., then turns right, and goes to SITE G/S. through the Air Force housing area and a suitable area on the north side of the SITE railway station.

(5) The mouth of the Layari River is normally a low grass hill, but in the rainy season, the area is submerged. The existing T/L towers are built in this area.

(6) 6 kV T/L between Mauripur G/S. and SITE G/S. passes through a rather good arrangement area, even though there are many houses around the T/L route, and it will be possible to reinforce/upgrade the existing T/L, for example, to 132 kV.

2. Newly Planned 220 kV T/L Route Between G/S. and West Wharf P.P.

West Wharf P.P. is situated about 12 km south of Baldia G/S. nearby is Baldia city, and Air Force base and Mauripur city. The survey was conducted along the route avoiding these crowded area, which is mainly the same as the planned route by KESC.

(1) From Baldia G/S. to Around Mauripur G/S.

From Baldia G/S. the route runs to southwest along the existing 132 kV T/L to KANUPP P.S. The route turns left at a certain point between the existing T/L Tower No. 73 and No. 78, and then reaches the seaside passing through the West side of Air Force area. (Taking into consideration a new construction plan of Mauripur North G/S., it will be favourable to take the route along the planned 132 kV Mauripur North line which will be branched from the existing 132 kV KANUPP line).

. The route runs along the coastal line through salt pond area to/around Mauripur G/S.

. It has been jundged that the T/L route selection, about 16 km from Baldia G/S. to/around Mauripur G/S., will be rather easy.

(2) From Around Mauripur G/S. to West Wharf P.P.

The following three plans are considered:

Plan A

. To take-in the 220 kV T/L to Mauripur G/S. and from here go to West Wharf by underground cable along the Mauripur Road. (Underground cable length: Approx. 7 km)

. The area of Mauripur G/S is about 8,700 m^2 pnd now used as a material storage area. This area is large enough to accommodates the above facilities.

. A plan to install 132 kV cable by voltage step down from 220 kV to 132 kV in Mauripur G/S. might be considered. However, in view of its complexity and high cost, the plan is not considered as feasible.

Plan B

. Does not take-in the 220 kV T/L to Mauripur G/S. and to install the last tower on the left bank of Layari River and lay down underground cable to West Wharf P.P.
(Underground cable length: Approx. 5 km)

. From the last tower, the cable runs along Mauripur Road after crosing the left bank of the Layari Rivedr, then turns left after passing Wazir Mansion Railway Station to West Wharf terminating at West Wharf P.P.

. In the area between the Mauripur paved road and railway, seen as a possible cable route, are parked many large trucks and the traffic on the road is heavy.

. The other route, namely, on the opposite side of the railway, might be considered. However, the road is narrow and raugged, (even difficult for jeep), and crowded with many small houses.

Plan C

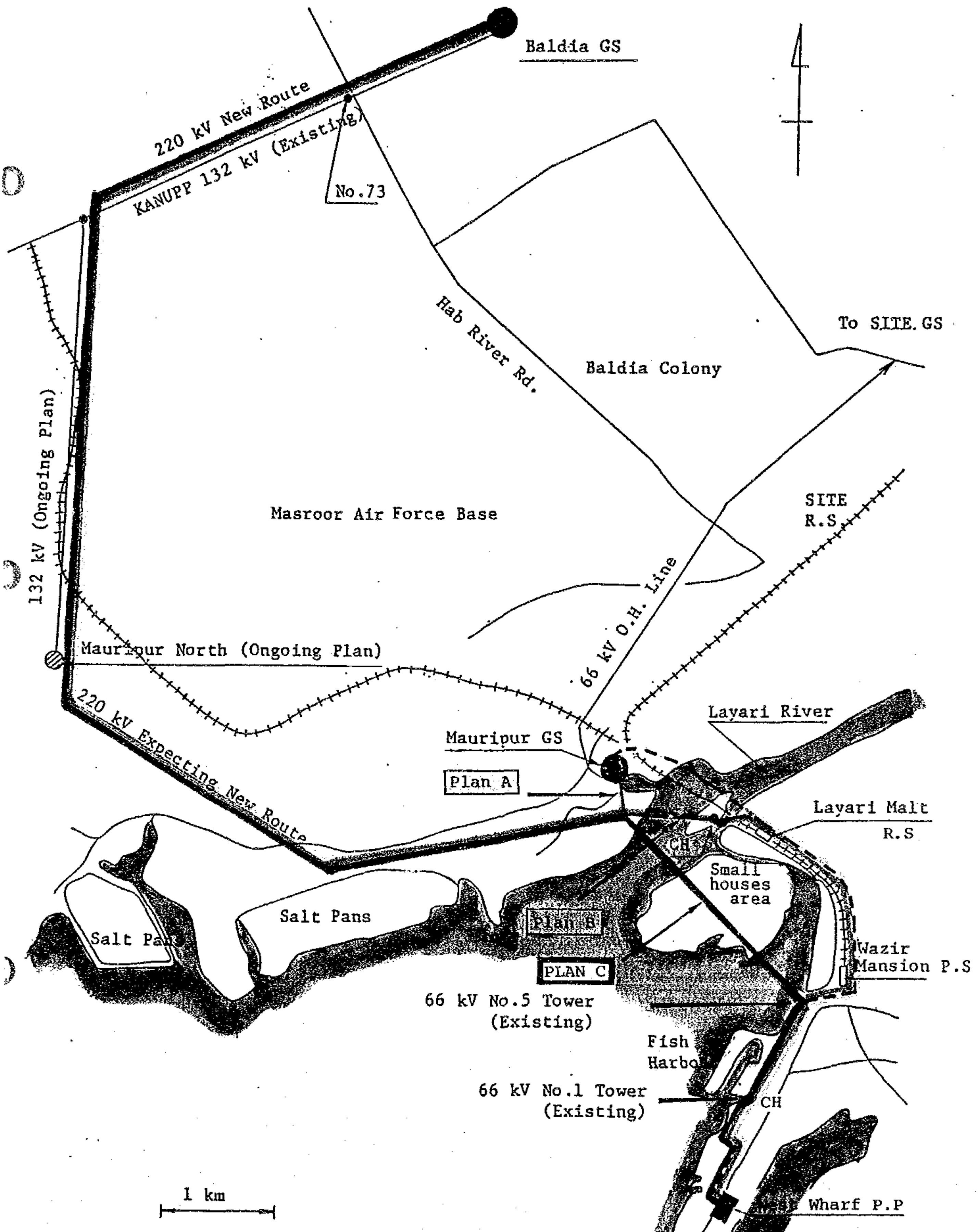
. Does not take-in the 220 kV T/L to Mauripur G/S, (it is the same as Plan B) and the overhead T/L crosses over the sea inlet to the marshy land situated near the mouth of Layari River and reaches Tower No. 5 of existing 66 kV West Wharf P.P. - Mauripur G/S. line.

- From Tower No. 5 to No. 1, about 1 km, the existing T/L is upgraded to a four (4) circuits tower (220 kV x 2, 66 kV x 2). The underground cable is laid from Tower No. 1 to West Wharf P.P.
- Plan C, is the shortest underground cable length among the three Plans. However, it requires construction of towers in the mangrove swamp island. Therefore, detailed study and investigation must be carried out at the implementing stage in view of soil conditions, construction methods and maintenance.

(3) Plan to install the Overhead Transmission Line up to West Wharf P.P.

The route to reach the offshore area of the Karachi Shipyard makes use of the shallows in the sea, and brings the overhead T/L to the West Wharf P.P. over the area, where the cooling water discharge pipes of the power plant are buried. However, the area belongs to the Karachi Shipyard, and also large cranes are operating in the neighbourhood. Consequently, it seems inappropriate to pass over the T/L over these areas.

Fig.A.2-2 220 kV Transmission Line Expected New Route



Annex A4 LIST OF COLLECTED DATA

NO.	TITLE OF COLLECTED DATA	DATE	NO.OF COPIES	ORGANIZATION ISSUED/OFFERED	PURCHASE DONATION
	NESPAK PRICE INDEX, 1987 Feb.			NESPAK	
	Guide to import & export			Karachi Law Pub.	
	Builing Code of Pakistan			Government Paki.	
	General Layout of A, B and BX stations			KESC	
	Map of Pakistan (1/300,000)			Survey of Paki.	
	Map of Sind (1/1,000,000)			DO	
	Karachi Guide Map (1/40,000)			DO	
	Karachi Guide Map (1/25,000)			DO	
	Chart of Karachi Harbour			DO	
	Chart of Approaches to Karachi			DO	
	Statistical Pocket Book of Paki. (1987)			Gov. of Paki.	
	Karachi Development Authority			Master Plan & Environmental Control Dep.	
	General Layout of Bin Qasim Thermal P.S.			NESPAK	
	Combined Fuel Oil, Natural Gas & Steam Feeding System for A,B & BX Stations			KESC	

LIST OF COLLECTED DATA

NO.	TITLE OF COLLECTED DATA	DATE	NO.OF COPIES	ORGANIZATION ISSUED/OFFERED	PURCHASE DONATION
	Study on Environmental Impact of Bin Qasim Thermal P.S.			KESC	✓
	Pakistan Statistical Year Book (1987)			Gov. of Paki.	
	Symbols & Abbreviations (1984)			Hydro Graphic Office	
	Site Plan of A & B Steam S.			KESC	
	Flow Diagram of Natural Gas at Gay Yard Stem S.on W.W.			KESC	
	Drawing of 11kv Building at W.W.			KESC	
	Layout of KESC's Salt Water Intake			KESC	
	Detail Drawing of KESC's Salt Water Intake			KESC	
	Key Plan of Licensed Area & Transmission System			KESC	
	Plan Showing Existing 220kv, 132kv &66kv Network			KESC	
	Partial Copy of KESC Power Development & Tarif Study			KESC	

LIST OF COLLECTED DATA

NO.	TITLE OF COLLECTED DATA	DATE	NO.OF COPIES	ORGANIZATION ISSUED/OFFERED	PURCHASE DONATION
	Partical Copy of Draft Appraisal Expantion of Transmission Network, Protection, Telecomunication, Load Dispatch (1987-91)			KESC	
	Power Flow Diagram, Load Dispatch Center Analysis Sheet			KESC	
	Computer Study Data for Evening Peak (1987)			KESC	
	Impedence Map System Constant				
	Load Forecast-System Peak Load			KESC	
	Short Circuit Analysis (1987)			KESC	
	Pertial Copy of Spec.for Transmission Line Designing			KESC	
	One Line Diagram			KESC	
	EHT Network of KESC			KESC	
	Power System Statistics			KESC	
	Comparative Operating Rsults for the Period July-June 1986-1987 (Provisional)			KESC	
	Statement Showing Tarifwise Units Sold for the Period July-June 1986-1987 (Provis.)			KESC	
	Rvenue 1985-1986			KESC	

TABLE-III

TIDAL LEVELS AND DATUMS

(1) DATUMS AT STANDARD AND SECONDARY PORTS

Level of zero of predictions which is chart datum in all cases.

KARACHI	4.31 metres (14.14 ft.) below a Bench Mark about 100 metres (110 yds) south west of the tidal observatory.
MUHAMMAD BIN QASIM PORT (ENTRANCE)	5.57 metres (18.61 ft.) below a Bench Mark on the Bundal Island which is the western bank of Phitti Creek and about 1.2 km (3/4 mile) north of the southern tip of the Island.
MUHAMMAD BIN QASIM PORT (PIPRI)	4.67 metres (15.35 ft.) below a Bench Mark situated close to the H.W. line in Gharo Creek and about 2.4 km (1½ miles) south west of Goth Mahmood Shah.
GWADAR	3.979 metres (13.05 ft.) below a Bench Mark on a top of a Triangulation mark (Pillar of concrete) named G-2, about 500 metres (550 yds) south of Custom House Building on high water line.
PASNI	3.81 metres (12.5 ft.) below a Bench Mark covered in cement at the top of concrete post about 1 metre (3.3 ft.) above ground and 0.49 metre (1.6 ft.) in diameter; erected in the sand near the entrance to the Coast Guard Camp Compund. The camp is near the Mazar at Pasni.

(2) TIDAL LEVELS AT STANDARD AND SECONDARY PORTS

PORTS	L.A.T.	M.L.L.W.	M.H.L.W.	M.S.L.	M.L.H.W.	M.H.H.W.	H.A.T.	Year of tidal Observation
	-430	+430	+1100	+1645	+2190	+2680	+3200	
Karachi	-1.4	+1.4	+3.6	+5.4	+7.2	+8.8	+10.5	1950, 1953
Md.Bin Qasim Ent.	-1.9	+1.8	+4.0	+5.7	+7.4	+9.6	+11.3	1972, 1973
Md.Bin Qasim Pipri	-2.0	+3.2	+4.7	+6.7	+8.7	+11.1	+13.0	1972, 1973
Gwadar	-1.1	+0.7	+3.4	+4.2	+6.3	+6.6	+ 8.4	1982
Pasni	-1.3	+0.8	+3.6	+4.6	+7.1	+7.2	+ 9.5	1985

The above levels, in feet, are referred to CHART DATUM, which is the same as the Zero of the tidal predictions in all cases.

All predictions in this book are calculated by the harmonic method.

NOTE:- The analysis for Pasni is based on one Synodic month.

DEFINITIONS OF TIDAL LEVELS AND DATUMS

Tidal Levels

(a) L.A.T. (Lowest Astronomical Tide). H.A.T. (Highest Astronomical Tide). The lowest and highest levels respectively which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions; these levels will not be reached every year. H.A.T. and L.A.T. are not the extreme levels which can be reached, as storm surges may cause considerably higher and lower levels to occur.

(b) M.L.W.S. (Mean Low Water Springs). M.H.W.S. (Mean High Water Springs). The height on mean high water springs is the average, throughout a year when the average maximum declination of the moon is 23½° of the heights, of two successive high waters during those periods of 24 hrs. (approximately once a fortnight) when the range of the tide is greatest. The height of mean low water springs is the average height obtained by the two successive low waters during same periods.

(c) M.H.W.N. (Mean High Water Neaps). M.L.W.N. (Mean Low Water Neaps). The height of mean high water neaps is the average, throughout a year as defined in (b) above, of the heights of two successive high water during those periods (approximately once a fortnight) when the range of the tide is least. The height of mean low water neaps is the average height obtained from the two successive low waters during the same periods.

NOTE. The average value of M.H.W.S. etc., varies from year to year in a cycle of approximately 18.6 years. The tidal levels given in Table III are average values for the whole cycle obtained by computing values of a year or more and correcting the results by the value of f of M_2

M.S.L. (Mean Sea level). Mean sea level is the average level of the sea surface over a long period, preferably 18.6 years, or the average level which would exist in the absence of tides.

M.H.H.W. (Mean Higher High Water). The height of mean higher high water is the mean of the higher of the two daily high waters over a long period of time. When only one high water occurs on a day this is taken as the higher high water.

M.L.H.W. (Mean Lower High Water). The height of mean lower high water is the mean of the lower of the two daily high water over a long period of time.

M.L.L.W. (Mean Lower Low Water). The height of mean lower low water is the mean of the lower of the two daily low waters over a long period of time. When only one low water occurs on a day this is taken as the lower low water.

M.H.L.W. (Mean Higher Low Water). The height of mean higher low water is the mean of the higher of the two daily low waters over a long period of time.

NOTE. The average value of M.H.H.W., etc., varies from year to year in a cycle of approximately 18.6 years. The tidal levels given in Table III are usually computed from a year when the levels are expected to be average that is when f of M_2 is 1.00.

PAKISTAN–KARACHI

Lat. 24° 48' N, Long 66° 58' E

TIME ZONE—0500 TIMES AND HEIGHTS OF HIGH AND LOW WATERS **YEAR 1988**

JANUARY

Day	TIME	FT	M	Day	TIME	FT	M
1	0250	5.3	1.6	16	0205	5.7	1.7
F	0750	7.6	2.3	SA	0649	7.6	2.3
	1456	0.4	0.1		1418	0.4	0.1
	2212	8.6	2.6		2145	8.5	2.6
2	0344	5.1	1.5	17	0307	5.3	1.6
SA	0841	7.5	2.3	SU	0801	7.8	2.4
	1538	0.3	0.1		1511	-0.2	-0.1
	2250	8.9	2.7		2227	9.2	2.8
3	0429	4.8	1.5	18	0359	4.7	1.4
SU	0928	7.4	2.3	M	0906	8.2	2.5
	1618	0.3	0.1		1601	-0.6	-0.2
	2324	9.1	2.8		2307	9.8	3.0
4	0508	4.6	1.4	19	0446	4.1	1.2
M	1013	7.4	2.3	TU	1006	8.5	2.6
	1654	0.4	0.1		1647	-0.8	-0.3
	2356	9.3	2.8		2346	10.2	3.1
5	0545	4.3	1.3	20	0532	3.5	1.1
TU	1056	7.5	2.3	W	1103	8.7	2.7
	1729	0.7	0.2		1733	-0.8	-0.2
6	0027	9.3	2.8	21	0024	10.5	3.2
W	0620	4.2	1.3	TH	0618	2.9	0.9
	1135	7.5	2.3		1156	8.8	2.7
	1802	0.9	0.3		1817	-0.3	-0.1
7	0056	9.3	2.8	22	0059	10.6	3.2
TH	0654	4.0	1.2	F	0703	2.3	0.7
	1211	7.5	2.3		1248	8.6	2.6
	1831	1.3	0.4		1859	0.4	0.1
8	0123	9.3	2.8	23	0134	10.5	3.2
F	0726	3.8	1.2	SA	0750	1.9	0.6
	1247	7.4	2.2		1340	8.2	2.5
	1859	1.8	0.5		1941	1.4	0.4
9	0148	9.1	2.8	24	0210	10.1	3.1
SA	0800	3.6	1.1	SU	0836	1.6	0.5
	1326	7.1	2.2		1436	7.6	2.3
	1929	2.4	0.7		2025	2.6	0.8
10	0214	8.9	2.7	25	0245	9.5	2.9
SU	0836	3.4	1.0	M	0927	1.5	0.5
	1411	6.8	2.1		1541	7.0	2.1
	2000	3.1	0.9		2111	3.9	1.2
11	0241	8.7	2.6	26	0321	8.8	2.7
M	0917	3.1	1.0	TU	1023	1.5	0.5
	1509	6.4	2.0		1711	6.6	2.0
	2038	3.9	1.2		2209	5.0	1.5
12	0310	8.4	2.6	27	0401	8.0	2.5
TU	1005	2.8	0.8	W	1129	1.5	0.5
	1625	6.2	1.9		1911	6.8	2.1
	2128	4.8	1.4		2343	5.8	1.8
13	0347	8.1	2.5	28	0454	7.4	2.2
W	1103	2.3	0.7	TH	1242	1.4	0.4
	1816	6.4	1.9		2033	7.4	2.3
	2241	5.5	1.7				
14	0436	7.8	2.4	29	0137	5.8	1.8
TH	1211	1.8	0.5	F	0610	6.9	2.1
	1958	7.0	2.1		1347	1.3	0.4
					2126	7.9	2.4
15	0028	5.9	1.8	30	0250	5.5	1.7
F	0538	7.6	2.3	SA	0729	6.7	2.1
	1319	1.1	0.3		1441	1.1	0.3
	2057	7.8	2.4		2203	8.3	2.5
				31	0340	5.0	1.5
				SU	0832	6.8	2.1
					1524	1.0	0.3
					2234	8.7	2.6

FEBRUARY

Day	TIME	FT	M	Day	TIME	FT	M
1	0418	4.6	1.4	16	0342	4.1	1.2
M	0926	7.1	2.2	TU	0906	8.2	2.5
	1603	0.9	0.3		1547	-0.3	-0.1
	2305	8.9	2.7		2240	9.8	3.0
2	0451	4.2	1.3	17	0429	3.2	1.0
TU	1011	7.3	2.2	W	1006	8.7	2.6
	1640	0.9	0.3		1633	-0.4	-0.1
	2333	9.2	2.8		2317	10.3	3.1
3	0524	3.9	1.2	18	0512	2.3	0.7
W	1051	7.6	2.3	TH	1101	9.0	2.7
	1712	1.0	0.3		1717	-0.2	-0.1
					2352	10.6	3.2
4	0000	9.4	2.9	19	0556	1.5	0.5
TH	0555	3.5	1.1	F	1153	9.1	2.8
	1129	7.8	2.4		1759	0.3	0.1
	1742	1.2	.4				
5	0026	9.5	2.9	20	0026	10.7	3.3
F	0624	3.2	1.0	SA	0638	1.0	0.3
	1204	7.9	2.4		1242	9.0	2.7
	1810	1.5	0.5		1840	1.2	0.4
6	0048	9.4	2.9	21	0058	10.5	3.2
SA	0652	2.9	0.9	SU	0720	0.6	0.2
	1240	7.8	2.4		1330	8.6	2.6
	1837	2.0	0.6		1920	2.2	0.7
7	0109	9.3	2.8	22	0130	9.9	3.0
SU	0720	2.6	0.8	M	0803	0.6	0.2
	1316	7.7	2.3		1419	8.0	2.4
	1903	2.6	0.8		2000	3.3	1.0
8	0129	9.1	2.8	23	0200	9.2	2.8
M	0751	2.3	0.7	TU	0846	0.9	0.3
	1356	7.4	2.2		1517	7.4	2.2
	1932	3.3	1.0		2043	4.4	1.3
9	0150	8.8	2.7	24	0229	8.4	2.6
TU	0828	2.0	0.6	W	0935	1.3	0.4
	1443	7.0	2.1		1637	6.8	2.1
	2004	4.1	1.3		2140	5.3	1.6
10	0215	8.5	2.6	25	0259	7.5	2.3
W	0910	1.9	0.6	TH	1039	1.8	0.5
	1545	6.6	2.0		1845	6.8	2.1
	2046	4.9	1.5		2326	5.9	1.8
11	0246	8.1	2.5	26	0338	6.7	2.0
TH	1006	1.8	0.6	F	1204	2.1	0.6
	1724	6.4	2.0		2012	7.2	2.2
	2152	5.7	1.7				
12	0334	7.7	2.3	27	0133	5.7	1.7
F	1121	1.7	0.5	SA	0531	6.2	1.9
	1937	6.9	2.1		1323	2.1	0.6
	2359	6.1	1.8		2100	7.7	2.3
13	0448	7.3	2.2	28	0241	5.2	1.6
SA	1249	1.3	0.4	SU	0726	6.2	1.9
	2041	7.7	2.3		1421	1.9	0.6
					2134	8.1	2.5
14	0150	5.7	1.7	29	0321	4.7	1.4
SU	0628	7.3	2.2	M	0831	6.6	2.0
	1400	0.7	0.2		1506	1.7	0.5
	2124	8.4	2.6		2203	8.4	2.6
15	0253	4.9	1.5				
M	0756	7.6	2.3				
	1457	0.1	0.0				
	2203	9.2	2.8				

MARCH

Day	TIME	FT	M	Day	TIME	FT	M
1	0354	4.1	1.3	16	0320	3.1	0.9
TU	0920	7.1	2.2	W	0904	8.3	2.5
	1542	1.6	0.5		1526	0.6	0.2
	2230	8.8	2.7		2202	9.8	3.0
2	0423	3.7	1.1	17	0405	2.0	0.6
W	1002	7.5	2.3	TH	1002	8.9	2.7
	1616	1.5	0.5		1612	0.7	0.2
	2257	9.1	2.8		2239	10.2	3.1
3	0453	3.2	1.0	18	0447	1.1	0.3
TH	1041	7.9	2.4	F	1056	9.3	2.8
	1647	1.6	0.5		1656	1.0	0.3
	2321	9.2	2.8		2314	10.4	3.2
4	0521	2.7	0.8	19	0529	0.4	0.1
F	1118	8.1	2.5	SA	1145	9.4	2.9
	1717	1.8	0.6		1738	1.6	0.5
	2345	9.3	2.8		2348	10.3	3.1
5	0548	2.3	0.7	20	0609	-0.1	0.0
SA	1153	8.3	2.5	SU	1231	9.3	2.8
	1746	2.2	0.7		1820	2.3	0.7
6	0006	9.3	2.8	21	0020	10.0	3.0
SU	0614	1.8	0.6	M	0648	-0.2	0.0
	1228	8.3	2.5		1316	9.0	2.7
	1813	2.6	0.8		1901	3.1	1.0
7	0026	9.2	2.8	22	0051	9.4	2.9
M	0642	1.5	0.4	TU	0727	0.1	0.0
	1303	8.2	2.5		1403	8.4	2.6
	1842	3.2	1.0		1941	4.0	1.2
8	0047	9.0	2.7	23	0120	8.6	2.6
TU	0713	1.2	0.4	W	0808	0.7	0.2
	1341	7.9	2.4		1453	7.8	2.4
	1912	3.8	1.2		2026	4.8	1.4
9	0108	8.7	2.7	24	0147	7.8	2.4
W	0747	1.2	0.4	TH	0852	1.4	0.4
	1425	7.5	2.3		1601	7.2	2.2
	1944	4.5	1.4		2127	5.4	1.6
10	0132	8.4	2.6	25	0214	7.0	2.1
TH	0831	1.3	0.4	F	0949	2.2	0.7
	1521	7.0	2.1		1752	6.9	2.1
	2029	5.2	1.6		2317	5.7	1.7
11	0205	8.0	2.4	26	0252	6.3	1.9
F	0927	1.5	0.5	SA	1118	2.7	0.8
	1654	6.7	2.1		1920	7.2	2.2
	2144	5.8	1.8				
12	0257	7.4	2.3	27	0106	5.4	1.6
SA	1050	1.8	0.5	SU	0519	5.8	1.8
	1859	7.1	2.2		1245	2.9	0.9
					2010	7.6	2.3
13	0000	5.8	1.8	28	0208	4.8	1.5
SU	0432	7.0	2.1	M	0719	6.1	1.9
	1226	1.6	0.5		1347	2.7	0.8
	2004	7.8	2.4		2045	8.0	2.4
14	0134	5.2	1.6	29	0246	4.2	1.3
M	0634	7.1	2.2	TU	0818	6.6	2.0
	1340	1.2	0.4		1432	2.6	0.8
	2048	8.5	2.6		2114	8.3	2.5
15	0232	4.2	1.3	30	0318	3.6	1.1
TU	0800	7.6	2.3	W	0904	7.2	2.2
	1436	0.8	0.2		1510	2.5	0.8
	2126	9.2	2.8		2142	8.6	2.6
				31	0347	3.0	0.9
				TH	0947	7.7	2.4
					1545	2.5	0.8
					2208	8.9	2.7

PAKISTAN—KARACHI

Lat. 24° 48′ N, Long 66° 58′ E

TIME ZONE—0500 TIMES AND HEIGHTS OF HIGH AND LOW WATERS **YEAR 1988**

APRIL

Day	TIME	FT	M	Day	TIME	FT	M
1	0415	2.5	0.7	16	0420	0.1	0.0
F	1025	8.2	2.5	SA	1047	9.4	2.9
	1618	2.6	0.8		1634	2.5	0.8
	2233	9.0	2.7		2232	9.9	3.0
2	0443	1.9	0.6	17	0500	-0.4	-0.1
SA	1103	8.5	2.6	SU	1135	9.6	2.9
	1650	2.8	0.9		1719	3.0	0.9
	2257	9.0	2.7		2308	9.6	2.9
3	0511	1.4	0.4	18	0541	-0.5	-0.2
SU	1139	8.8	2.7	M	1220	9.5	2.9
	1722	3.2	1.0		1803	3.5	1.1
	2321	8.9	2.7		2343	9.2	2.8
4	0539	0.9	0.3	19	0618	-0.3	-0.1
M	1214	8.8	2.7	TU	1302	9.3	2.8
	1753	3.5	1.1		1847	4.0	1.2
	2343	8.9	2.7				
5	0609	0.6	0.2	20	0016	8.7	2.6
TU	1251	8.7	2.7	W	0656	0.2	0.1
	1826	4.0	1.2		1346	8.8	2.7
					1930	4.5	1.4
6	0007	8.7	2.7	21	0047	8.1	2.5
W	0642	0.5	0.2	TH	0734	0.9	0.3
	1330	8.5	2.6		1432	8.2	2.5
	1901	4.5	1.4		2019	4.9	1.5
7	0034	8.5	2.6	22	0118	7.4	2.3
TH	0720	0.7	0.2	F	0817	1.7	0.5
	1415	8.0	2.4		1528	7.7	2.3
	1941	4.9	1.5		2121	5.3	1.6
8	0105	8.2	2.5	23	0150	6.8	2.1
F	0807	1.0	0.3	SA	0907	2.5	0.8
	1514	7.6	2.3		1646	7.4	2.2
	2039	5.4	1.6		2247	5.4	1.6
9	0147	7.7	2.4	24	0238	6.2	1.9
SA	0909	1.5	0.5	SU	1019	3.2	1.0
	1639	7.4	2.2		1806	7.4	2.3
	2209	5.6	1.7				
10	0252	7.1	2.2	25	0014	5.1	1.5
SU	1030	2.0	0.6	M	0456	5.8	1.8
	1811	7.6	2.3		1142	3.5	1.1
	2355	5.2	1.6		1901	7.7	2.3
11	0450	6.8	2.1	26	0118	4.5	1.4
M	1200	2.1	0.6	TU	0651	6.1	1.9
	1913	8.2	2.5		1251	3.6	1.1
					1941	8.0	2.4
12	0112	4.3	1.3	27	0200	3.9	1.2
TU	0641	7.1	2.2	W	0754	6.7	2.0
	1312	2.0	0.6		1344	3.6	1.1
	2000	8.8	2.7		2014	8.3	2.5
13	0208	3.2	1.0	28	0233	3.2	1.0
W	0758	7.7	2.4	TH	0843	7.3	2.2
	1410	1.9	0.6		1429	3.6	1.1
	2039	9.4	2.8		2042	8.5	2.6
14	0255	2.0	0.6	29	0304	2.5	0.7
TH	0900	8.4	2.6	F	0927	7.9	2.4
	1502	2.0	0.6		1509	3.7	1.1
	2118	9.7	3.0		2110	8.6	2.6
15	0338	1.0	0.3	30	0334	1.8	0.5
F	0956	9.0	2.7	SA	1008	8.4	2.6
	1549	2.2	0.7		1547	3.8	1.2
	2155	9.9	3.0		2138	8.6	2.6

MAY

Day	TIME	FT	M	Day	TIME	FT	M
1	0403	1.2	0.4	16	0434	-0.5	-0.1
SU	1047	8.8	2.7	M	1125	9.6	2.9
	1625	4.0	1.2		1705	4.2	1.3
	2206	8.6	2.6		2233	8.9	2.7
2	0436	0.7	0.2	17	0515	-0.4	-0.1
M	1125	9.1	2.8	TU	1209	9.6	2.9
	1701	4.2	1.3		1752	4.3	1.3
	2236	8.6	2.6		2312	8.5	2.6
3	0508	0.3	0.1	18	0553	0.0	0.0
TU	1204	9.2	2.8	W	1249	9.4	2.9
	1739	4.4	1.3		1837	4.5	1.4
	2307	8.6	2.6		2349	8.1	2.5
4	0545	0.1	0.0	19	0633	0.5	0.2
W	1244	9.2	2.8	TH	1330	9.1	2.8
	1818	4.6	1.4		1922	4.7	1.4
	2339	8.5	2.6				
5	0624	0.2	0.1	20	0026	7.7	2.3
TH	1326	9.0	2.7	F	0711	1.2	0.4
	1901	4.9	1.5		1411	8.7	2.6
					2010	4.9	1.5
6	0016	8.3	2.5	21	0101	7.3	2.2
F	0708	0.5	0.2	SA	0748	1.9	0.6
	1412	8.7	2.6		1455	8.3	2.5
	1953	5.1	1.5		2102	5.0	1.5
7	0058	8.0	2.4	22	0141	6.8	2.1
SA	0758	1.0	0.3	SU	0831	2.6	0.8
	1509	8.4	2.6		1544	8.1	2.5
	2057	5.2	1.6		2202	4.9	1.5
8	0151	7.5	2.3	23	0236	6.3	1.9
SU	0859	1.6	0.5	M	0921	3.3	1.0
	1615	8.3	2.5		1639	7.9	2.4
	2215	4.9	1.5		2308	4.7	1.4
9	0314	7.0	2.1	24	0411	6.0	1.8
M	1012	2.2	0.7	TU	1023	3.9	1.2
	1722	8.4	2.6		1732	7.9	2.4
	2335	4.3	1.3				
10	0505	6.8	2.1	25	0010	4.2	1.3
TU	1128	2.7	0.8	W	0600	6.1	1.9
	1820	8.7	2.7		1132	4.3	1.3
					1818	8.0	2.4
11	0042	3.3	1.0	26	0102	3.5	1.1
W	0641	7.1	2.2	TH	0720	6.7	2.0
	1238	3.0	0.9		1240	4.5	1.4
	1909	9.0	2.8		1858	8.1	2.5
12	0140	2.2	0.7	27	0143	2.8	0.8
TH	0756	7.8	2.4	F	0818	7.3	2.2
	1341	3.3	1.0		1340	4.7	1.4
	1951	9.3	2.8		1932	8.2	2.5
13	0228	1.1	0.3	28	0218	2.0	0.6
F	0856	8.5	2.6	SA	0906	7.9	2.4
	1438	3.5	1.1		1432	4.8	1.5
	2032	9.4	2.9		2007	8.3	2.5
14	0311	0.3	0.1	29	0255	1.3	0.4
SA	0951	9.0	2.7	SU	0951	8.5	2.6
	1530	3.7	1.1		1518	4.8	1.5
	2113	9.4	2.9		2042	8.3	2.5
15	0354	-0.3	-0.1	30	0330	0.7	0.2
SU	1040	9.4	2.9	M	1033	8.9	2.7
	1619	4.0	1.2		1603	4.8	1.5
	2154	9.2	2.8		2120	8.4	2.6
				31	0408	0.2	0.1
				TU	1115	9.3	2.8
					1646	4.8	1.5
					2201	8.5	2.6

JUNE

Day	TIME	FT	M	Day	TIME	FT	M
1	0448	-0.1	0.0	16	0536	0.4	0.1
W	1156	9.5	2.9	TH	1235	9.4	2.9
	1729	4.8	1.5		1824	4.5	1.4
	2243	8.5	2.6		2335	7.8	2.4
2	0531	-0.1	0.0	17	0613	0.9	0.3
TH	1238	9.6	2.9	F	1311	9.3	2.8
	1816	4.8	1.4		1905	4.5	1.4
	2328	8.5	2.6				
3	0614	0.0	0.0	18	0014	7.6	2.3
F	1320	9.5	2.9	SA	0648	1.4	0.4
	1903	4.7	1.4		1344	9.1	2.8
					1946	4.4	1.4
4	0016	8.3	2.5	19	0054	7.3	2.2
SA	0702	0.4	0.1	SU	0722	1.9	0.6
	1404	9.4	2.9		1417	8.9	2.7
	1956	4.5	1.4		2028	4.4	1.3
5	0108	8.0	2.4	20	0134	7.0	2.1
SU	0751	0.9	0.3	M	0756	2.6	0.8
	1450	9.3	2.8		1449	8.7	2.6
	2055	4.3	1.3		2111	4.2	1.3
6	0211	7.5	2.3	21	0224	6.7	2.0
M	0845	1.7	0.5	TU	0832	3.2	1.0
	1540	9.1	2.8		1524	8.4	2.6
	2158	3.9	1.2		2159	4.0	1.2
7	0330	7.0	2.1	22	0328	6.3	1.9
TU	0945	2.6	0.8	W	0916	3.9	1.2
	1633	9.0	2.8		1601	8.2	2.5
	2304	3.2	1.0		2251	3.6	1.1
8	0501	6.9	2.1	23	0454	6.2	1.9
W	1051	3.4	1.0	TH	1012	4.6	1.4
	1725	9.0	2.7		1641	8.0	2.5
					2348	3.1	0.9
9	0010	2.4	0.7	24	0635	6.5	2.0
TH	0634	7.1	2.2	F	1122	5.2	1.6
	1203	4.1	1.3		1728	7.9	2.4
	1817	8.9	2.7				
10	0109	1.5	0.5	25	0042	2.4	0.7
F	0753	7.7	2.4	SA	0753	7.1	2.2
	1315	4.5	1.4		1245	5.5	1.7
	1905	8.9	2.7		1816	7.9	2.4
11	0203	0.7	0.2	26	0133	1.7	0.5
SA	0855	8.3	2.5	SU	0849	7.8	2.4
	1421	4.7	1.4		1400	5.5	1.7
	1953	8.7	2.7		1906	7.9	2.4
12	0249	0.2	0.0	27	0219	1.1	0.3
SU	0948	8.8	2.7	M	0937	8.4	2.5
	1518	4.8	1.5		1457	5.4	1.6
	2038	8.6	2.6		1958	8.0	2.4
13	0333	-0.1	0.0	28	0306	0.5	0.1
M	1034	9.2	2.8	TU	1020	8.9	2.7
	1609	4.8	1.5		1548	5.1	1.6
	2124	8.4	2.5		2050	8.2	2.5
14	0415	-0.1	0.0	29	0351	0.0	0.0
TU	1118	9.4	2.9	W	1104	9.3	2.8
	1657	4.7	1.4		1634	4.9	1.5
	2209	8.2	2.5		2144	8.4	2.6
15	0457	0.1	0.0	30	0436	-0.3	-0.1
W	1159	9.4	2.9	TH	1145	9.7	2.9
	1742	4.6	1.4		1719	4.5	1.4
	2254	8.0	2.4		2237	8.6	2.6

PAKISTAN–KARACHI

Lat. 24° 48' N, Long 66° 58' E

TIME ZONE—0500 TIMES AND HEIGHTS OF HIGH AND LOW WATERS YEAR 1988

JULY

	TIME	FT	M		TIME	FT	M
1	0522	-0.4	-0.1	16	0553	1.1	0.3
F	1224	9.9	3.0	SA	1242	9.3	2.8
	1806	4.2	1.3		1838	3.8	1.2
	2329	8.6	2.6				
2	0607	-0.2	-0.1	17	0007	7.7	2.4
SA	1302	10.1	3.1	SU	0626	1.5	0.4
	1854	3.8	1.1		1309	9.3	2.8
					1912	3.6	1.1
3	0023	8.5	2.6	18	0044	7.6	2.3
SU	0652	0.3	0.1	M	0654	2.0	0.6
	1341	10.1	3.1		1334	9.1	2.8
	1943	3.3	1.0		1944	3.5	1.1
4	0118	8.2	2.5	19	0122	7.4	2.3
M	0737	1.0	0.3	TU	0722	2.5	0.8
	1419	9.9	3.0		1358	8.9	2.7
	2033	2.9	0.9		2018	3.3	1.0
5	0217	7.8	2.4	20	0203	7.1	2.2
TU	0824	2.0	0.6	W	0753	3.2	1.0
	1500	9.6	2.9		1424	8.6	2.6
	2128	2.5	0.8		2056	3.0	0.9
6	0324	7.2	2.2	21	0253	6.7	2.0
W	0916	3.1	0.9	TH	0826	4.0	1.2
	1542	9.2	2.8		1450	8.3	2.5
	2227	2.1	0.6		2140	2.8	0.9
7	0447	6.9	2.1	22	0358	6.4	2.0
TH	1015	4.2	1.3	F	0911	4.7	1.4
	1630	8.8	2.7		1524	8.0	2.4
	2332	1.7	0.5		2233	2.5	0.8
8	0627	7.0	2.1	23	0535	6.4	1.9
F	1131	5.0	1.5	SA	1015	5.4	1.7
	1724	8.3	2.5		1609	7.7	2.3
					2339	2.2	0.7
9	0040	1.2	0.4	24	0730	6.8	2.1
SA	0754	7.5	2.3	SU	1155	5.8	1.8
	1259	5.4	1.6		1710	7.5	2.3
	1823	8.0	2.4				
10	0140	0.8	0.2	25	0052	1.7	0.5
SU	0857	8.1	2.5	M	0835	7.5	2.3
	1417	5.3	1.6		1339	5.7	1.8
	1923	7.8	2.4		1823	7.5	2.3
11	0232	0.5	0.2	26	0156	1.1	0.3
M	0947	8.5	2.6	TU	0921	8.2	2.5
	1516	5.1	1.6		1443	5.3	1.6
	2019	7.7	2.3		1936	7.7	2.3
12	0320	0.4	0.1	27	0249	0.4	0.1
TU	1029	8.9	2.7	W	1003	8.8	2.7
	1605	4.8	1.5		1533	4.8	1.5
	2111	7.7	2.3		2041	8.1	2.5
13	0402	0.4	0.1	28	0338	-0.1	0.0
W	1107	9.1	2.8	TH	1043	9.3	2.8
	1647	4.5	1.4		1619	4.2	1.3
	2201	7.7	2.3		2141	8.4	2.6
14	0443	0.5	0.2	29	0425	-0.4	-0.1
TH	1141	9.2	2.8	F	1121	9.8	3.0
	1726	4.3	1.3		1704	3.6	1.1
	2247	7.8	2.4		2237	8.8	2.7
15	0519	0.8	0.2	30	0508	-0.4	-0.1
F	1213	9.3	2.8	SA	1157	10.2	3.1
	1803	4.0	1.2		1748	2.9	0.9
	2328	7.8	2.4		2331	8.9	2.7
				31	0552	-0.1	0.0
				SU	1233	10.4	3.2
					1833	2.3	0.7

AUGUST

	TIME	FT	M		TIME	FT	M
1	0023	8.9	2.7	16	0030	8.0	2.4
M	0635	0.5	0.1	TU	0626	2.2	0.7
	1308	10.4	3.2		1249	9.1	2.8
	1918	1.8	0.5		1901	2.3	0.7
2	0115	8.6	2.6	17	0103	7.8	2.4
TU	0718	1.4	0.4	W	0652	2.8	0.8
	1341	10.1	3.1		1309	8.8	2.7
	2004	1.5	0.4		1929	2.1	0.6
3	0208	8.1	2.5	18	0141	7.5	2.3
W	0801	2.4	0.7	TH	0719	3.4	1.0
	1417	9.6	2.9		1330	8.5	2.6
	2053	1.3	0.4		2001	2.0	0.6
4	0309	7.5	2.3	19	0224	7.1	2.2
TH	0848	3.6	1.1	F	0750	4.1	1.3
	1453	8.9	2.7		1353	8.2	2.5
	2147	1.3	0.4		2041	2.0	0.6
5	0426	7.0	2.1	20	0317	6.7	2.0
F	0944	4.7	1.4	SA	0829	4.8	1.5
	1535	8.1	2.5		1422	7.8	2.4
	2251	1.4	0.4		2133	2.0	0.6
6	0618	6.9	2.1	21	0441	6.4	2.0
SA	1110	5.5	1.7	SU	0931	5.5	1.7
	1629	7.4	2.3		1507	7.4	2.2
					2244	2.0	0.6
7	0009	1.5	0.4	22	0705	6.7	2.0
SU	0754	7.3	2.2	M	1128	5.9	1.8
	1302	5.6	1.7		1619	7.0	2.1
	1750	6.9	2.1				
8	0122	1.3	0.4	23	0018	1.8	0.5
M	0853	7.8	2.4	TU	0814	7.3	2.2
	1421	5.2	1.6		1326	5.5	1.7
	1913	6.8	2.1		1803	7.0	2.1
9	0221	1.1	0.3	24	0136	1.2	0.4
TU	0937	8.2	2.5	W	0857	8.0	2.5
	1513	4.8	1.5		1426	4.8	1.5
	2019	7.0	2.1		1933	7.4	2.3
10	0309	1.0	0.3	25	0232	0.6	0.2
W	1012	8.6	2.6	TH	0934	8.7	2.7
	1554	4.3	1.3		1514	4.0	1.2
	2113	7.3	2.2		2042	8.0	2.5
11	0349	0.9	0.3	26	0321	0.2	0.1
TH	1043	8.8	2.7	F	1011	9.4	2.9
	1629	3.9	1.2		1558	3.1	0.9
	2159	7.6	2.3		2141	8.6	2.6
12	0426	1.0	0.3	27	0406	0.0	0.0
F	1112	9.0	2.7	SA	1046	9.9	3.0
	1703	3.5	1.1		1641	2.2	0.7
	2241	7.8	2.4		2236	9.1	2.8
13	0500	1.1	0.3	28	0450	0.1	0.0
SA	1139	9.2	2.8	SU	1121	10.3	3.1
	1735	3.2	1.0		1724	1.3	0.4
	2319	8.0	2.4		2326	9.3	2.8
14	0529	1.4	0.4	29	0532	0.5	0.1
SU	1204	9.2	2.8	M	1156	10.4	3.2
	1804	2.9	0.9		1807	0.7	0.2
	2355	8.0	2.4				
15	0559	1.7	0.5	30	0017	9.3	2.8
M	1228	9.2	2.8	TU	0614	1.2	0.4
	1833	2.6	0.8		1230	10.2	3.1
					1849	0.3	0.1
				31	0105	9.0	2.7
				W	0656	2.1	0.6
					1302	9.8	3.0
					1932	0.2	0.1

SEPTEMBER

	TIME	FT	M		TIME	FT	M
1	0154	8.4	2.6	16	0122	8.0	2.5
TH	0739	3.1	0.9	F	0656	3.8	1.2
	1334	9.1	2.8		1244	8.3	2.5
	2015	0.5	0.1		1919	1.1	0.3
2	0249	7.7	2.4	17	0203	7.6	2.3
F	0825	4.1	1.2	SA	0727	4.4	1.3
	1408	8.3	2.5		1306	7.9	2.4
	2106	1.0	0.3		1957	1.3	0.4
3	0401	7.1	2.2	18	0252	7.1	2.2
SA	0924	5.0	1.5	SU	0808	5.0	1.5
	1443	7.4	2.3		1337	7.6	2.3
	2209	1.6	0.5		2050	1.7	0.5
4	0557	6.9	2.1	19	0409	6.7	2.0
SU	1105	5.5	1.7	M	0918	5.6	1.7
	1534	6.6	2.0		1425	7.1	2.2
	2336	2.0	0.6		2208	2.0	0.6
5	0736	7.2	2.2	20	0618	6.8	2.1
M	1306	5.3	1.6	TU	1128	5.7	1.7
	1738	6.0	1.8		1555	6.6	2.0
					2349	2.0	0.6
6	0102	2.1	0.6	21	0733	7.4	2.3
TU	0831	7.6	2.3	W	1308	5.0	1.5
	1415	4.8	1.5		1807	6.7	2.0
	1920	6.2	1.9				
7	0204	1.9	0.6	22	0111	1.7	0.5
W	0907	8.0	2.4	TH	0815	8.1	2.5
	1459	4.2	1.3		1405	4.0	1.2
	2022	6.7	2.0		1936	7.3	2.2
8	0250	1.7	0.5	23	0210	1.2	0.4
TH	0938	8.3	2.5	F	0853	8.8	2.7
	1531	3.6	1.1		1452	2.9	0.9
	2110	7.2	2.2		2041	8.1	2.5
9	0328	1.6	0.5	24	0259	1.0	0.3
F	1005	8.6	2.6	SA	0930	9.4	2.9
	1602	3.1	1.0		1534	1.7	0.5
	2152	7.6	2.3		2137	8.8	2.7
10	0402	1.7	0.5	25	0345	0.9	0.3
SA	1032	8.8	2.7	SU	1005	9.9	3.0
	1632	2.7	0.8		1616	0.7	0.2
	2230	8.0	2.4		2230	9.3	2.8
11	0433	1.8	0.5	26	0429	1.2	0.4
SU	1057	8.9	2.7	M	1041	10.1	3.1
	1700	2.2	0.7		1658	-0.1	0.0
	2305	8.3	2.5		2319	9.6	2.9
12	0503	2.0	0.6	27	0512	1.6	0.5
M	1121	9.0	2.7	TU	1117	10.0	3.1
	1726	1.8	0.6		1739	-0.6	-0.2
	2341	8.4	2.6				
13	0532	2.4	0.7	28	0007	9.6	2.9
TU	1143	8.9	2.7	W	0556	2.2	0.7
	1752	1.5	0.5		1152	9.7	3.0
					1818	-0.7	-0.2
14	0014	8.4	2.6	29	0052	9.3	2.8
W	0559	2.8	0.9	TH	0640	2.9	0.9
	1203	8.7	2.7		1226	9.2	2.8
	1818	1.2	0.4		1859	-0.4	-0.1
15	0047	8.3	2.5	30	0140	8.8	2.7
TH	0627	3.3	1.0	F	0723	3.7	1.1
	1223	8.5	2.6		1258	8.5	2.6
	1847	1.1	0.3		1941	0.2	0.1

PAKISTAN–KARACHI

Lat. 24° 48' N, Long 66° 58' E

TIME ZONE –0500 | TIMES AND HEIGHTS OF HIGH AND LOW WATERS | YEAR 1988

OCTOBER

Day	TIME	FT	M	Day	TIME	FT	M
1	0229	8.1	2.5	16	0150	8.1	2.5
SA	0812	4.4	1.4	SU	0722	4.8	1.5
	1330	7.7	2.3		1238	7.8	2.4
	2028	1.0	0.3		1933	1.0	0.3
2	0334	7.4	2.3	17	0241	7.7	2.3
SU	0917	5.0	1.5	M	0814	5.1	1.6
	1404	6.8	2.1		1316	7.4	2.3
	2127	1.9	0.6		2026	1.5	0.5
3	0511	7.0	2.1	18	0351	7.3	2.2
M	1058	5.3	1.6	TU	0933	5.3	1.6
	1452	6.0	1.8		1414	6.8	2.1
	2253	2.6	0.8		2142	2.1	0.6
4	0647	7.1	2.2	19	0522	7.4	2.2
TU	1245	4.9	1.5	W	1117	5.1	1.5
	1735	5.6	1.7		1603	6.4	1.9
					2315	2.4	0.7
5	0024	2.9	0.9	20	0634	7.8	2.4
W	0743	7.5	2.3	TH	1240	4.2	1.3
	1350	4.3	1.3		1811	6.6	2.0
	1916	6.0	1.8				
6	0130	2.8	0.9	21	0035	2.4	0.7
TH	0819	7.8	2.4	F	0723	8.4	2.6
	1429	3.7	1.1		1337	3.0	0.9
	2015	6.6	2.0		1934	7.3	2.2
7	0219	2.7	0.8	22	0140	2.3	0.7
F	0850	8.1	2.5	SA	0805	8.9	2.7
	1500	3.0	0.9		1425	1.8	0.5
	2059	7.2	2.2		2038	8.2	2.5
8	0257	2.7	0.8	23	0233	2.3	0.7
SA	0917	8.4	2.6	SU	0845	9.4	2.9
	1528	2.4	0.7		1510	0.6	0.2
	2138	7.7	2.4		2133	8.9	2.7
9	0333	2.7	0.8	24	0323	2.4	0.7
SU	0944	8.5	2.6	M	0923	9.6	2.9
	1556	1.9	0.6		1551	-0.3	-0.1
	2215	8.2	2.5		2223	9.4	2.9
10	0405	2.8	0.9	25	0411	2.6	0.8
M	1009	8.6	2.6	TU	1001	9.6	2.9
	1623	1.4	0.4		1633	-0.9	-0.3
	2251	8.6	2.6		2312	9.7	3.0
11	0437	3.0	0.9	26	0457	2.9	0.9
TU	1033	8.6	2.6	W	1040	9.5	2.9
	1650	0.9	0.3		1714	-1.2	-0.4
	2325	8.8	2.7		2357	9.8	3.0
12	0508	3.3	1.0	27	0542	3.3	1.0
W	1057	8.5	2.6	TH	1118	9.1	2.8
	1717	0.6	0.2		1753	-1.0	-0.3
13	0000	8.9	2.7	28	0042	9.6	2.9
TH	0539	3.6	1.1	F	0628	3.7	1.1
	1119	8.4	2.6		1155	8.6	2.6
	1745	0.4	0.1		1834	-0.5	-0.1
14	0034	8.8	2.7	29	0126	9.1	2.8
F	0611	4.0	1.2	SA	0715	4.1	1.3
	1143	8.2	2.5		1231	7.9	2.4
	1816	0.4	0.1		1915	0.3	0.1
15	0111	8.5	2.6	30	0212	8.6	2.6
SA	0644	4.4	1.3	SU	0805	4.5	1.4
	1209	8.0	2.5		1306	7.3	2.2
	1851	0.6	0.2		1957	1.3	0.4
				31	0304	8.0	2.4
				M	0907	4.8	1.5
					1344	6.6	2.0
					2048	2.2	0.7

NOVEMBER

Day	TIME	FT	M	Day	TIME	FT	M
1	0412	7.5	2.3	16	0328	8.3	2.5
TU	1026	4.9	1.5	W	0934	4.6	1.4
	1439	5.9	1.8		1431	6.8	2.1
	2154	3.0	0.9		2121	2.2	0.7
2	0528	7.4	2.3	17	0430	8.2	2.5
W	1152	4.6	1.4	TH	1051	4.1	1.3
	1657	5.5	1.7		1616	6.4	2.0
	2317	3.6	1.1		2237	2.8	0.9
3	0630	7.5	2.3	18	0532	8.4	2.6
TH	1259	4.0	1.2	F	1203	3.2	1.0
	1849	5.9	1.8		1803	6.6	2.0
					2353	3.3	1.0
4	0031	3.8	1.2	19	0626	8.6	2.6
F	0715	7.7	2.4	SA	1305	2.1	0.6
	1346	3.4	1.0		1929	7.3	2.2
	1954	6.5	2.0				
5	0132	3.9	1.2	20	0105	3.6	1.1
SA	0750	7.9	2.4	SU	0715	8.9	2.7
	1419	2.6	0.8		1358	0.9	0.3
	2041	7.2	2.2		2035	8.1	2.5
6	0219	3.9	1.2	21	0210	3.8	1.2
SU	0819	8.1	2.5	M	0758	9.0	2.8
	1450	2.0	0.6		1445	0.0	0.0
	2121	7.8	2.4		2130	8.8	2.7
7	0300	3.9	1.2	22	0306	3.9	1.2
M	0849	8.2	2.5	TU	0843	9.1	2.8
	1518	1.4	0.4		1528	-0.7	-0.2
	2201	8.3	2.5		2220	9.4	2.9
8	0338	4.0	1.2	23	0358	3.9	1.2
TU	0917	8.2	2.5	W	0927	8.9	2.7
	1548	0.8	0.2		1612	-1.0	-0.3
	2237	8.8	2.7		2307	9.7	3.0
9	0416	4.1	1.2	24	0447	4.0	1.2
W	0945	8.2	2.5	TH	1011	8.7	2.7
	1618	0.4	0.1		1654	-1.0	-0.3
	2314	9.1	2.8		2350	9.8	3.0
10	0451	4.2	1.3	25	0535	4.0	1.2
TH	1015	8.1	2.5	F	1054	8.4	2.6
	1650	0.1	0.0		1735	-0.7	-0.2
	2350	9.2	2.8				
11	0528	4.4	1.3	26	0033	9.7	2.9
F	1046	8.1	2.5	SA	0621	4.1	1.2
	1722	0.0	0.0		1136	8.1	2.5
					1816	-0.1	0.0
12	0027	9.2	2.8	27	0113	9.4	2.9
SA	0604	4.5	1.4	SU	0708	4.2	1.3
	1118	8.1	2.5		1216	7.6	2.3
	1759	0.0	0.0		1855	0.6	0.2
13	0105	9.0	2.8	28	0153	9.0	2.8
SU	0644	4.6	1.4	M	0754	4.3	1.3
	1153	8.0	2.4		1256	7.2	2.2
	1840	0.3	0.1		1933	1.4	0.4
14	0146	8.8	2.7	29	0232	8.6	2.6
M	0729	4.8	1.5	TU	0845	4.4	1.3
	1233	7.8	2.4		1339	6.7	2.0
	1923	0.8	0.2		2012	2.3	0.7
15	0233	8.5	2.6	30	0314	8.3	2.5
TU	0825	4.8	1.5	W	0940	4.4	1.3
	1320	7.3	2.2		1432	6.1	1.9
	2017	1.4	0.4		2056	3.1	0.9

DECEMBER

Day	TIME	FT	M	Day	TIME	FT	M
1	0401	8.0	2.4	16	0342	9.0	2.8
TH	1040	4.2	1.3	F	1018	2.9	0.9
	1555	5.7	1.7		1612	6.6	2.0
	2148	3.9	1.2		2158	3.4	1.0
2	0451	7.8	2.4	17	0433	8.8	2.7
F	1145	3.8	1.1	SA	1124	2.2	0.7
	1749	5.8	1.8		1750	6.7	2.0
	2257	4.5	1.4		2310	4.3	1.3
3	0541	7.7	2.3	18	0526	8.7	2.6
SA	1242	3.2	1.0	SU	1230	1.4	0.4
	1920	6.3	1.9		1925	7.2	2.2
4	0016	4.9	1.5	19	0033	4.8	1.5
SU	0626	7.7	2.3	M	0623	8.5	2.6
	1327	2.5	0.8		1330	0.6	0.2
	2021	7.0	2.1		2036	8.0	2.4
5	0130	5.0	1.5	20	0153	5.0	1.5
M	0706	7.7	2.3	TU	0718	8.4	2.6
	1405	1.8	0.5		1424	-0.1	0.0
	2106	7.7	2.3		2133	8.6	2.6
6	0228	5.0	1.5	21	0259	4.9	1.5
TU	0744	7.7	2.3	W	0811	8.2	2.5
	1442	1.2	0.4		1511	-0.5	-0.1
	2148	8.3	2.5		2220	9.2	2.8
7	0317	5.0	1.5	22	0354	4.7	1.4
W	0824	7.7	2.4	TH	0903	8.1	2.5
	1517	0.6	0.2		1558	-0.6	-0.2
	2227	8.8	2.7		2304	9.5	2.9
8	0359	4.9	1.5	23	0443	4.4	1.4
TH	0903	7.8	2.4	F	0955	8.0	2.4
	1554	0.2	0.1		1640	-0.5	-0.1
	2305	9.2	2.8		2343	9.6	2.9
9	0440	4.8	1.5	24	0529	4.2	1.3
F	0944	7.9	2.4	SA	1043	7.9	2.4
	1632	-0.1	0.0		1722	-0.2	-0.1
	2343	9.4	2.9				
10	0519	4.7	1.4	25	0020	9.7	3.0
SA	1026	8.0	2.5	SU	0611	4.0	1.2
	1711	-0.2	-0.1		1128	7.8	2.4
					1800	0.3	0.1
11	0021	9.6	2.9	26	0055	9.6	2.9
SU	0600	4.5	1.4	M	0652	3.9	1.2
	1110	8.1	2.5		1210	7.6	2.3
	1752	-0.2	-0.1		1837	0.9	0.3
12	0058	9.6	2.9	27	0126	9.4	2.9
M	0642	4.4	1.3	TU	0732	3.8	1.1
	1155	8.1	2.5		1251	7.4	2.2
	1834	0.1	0.0		1909	1.5	0.5
13	0136	9.6	2.9	28	0157	9.2	2.8
TU	0729	4.1	1.3	W	0811	3.7	1.1
	1244	7.9	2.4		1330	7.0	2.1
	1919	0.7	0.2		1940	2.3	0.7
14	0215	9.4	2.9	29	0225	8.9	2.7
W	0821	3.9	1.2	TH	0850	3.6	1.1
	1339	7.5	2.3		1414	6.6	2.0
	2005	1.4	0.4		2010	3.0	0.9
15	0257	9.3	2.8	30	0253	8.6	2.6
TH	0917	3.5	1.1	F	0933	3.4	1.0
	1448	7.0	2.1		1509	6.2	1.9
	2057	2.4	0.7		2043	3.8	1.2
				31	0323	8.2	2.5
				SA	1019	3.2	1.0
					1626	6.0	1.8
					2128	4.6	1.4