Table 3.2-1 (2)

Serial No.	Location (Load center)	Its objected area (Kotamadya & Kecamatan wise)
18.	Duri	Kec. Mandau
19.	Minas	Kec. Siak Sri Indrapura
20.	Bagan Siapi-api	Kec. Bangko, Kec. Tanan Putih
21.	Rengat	Kec. Rengat, Kec. P. Penyu, Kec. Siberida
22.	Tembilahan	Kec. Tembilahan, Kec. Tempuling, Kec. Enok
23.	Teluk Kuantan	Kec. Kuantan Tengah, Kec. Kuantan Mudik Kec. Indragiri
24.	Cerenti	Kec. Cerenti, Kec. Peranap
25.	Ujungbatu	P. Pangarayan, Kec. Tandun, Kec. Rambah
26.	Others in Riau Province	Other Kecamatan in Riau Province

Table 3.2 - 2 Electrification Ratio

unit:(%)

S.No.	Location	Electrification ratio by year		Target of Electrification ratio by year 2005		
		1982	1984	Low	Basic	High
1	Padang	23	33	-5	80	+5
2	Bukittinggi	33	43	-5	80	+5
3	Payakumbuh	7	9		60	
4	Batusangkar	13	18		60	
5	Padang Panjang	14	17		60	
6	Pariaman	4	6		50	
7	Solok	7	11		60	
8	Sawahlunto	2	4	-10	60	+10
9	Painan	7	9		50	
10	Lubuk Sikaping	4	5		50	
11	Surantih	0	4		30	
12	Sungaidareh	0	1		30	
13	Sungai Penuh	5	9		50	
14	Others(W.S)	-	1		30	
15	Pekanbaru	37	46	-5	80	+5
16	Bangkinang	4	8		50	
17	Dumai	13	18		60	
18	Duri	7	16		60	
19	Minas	0	0		50	
20	B.Siapi-api	13	15		50	
21	Rengat	4	7	-10	50	+10
22	Tembilahan	6	8		50	
23	Teluk Kuantan	2	3		50	
24	Cerenti	0.1	1		30	
25	Ujungbatu	0.1	1		30	
26	Others(R)	-	2		30	

Table 3.2 - 3 Constituent Ratio of Number of Consumer

S.No.	Location	for commercial	for public
1	Padang	0.054	0.030
2	Bukittinggi	0.044	0.040
3	Payakumbuh	0.034	0.050
4	Batusangkar	0.050	0.050
5	Padang Panjang	0.100	0.060
6	Pariaman	0.070	0.050
7	Solok	0.020	0.050
8	Sawahlunto	0.100	0.050
9	Painan	0.030	0.040
10	Lubuk Sikaping	0.050	0.100
11	Surantih	0.010	0.010
12	Sungaidareh	0.010	0.010
13	Sungai Penuh	0.050	0.050
14	Others(W.S)	0.010	0.010
15	Pekanbaru	0.100	0.030
16	Bangkinang	0.090	0.070
17	Dumai	0.100	0.020
18	Duri	0.150	0.020
19	Minas	0.100	0.010
20	B.Siapi-api	0.100	0.030
21	Rengat	0.150	0.050
22	Tembilahan	0.130	0.050
23	Teluk Kuantan	0.100	0.060
24	Cerenti	0.100	0.100
25	Ujungbatu	0.100	0.070
26	Others(R)	0.010	0.010

Table 3.3 - 1 POWER DEMAND FORECAST (SALES) : WILAYAH III Basic Case (incld. PERTAMINA)

Location	Year / Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86- -90/91	90/91- -95/96	95/96- -00/01	00/01- -05/06	85/86- -05/06
Padang	(GWh)	51.2	56.2	65.3	78.3	90.5	103.4	117.1	131.5	146.9	158.5	170.9	184.2	198.4	213.6	228.6	244.6	261.5	279.5	298.6	316.9	336.1	356.6	378.2	401.1	13.4	7.8	6.9	6.1	8.5
Bukittinggi	(GWh)	18.3	16.5	16.8	18.1	19.5	20.9	22.5	24.1	25.9	27.5	29.2	31.0	32.9	34.9	36.8	38.9	41.0	43.3	45.6	47.7	49.8	52.1	54.4	56.9	7.4	6.1	5.5	4.5	5.9
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	20.0	38.7	48.8	58.9	65.5	68.4	71.5	75.0	78.8	83.0	89.3	96.1	103.2	110.9	119.0	127.4	136.1	145.4	155.1	165.4	49.7	4.8	7.5	6.8	15.9
Batusangkar	(GWh)	2.7	3.3	3.4	3.8	4.2	4.6	5.1	5.6	6.2	6.7	7.4	8.0	8.8	9.6	10.4	11.2	12.1	13.0	14.1	15.1	16.1	17.2	18.4	19.6	10.3	9.1	8.0	6.8	8.5
Padang Panjang	(GWh)	3.5	3.3	3.6	4.4	5.1	5.8	6.6	7.4	8.2	8.9	9.6	10.4	11.2	12.2	13.1	14.1	15.2	16.4	17.6	18.8	20.0	21.4	22.8	24.3	13.3	8.3	7.6	6.7	8.9
Pariaman	(GWh)	1.6	3.6	3.3	4.4	7.3	11.7	14.6	17.5	19.7	21.0	22.5	24.1	25.9	27.9	30.6	33.5	36.6	40.1	43.9	47.8	52.0	56.5	61.4	66.7	35.0	7.2	9.5	8.7	14.6
Solok	(GWh)	3.5	4.0	4.1	5.4	6.2	7.2	8.2	9.5	10.9	12.4	14.0	15.9	18.1	20.5	25.5	30.8	36.4	42.3	48.5	52.5	56.7	61.3	66.2	71.5	15.1	13.5	18.8	8.1	13.8
Sawah Lunto	(GWh)	0.6	0.8	0.9	1.3	3.0	5.7	7.3	8.9	9.9	10.8	11.9	13.0	14.2	15.6	18.4	21.3	24.4	27.6	31.0	33.3	35.8	38.5	41.3	44.3	50.1	9.5	14.7	7.4	19.3
Painan	(GWh)	1.5	1.7	1.9	2.2	2.5	2.8	3.1	3.6	4.0	4.5	5.1	5.8	6.5	7.4	8.6	9.8	11.2	12.8	14.4	15.8	17.2	18.9	20.6	22.6	12.7	13.1	14.2	9.4	12.4
Lubuk Sikaping	(GWh)	1.0	1.1	1.2	1.8	2.2	2.5	3.0	3.5	4.2	4.8	5.6	6.4	7.4	8.5	10.0	11.7	13.6	15.6	17.9	19.6	21.6	23.7	26.1	28.8	18.5	15.1	16.1	10.0	14.9
Surantih	(GWh)	0.0	0.0	0.2	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.7	1.9	2.2	2.5	2.8	3.2	3.6	4.0	4.5	5.0	5.6	6.3	14.9	13.7	13.6	11.8	13.5
Sungaidareh	(GWh)	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.8	0.9	1.1	1.4	1.7	2.0	2.4	2.8	3.3	4.0	14.9	24.6	23.2	18.7	20.3
Sungai Penuh	(GWh)	2.5	2.8	3.2	3.5	4.1	4.7	5.3	6.1	7.0	8.4	9.9	11.5	13.2	15.2	16.8	18.7	20.7	23.0	25.4	27.8	30.4	33.2	36.3	39.7	14.9	16.8	10.8	9.3	12.9
Others(W.S)	(GWh)	2.2	6.5	2.2	2.6	3.1	3.7	4.4	5.3	6.3	7.5	9.0	10.8	13.0	15.6	18.5	21.9	25.9	30.6	36.3	42.1	48.9	56.8	65.9	76.5	19.4	19.9	18.4	16.1	18.4
WEST SUMATRA	(GWh)	93.5	104.8	112.0	135.1	168.4	212.5	247.0	283.0	315.9	340.8	368.3	398.0	430.6	466.5	509.6	556.0	605.7	659.7	717.6	770.8	827.6	889.4	955.6	1027.7	18.5	8.1	9.0	7.4	10.7
Pekanbaru	(GWh)	33.1	40.8	40.7	49.2	56.7	64.6	72.7	81.1	89.9	101.4	114.4	191.9	223.6	237.0	250.5	264.5	278.9	293.8	309.2	326.9	345.0	363.8	383.1	403.1	12.8	21.4	5.5	5.4	11.1
Bangkinang	(GWh)	1.2	1.5	2.1	3.0	4.0	5.0	6.2	7.5	8.9	10.1	11.6	13.1	14.9	16.8	18.7	20.9	23.3	26.0	29.0	31.9	35.2	38.8	42.8	47.3	24.3	13.5	11.5	10.3	14.8
Dumai	(GWh)	6.1	7.7	7.9	8.4	9.8	11.3	12.9	14.7	16.6	18.2	20.0	22.0	24.1	26.5	35.2	44.0	53.1	62.5	72.1	76.9	81.9	87.2	92.8	98.8	14.6	9.8	22.2	6.5	13.1
Duri	(GWh)	0.8	1.2	1.7	1.9	2.2	2.4	2.8	3.1	3.5	3.9	4.4	5.0	5.6	6.3	7.4	8.5	9.8	11.1	12.5	13.7	14.9	16.2	17.7	19.3	13.0	12.5	14.7	9.1	12.3
Minas	(GWh)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.5	0.6	0.9	18.0	35.2	52.6	70.2	88.1	94.0	100.1	106.7	113.9	121.7		35.1	150.1	6.7	
B.Siapi-api	(GWh)	3.1	3.1	3.3	3.7	4.1	4.6	5.1	5.7	6.3	7.0	7.8	8.6	9.5	10.5	11.5	12.7	13.9	15.3	16.8	18.6	20.6	22.8	25.1	27.5	11.2	10.8	9.9	10.4	10.5
Rengat	(GWh)	1.9	2.2	2.4	3.6	4.7	5.8	7.1	8.5	10.0	11.8	13.8	15.9	18.3	20.9	23.1	25.6	28.4	31.4	34.9	41.3	48.2	55.3	62.9	71.0	22.7	15.9	10.8	15.3	16.1
Tembilahan	(GWh)	2.3	2.6	2.7	3.2	3.7	4.3	5.1	5.9	6.9	8.0	9.2	10.6	12.2	14.1	16.1	18.3	20.8	23.7	26.9	31.2	35.8	40.9	46.4	52.5	16.6	15.4	13.8	14.3	15.0
Teluk Kuantan	(GWh)	0.4	0.5	0.5	0.6	0.7	0.9	1.1	1.4	1.7	2.1	2.6	3.1	3.8	4.6	5.4	6.3	7.3	8.6	10.1	11.7	13.5	15.5	17.9	20.5	23.2	22.0	17.0	15.2	19.3
Cerenti	(GWh)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.8	0.9	1.1	1.4	1.9	2.4	3.1	3.8	4.6	14.9	20.1	22.9	26.9	21.1
Ujungbatu	(GWh)	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.1	1.4	1.7	2.1	2.6	3.2	4.3	5.6	7.1	8.7	10.6	32.0	22.4	23.8	27.1	26.3
Others(R)	(GWh)	2.3	0.9	4.3	4.8	5.4	6.0	6.7	7.4	8.3	10.0	12.1	14.6	17.6	21.2	25.3	30.1	35.9	42.8	51.0	59.7	69.8	81.6	95.5	111.7	11.6	20.6	19.2	17.0	17.0
RIAU	(GWh)	51.3	60.7	65.8	78.6	91.6	105.3	120.1	135.8	152.9	173.4	197.1	286.3	331.5	360.4	413.2	468.6	527.0	589.1	655.2	712.1	773.0	839.0	910.6	988.6	14.2	18.7	12.7	8.6	13.5
<1> WILAYAH III	(GWh)	144.8	165.5	177.8	213.7	260.0	317.8	367.1	418.8	468.8	514.2	565.4	684.3	762.1	826.9	922.8	1024.6	1132.7	1248.8	1372.8	1482.9	1600.6	1728.4	1866.2	2016.3	17.0	12.0	10.7	8.0	11.9
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)														96.0	209.0	235.0	261.0	289.0	318.0	348.0	381.0	414.0	450.0	486.0			27.1	8.9	
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	309.7	367.0	435.8	498.1	564.8	629.8	693.2	763.4	904.3	1006.1	1192.9	1415.8	1557.6	1706.7	1865.8	2035.8	2192.9	2361.6	2541.4	2735.2	2942.3	15.3	13.6	11.3	7.6	11.9

Table 3.3 - 2 POWER DEMAND FORECAST OF 150kV SYSTEM (SALES) : WILAYAH III Basic Case (incld. PERTAMINA)

Location	Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86- -90/91	90/91- -95/96	95/96- -00/01	00/01- -05/06	85/86- -05/06
Padang	(GWh)	51.2	56.2	65.3	78.3	90.5	103.4	117.1	131.5	146.9	158.5	170.9	184.2	198.4	213.6	228.6	244.6	261.5	279.5	298.6	316.9	336.1	356.6	378.2	401.1	13.4	7.8	6.9	6.1	8.5
Bukittinggi	(GWh)	18.3	16.5	16.8	18.1	19.5	20.9	22.5	24.1	25.9	27.5	29.2	31.0	32.9	34.9	36.8	38.9	41.0	43.3	45.6	47.7	49.8	52.1	54.4	56.9	7.4	6.1	5.5	4.5	5.9
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	20.0	38.7	48.8	58.9	65.5	68.4	71.5	75.0	78.8	83.0	89.3	96.1	103.2	110.9	119.0	127.4	136.1	145.4	155.1	165.4	49.7	4.8	7.5	6.8	15.9
Batusangkar	(GWh)	2.7	3.3	3.4	3.8	4.2	4.6	5.1	5.6	6.2	6.7	7.4	8.0	8.8	9.6	10.4	11.2	12.1	13.0	14.1	15.1	16.1	17.2	18.4	19.6	10.3	9.1	8.0	6.8	8.5
Padang Panjang	(GWh)	3.5	3.3	3.6	4.4	5.1	5.8	6.6	7.4	8.2	8.9	9.6	10.4	11.2	12.2	13.1	14.1	15.2	16.4	17.6	18.8	20.0	21.4	22.8	24.3	13.3	8.3	7.6	6.7	8.9
Pariaman	(GWh)	1.6	3.6	3.3	4.4	7.3	11.7	14.6	17.5	19.7	21.0	22.5	24.1	25.9	27.9	30.6	33.5	36.6	40.1	43.9	47.8	52.0	56.5	61.4	66.7	35.0	7.2	9.5	8.7	14.6
Solok	(GWh)	3.5	4.0	4.1		6.2	7.2	8.2	9.5	10.9	12.4	14.0	15.9	18.1	20.5	25.5	30.8	36.4	42.3	48.5	52.5	56.7	61.3	66.2	71.5		13.5	18.8	8.1	
Sawah Lunto	(GWh)	0.6	0.8	0.9		3.0	5.7	7.3	8.9	9.9	10.8	11.9	13.0	14.2	15.6	18.4	21.3	24.4	27.6	31.0	33.3	35.8	38.5	41.3	44.3		9.5	14.7	7.4	
Painan	(GWh)	1.5	1.7	1.9																14.4	15.8	17.2	18.9	20.6	22.6				9.4	
Lubuk Sikaping	(GWh)	1.0	1.1	1.2																17.9	19.6	21.6	23.7	26.1	28.8				10.0	
Surantih	(GWh)	0.0	0.0	0.2																										
Sungaidareh	(GWh)	0.0	0.0	0.1																										
Sungai Penuh	(GWh)	2.5	2.8	3.2																										
Others(W.S)	(GWh)	2.2	6.5	2.2																										
WEST SUMATRA	(GWh)	93.5	104.8	112.0	117.7	155.8	198.0	230.2	263.4	293.2	314.2	337.0	361.6	388.3	417.3	452.7	490.5	530.4	573.1	650.6	694.9	741.4	791.6	844.5	901.2	20.0	7.3	9.3	6.7	10.7
Pekanbaru	(GWh)	33.1	40.8	40.7									127.4	223.6	237.0	250.5	264.5	278.9	293.8	309.2	326.9	345.0	363.8	383.1	403.1			5.5	5.4	
Bangkinang	(GWh)	1.2	1.5	2.1									7.0	14.9	16.8	18.7	20.9	23.3	26.0	29.0	31.9	35.2	38.8	42.8	47.3			11.5	10.3	
Dumai	(GWh)	6.1	7.7	7.9											26.5	35.2	44.0	53.1	62.5	72.1	76.9	81.9	87.2	92.8	98.8			22.2	6.5	
Duri	(GWh)	0.8	1.2	1.7											6.3	7.4	8.5	9.8	11.1	12.5	13.7	14.9	16.2	17.7	19.3			14.7	9.1	
Minas	(GWh)	0.0	0.0	0.0												18.0	35.2	52.6	70.2	88.1	94.0	100.1	106.7	113.9	121.7				6.7	
B.Siapi-api	(GWh)	3.1	3.1	3.3																16.8	18.6	20.6	22.8	25.1	27.5				10.4	
Rengat	(GWh)	1.9	2.2	2.4																34.9	41.3	48.2	55.3	62.9	71.0				15.3	
Tembilahan	(GWh)	2.3	2.6	2.7																26.9	31.2	35.8	40.9	46.4	52.5				14.3	
Teluk Kuantan	(GWh)	0.4	0.5	0.5																10.1	11.7	13.5	15.5	17.9	20.5				15.2	
Cerenti	(GWh)	0.0	0.1	0.1																										
Ujungbatu	(GWh)	0.1	0.1	0.1																										
Others(R)	(GWh)	2.3	0.9	4.3																										
RIAU	(GWh)	51.3	60.7	65.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	134.4	238.5	286.6	329.8	373.1	417.7	463.6	599.6	646.2	695.2	747.2	802.6	861.7			15.9	7.5	
<1> WILAYAH III 150kV SYSTEM	(GWh)	144.8	165.5	177.8	117.7	155.8	198.0	230.2	263.4	293.2	314.2	337.0	496.0	626.8	703.9	782.5	863.6	948.1	1036.7	1250.2	1341.1	1436.6	1538.8	1647.1	1762.9	20.0	19.1	12.2	7.1	14.5
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)														96.0	209.0	235.0	261.0	289.0	318.0	348.0	381.0	414.0	450.0	486.0			27.1	8.9	
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	213.7	262.8	316.0	361.2	409.4	454.2	493.2	535.0	716.0	870.8	1069.9	1275.5	1396.6	1522.1	1653.7	1913.2	2051.1	2197.6	2351.8	2516.1	2688.9	16.3	18.7	12.3	7.0	13.5

Table 3.3 - 3 POWER DEMAND FORECAST (SALES) : WILAYAH III Basic Case (excld. PERTAMINA)

Location	Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86- -90/91	90/91- -95/96	95/96- -00/01	00/01- -05/06	85/86- -05/06
Padang	(GWh)	51.2	56.2	65.3	78.3	90.5	103.4	117.1	131.5	146.9	158.5	170.9	184.2	198.4	213.6	228.6	244.6	261.5	279.5	298.6	316.9	336.1	356.6	378.2	401.1	13.4	7.8	6.9	6.1	8.5
Bukittinggi	(GWh)	18.3	16.5	16.8	18.1	19.5	20.9	22.5	24.1	25.9	27.5	29.2	31.0	32.9	34.9	36.8	38.9	41.0	43.3	45.6	47.7	49.8	52.1	54.4	56.9	7.4	6.1	5.5	4.5	5.9
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	20.0	38.7	48.8	58.9	65.5	68.4	71.5	75.0	78.8	83.0	89.3	96.1	103.2	110.9	119.0	127.4	136.1	145.4	155.1	165.4	49.7	4.8	7.5	6.8	15.9
Batusangkar	(GWh)	2.7	3.3	3.4	3.8	4.2	4.6	5.1	5.6	6.2	6.7	7.4	8.0	8.8	9.6	10.4	11.2	12.1	13.0	14.1	15.1	16.1	17.2	18.4	19.6	10.3	9.1	8.0	6.8	8.5
Padang Panjang	(GWh)	3.5	3.3	3.6	4.4	5.1	5.8	6.6	7.4	8.2	8.9	9.6	10.4	11.2	12.2	13.1	14.1	15.2	16.4	17.6	18.8	20.0	21.4	22.8	24.3	13.3	8.3	7.6	6.7	8.9
Pariaman	(GWh)	1.6	3.6	3.3	4.4	7.3	11.7	14.6	17.5	19.7	21.0	22.5	24.1	25.9	27.9	30.6	33.5	36.6	40.1	43.9	47.8	52.0	56.5	61.4	66.7	35.0	7.2	9.5	8.7	14.6
Solok	(GWh)	3.5	4.0	4.1	5.4	6.2	7.2	8.2	9.5	10.9	12.4	14.0	15.9	18.1	20.5	25.5	30.8	36.4	42.3	48.5	52.5	56.7	61.3	66.2	71.5	15.1	13.5	18.8	8.1	13.8
Sawah Lunto	(GWh)	0.6	0.8	0.9	1.3	3.0	5.7	7.3	8.9	9.9	10.8	11.9	13.0	14.2	15.6	18.4	21.3	24.4	27.6	31.0	33.3	35.8	38.5	41.3	44.3	50.1	9.5	14.7	7.4	19.3
Painan	(GWh)	1.5	1.7	1.9	2.2	2.5	2.8	3.1	3.6	4.0	4.5	5.1	5.8	6.5	7.4	8.6	9.8	11.2	12.8	14.4	15.8	17.2	18.9	20.6	22.6	12.7	13.1	14.2	9.4	12.4
Lubuk Sikaping	(GWh)	1.0	1.1	1.2	1.8	2.2	2.5	3.0	3.5	4.2	4.8	5.6	6.4	7.4	8.5	10.0	11.7	13.6	15.6	17.9	19.6	21.6	23.7	26.1	28.8	18.5	15.1	16.1	10.0	14.9
Surantih	(GWh)	0.0	0.0	0.2	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.7	1.9	2.2	2.5	2.8	3.2	3.6	4.0	4.5	5.0	5.6	6.3	14.9	13.7	13.6	11.8	13.5
Sungaidareh	(GWh)	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.8	0.9	1.1	1.4	1.7	2.0	2.4	2.8	3.3	4.0	14.9	24.6	23.2	18.7	20.3
Sungai Penuh	(GWh)	2.5	2.8	3.2	3.5	4.1	4.7	5.3	6.1	7.0	8.4	9.9	11.5	13.2	15.2	16.8	18.7	20.7	23.0	25.4	27.8	30.4	33.2	36.3	39.7	14.9	16.8	10.8	9.3	12.9
Others(W.S)	(GWh)	2.2	6.5	2.2	2.6	3.1	3.7	4.4	5.3	6.3	7.5	9.0	10.8	13.0	15.6	18.5	21.9	25.9	30.6	36.3	42.1	48.9	56.8	65.9	76.5	19.4	19.9	18.4	16.1	18.4
WEST SUMATRA	(GWh)	93.5	104.8	112.0	135.1	168.4	212.5	247.0	283.0	315.9	340.8	368.3	398.0	430.6	466.5	509.6	556.0	605.7	659.7	717.6	770.8	827.6	889.4	955.6	1027.7	18.5	8.1	9.0	7.4	10.7
Pekanbaru	(GWh)	33.1	40.8	40.7	49.2	56.7	64.6	72.7	81.1	89.9	101.4	114.4	191.9	223.6	237.0	250.5	264.5	278.9	293.8	309.2	326.9	345.0	363.8	383.1	403.1	12.8	21.4	5.5	5.4	11.1
Bangkinang	(GWh)	1.2	1.5	2.1	3.0	4.0	5.0	6.2	7.5	8.9	10.1	11.6	13.1	14.9	16.8	18.7	20.9	23.3	26.0	29.0	31.9	35.2	38.8	42.8	47.3	24.3	13.5	11.5	10.3	14.8
Dumai	(GWh)	6.1	7.7	7.9	8.4	9.8	11.3	12.9	14.7	16.6	18.2	20.0	22.0	24.1	26.5	35.2	44.0	53.1	62.5	72.1	76.9	81.9	87.2	92.8	98.8	14.6	9.8	22.2	6.5	13.1
Duri	(GWh)	0.8	1.2	1.7	1.9	2.2	2.4	2.8	3.1	3.5	3.9	4.4	5.0	5.6	6.3	7.4	8.5	9.8	11.1	12.5	13.7	14.9	16.2	17.7	19.3	13.0	12.5	14.7	9.1	12.3
Minas	(GWh)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.5	0.6	0.9	18.0	35.2	52.6	70.2	88.1	94.0	100.1	106.7	113.9	121.7		35.1	150.1	6.7	
B.Siapi-api	(GWh)	3.1	3.1	3.3	3.7	4.1	4.6	5.1	5.7	6.3	7.0	7.8	8.6	9.5	10.5	11.5	12.7	13.9	15.3	16.8	18.6	20.6	22.8	25.1	27.5	11.2	10.8	9.9	10.4	10.5
Rengat	(GWh)	1.9	2.2	2.4	3.6	4.7	5.8	7.1	8.5	10.0	11.8	13.8	15.9	18.3	20.9	23.1	25.6	28.4	31.4	34.9	41.3	48.2	55.3	62.9	71.0	22.7	15.9	10.8	15.3	16.1
Tembilahan	(GWh)	2.3	2.6	2.7	3.2	3.7	4.3	5.1	5.9	6.9	8.0	9.2	10.6	12.2	14.1	16.1	18.3	20.8	23.7	26.9	31.2	35.8	40.9	46.4	52.5	16.6	15.4	13.8	14.3	15.0
Teluk Kuantan	(GWh)	0.4	0.5	0.5	0.6	0.7	0.9	1.1	1.4	1.7	2.1	2.6	3.1	3.8	4.6	5.4	6.3	7.3	8.6	10.1	11.7	13.5	15.5	17.9	20.5	23.2	22.0	17.0	15.2	19.3
Cerenti	(GWh)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.8	0.9	1.1	1.4	1.9	2.4	3.1	3.8	4.6	14.9	20.1	22.9	26.9	21.1
Ujungbatu	(GWh)	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.1	1.4	1.7	2.1	2.6	3.2	4.3	5.6	7.1	8.7	10.6	32.0	22.4	23.8	27.1	26.3
Others(R)	(GWh)	2.3	0.9	4.3	4.8	5.4	6.0	6.7	7.4	8.3	10.0	12.1	14.6	17.6	21.2	25.3	30.1	35.9	42.8	51.0	59.7	69.8	81.6	95.5	111.7	11.6	20.6	19.2	17.0	17.0
RIAU	(GWh)	51.3	60.7	65.8	78.6	91.6	105.3	120.1	135.8	152.9	173.4	197.1	286.3	331.5	360.4	413.2	468.6	527.0	589.1	655.2	712.1	773.0	839.0	910.6	988.6	14.2	18.7	12.7	8.6	13.5
<1> WILAYAH III	(GWh)	144.8	165.5	177.8	213.7	260.0	317.8	367.1	418.8	468.8	514.2	565.4	684.3	762.1	826.9	922.8	1024.6	1132.7	1248.8	1372.8	1482.9	1600.6	1728.4	1866.2	2016.3	17.0	12.0	10.7	8.0	11.9
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)																													
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	309.7	367.0	435.8	498.1	564.8	629.8	693.2	763.4	904.3	1006.1	1096.9	1206.8	1322.6	1445.7	1576.8	1717.8	1844.9	1980.6	2127.4	2285.2	2456.3	15.3	11.7	9.4	7.4	10.9

Table 3.3 - 4 POWER DEMAND FORECAST OF 150kV SYSTEM (SALES) : WILAYAH III Basic Case (excld. PERTAMINA)

Location	Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86-90/91	90/91-95/96	95/96-00/01	00/01-05/06	85/86-05/06
Padang	(GWh)	51.2	56.2	65.3	78.3	90.5	103.4	117.1	131.5	146.9	158.5	170.9	184.2	198.4	213.6	228.6	244.6	261.5	279.5	298.6	316.9	336.1	356.6	378.2	401.1	13.4	7.8	6.9	6.1	8.5
Bukittinggi	(GWh)	18.3	16.5	16.8	18.1	19.5	20.9	22.5	24.1	25.9	27.5	29.2	31.0	32.9	34.9	36.8	38.9	41.0	43.3	45.6	47.7	49.8	52.1	54.4	56.9	7.4	6.1	5.5	4.5	5.9
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	20.0	38.7	48.8	58.9	65.5	68.4	71.5	75.0	78.8	83.0	89.3	96.1	103.2	110.9	119.0	127.4	136.1	145.4	155.1	165.4	49.7	4.8	7.5	6.8	15.9
Batusangkar	(GWh)	2.7	3.3	3.4	3.8	4.2	4.6	5.1	5.6	6.2	6.7	7.4	8.0	8.8	9.6	10.4	11.2	12.1	13.0	14.1	15.1	16.1	17.2	18.4	19.6	10.3	9.1	8.0	6.8	8.5
Padang Panjang	(GWh)	3.5	3.3	3.6	4.4	5.1	5.8	6.6	7.4	8.2	8.9	9.6	10.4	11.2	12.2	13.1	14.1	15.2	16.4	17.6	18.8	20.0	21.4	22.8	24.3	13.3	8.3	7.6	6.7	8.9
Pariaman	(GWh)	1.6	3.6	3.3	4.4	7.3	11.7	14.6	17.5	19.7	21.0	22.5	24.1	25.9	27.9	30.6	33.5	36.6	40.1	43.9	47.8	52.0	56.5	61.4	66.7	35.0	7.2	9.5	8.7	14.6
Solok	(GWh)	3.5	4.0	4.1		6.2	7.2	8.2	9.5	10.9	12.4	14.0	15.9	18.1	20.5	25.5	30.8	36.4	42.3	48.5	52.5	56.7	61.3	66.2	71.5		13.5	18.8	8.1	
Sawah Lunto	(GWh)	0.6	0.8	0.9		3.0	5.7	7.3	8.9	9.9	10.8	11.9	13.0	14.2	15.6	18.4	21.3	24.4	27.6	31.0	33.3	35.8	38.5	41.3	44.3		9.5	14.7	7.4	
Painan	(GWh)	1.5	1.7	1.9																14.4	15.8	17.2	18.9	20.6	22.6				9.4	
Lubuk Sikaping	(GWh)	1.0	1.1	1.2																17.9	19.6	21.6	23.7	26.1	28.8				10.0	
Surantih	(GWh)	0.0	0.0	0.2																										
Sungaidareh	(GWh)	0.0	0.0	0.1																										
Sungai Penuh	(GWh)	2.5	2.8	3.2																										
Others (W.S)	(GWh)	2.2	6.5	2.2																										
WEST SUMATRA	(GWh)	93.5	104.8	112.0	117.7	155.8	198.0	230.2	263.4	293.2	314.2	337.0	361.6	388.3	417.3	452.7	490.5	530.4	573.1	650.6	694.9	741.4	791.6	844.5	901.2	20.0	7.3	9.3	6.7	10.7
Pekanbaru	(GWh)	33.1	40.8	40.7									127.4	223.6	237.0	250.5	264.5	278.9	293.8	309.2	326.9	345.0	363.8	383.1	403.1			5.5	5.4	
Bangkinang	(GWh)	1.2	1.5	2.1									7.0	14.9	16.8	18.7	20.9	23.3	26.0	29.0	31.9	35.2	38.8	42.8	47.3			11.5	10.3	
Dumai	(GWh)	6.1	7.7	7.9											26.5	35.2	44.0	53.1	62.5	72.1	76.9	81.9	87.2	92.8	98.8			22.2	6.5	
Duri	(GWh)	0.8	1.2	1.7											6.3	7.4	8.5	9.8	11.1	12.5	13.7	14.9	16.2	17.7	19.3			14.7	9.1	
Minas	(GWh)	0.0	0.0	0.0												18.0	35.2	52.6	70.2	88.1	94.0	100.1	106.7	113.9	121.7				6.7	
B.Siapi-api	(GWh)	3.1	3.1	3.3																16.8	18.6	20.6	22.8	25.1	27.5				10.4	
Rengat	(GWh)	1.9	2.2	2.4																34.9	41.3	48.2	55.3	62.9	71.0				15.3	
Tembilahan	(GWh)	2.3	2.6	2.7																26.9	31.2	35.8	40.9	46.4	52.5				14.3	
Teluk Kuantan	(GWh)	0.4	0.5	0.5																10.1	11.7	13.5	15.5	17.9	20.5				15.2	
Cerenti	(GWh)	0.0	0.1	0.1																										
Ujungbatu	(GWh)	0.1	0.1	0.1																										
Others (R)	(GWh)	2.3	0.9	4.3																										
RIAU	(GWh)	51.3	60.7	65.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	134.4	238.5	286.6	329.8	373.1	417.7	463.6	599.6	646.2	695.2	747.2	802.6	861.7			15.9	7.5	
<1> WILAYAH III 150kV SYSTEM	(GWh)	144.8	165.5	177.8	117.7	155.8	198.0	230.2	263.4	293.2	314.2	337.0	496.0	626.8	703.9	782.5	863.6	948.1	1036.7	1250.2	1341.1	1436.6	1538.8	1647.1	1762.9	20.0	19.1	12.2	7.1	11.5
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)																													
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	213.7	262.8	316.0	361.2	409.4	454.2	493.2	535.0	716.0	870.8	973.9	1066.5	1161.6	1261.1	1364.7	1595.2	1703.1	1816.6	1937.8	2066.1	2202.9	16.3	16.5	10.4	6.7	12.4

Table 3.3 - 5 POWER DEMAND FORECAST (SALES) : WILAYAH III High Case (incld. PERTAMINA)

Location	Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86- -90/91	90/91- -95/96	95/96- -00/01	00/01- -05/06	85/86- -05/06
Padang	(GWh)	51.2	56.2	65.3	78.8	91.6	105.2	119.7	135.1	151.7	164.1	177.3	191.6	206.9	223.3	239.0	255.6	273.3	292.0	312.0	330.6	350.1	370.8	392.8	416.0	14.0	8.0	6.9	5.9	8.7
Bukittinggi	(GWh)	18.3	16.5	16.8	18.2	19.7	21.3	23.0	24.9	26.8	28.6	30.5	32.4	34.6	36.8	38.9	41.1	43.3	45.7	48.3	50.4	52.6	54.9	57.3	59.8	8.0	6.5	5.6	4.4	6.1
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	20.2	39.2	49.7	59.9	66.9	70.2	73.8	77.8	82.3	87.4	94.4	101.9	109.9	118.5	127.7	136.7	146.1	156.1	166.6	177.7	50.4	5.5	7.9	6.8	16.3
Batusangkar	(GWh)	2.7	3.3	3.4	3.8	4.3	4.8	5.4	6.0	6.7	7.4	8.2	9.0	9.9	10.9	11.8	12.8	13.9	15.0	16.3	17.4	18.6	19.8	21.2	22.6	12.0	10.2	8.4	6.8	9.3
Padang Panjang	(GWh)	3.5	3.3	3.6	4.5	5.2	6.0	6.9	7.9	8.9	9.7	10.6	11.6	12.6	13.8	15.0	16.2	17.5	18.9	20.5	21.8	23.2	24.7	26.3	28.0	14.6	9.2	8.2	6.4	9.6
Pariaman	(GWh)	1.6	3.6	3.3	4.5	7.6	12.0	15.0	18.0	20.5	22.0	23.7	25.6	27.8	30.3	33.4	36.8	40.5	44.6	49.2	53.6	58.3	63.5	69.0	75.1	35.4	8.1	10.2	8.8	15.1
Solok	(GWh)	3.5	4.0	4.1	5.4	6.4	7.5	8.8	10.2	11.9	13.7	15.7	18.1	20.7	23.7	29.2	35.0	41.1	47.7	54.7	59.1	63.8	68.8	74.2	80.0	17.1	14.8	18.2	7.9	14.4
Sawah Lunto	(GWh)	0.6	0.8	0.9	1.3	3.0	5.7	7.3	9.0	10.1	11.2	12.3	13.6	15.0	16.6	19.6	22.7	26.0	29.5	33.3	35.8	38.5	41.3	44.3	47.5	50.7	10.4	14.9	7.4	19.7
Painan	(GWh)	1.5	1.7	1.9	2.2	2.5	2.9	3.3	3.8	4.4	5.1	5.8	6.6	7.6	8.7	10.0	11.5	13.2	15.0	17.0	18.6	20.4	22.3	24.4	26.7	14.9	14.6	14.3	9.4	13.3
Lubuk Sikaping	(GWh)	1.0	1.1	1.2	1.9	2.2	2.7	3.2	3.9	4.6	5.4	6.3	7.4	8.6	10.0	11.8	13.8	16.0	18.5	21.2	23.3	25.6	28.1	30.9	34.0	19.3	16.8	16.2	9.9	15.5
Surantih	(GWh)	0.0	0.0	0.2	0.5	0.6	0.7	0.8	1.0	1.1	1.3	1.5	1.7	2.0	2.4	2.7	3.1	3.5	4.1	4.7	5.2	5.9	6.7	7.5	8.4	17.1	16.9	14.4	12.3	15.2
Sungaidareh	(GWh)	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.7	0.8	1.0	1.3	1.5	1.9	2.3	2.8	3.3	3.9	4.6	5.5	24.6	21.7	23.5	19.0	22.2
Sungai Penuh	(GWh)	2.5	2.8	3.2	3.6	4.2	4.9	5.7	6.6	7.7	9.2	10.9	12.8	14.9	17.1	19.1	21.2	23.6	26.3	29.2	32.0	35.1	38.5	42.2	46.3	16.4	17.3	11.3	9.7	13.6
Others (W.S)	(GWh)	2.2	6.5	2.2	2.7	3.2	3.9	4.7	5.7	6.9	8.4	10.3	12.5	15.3	18.6	22.3	26.8	32.1	38.4	46.0	53.6	62.5	72.8	84.8	98.8	20.6	21.9	19.9	16.5	19.7
WEST SUMATRA	(GWh)	93.5	104.8	112.0	136.2	170.8	216.9	253.7	292.2	328.5	356.6	387.3	421.2	458.9	500.4	548.2	599.8	655.4	716.1	782.4	840.9	904.0	972.2	1046.1	1126.4	19.3	8.8	9.4	7.6	11.1
Pekanbaru	(GWh)	33.1	40.8	40.7	49.5	57.4	65.6	74.1	83.0	92.4	102.5	113.8	198.6	229.8	241.9	255.8	270.2	285.1	300.4	316.4	334.4	352.9	372.1	391.9	412.3	13.3	21.2	5.5	5.4	11.2
Bangkinang	(GWh)	1.2	1.5	2.1	3.0	4.1	5.2	6.5	7.9	9.4	10.9	12.5	14.3	16.4	18.7	21.0	23.6	26.5	29.7	33.4	36.8	40.7	44.9	49.6	54.8	25.7	14.7	12.3	10.4	15.6
Dumai	(GWh)	6.1	7.7	7.9	8.5	10.0	11.7	13.6	15.6	17.8	19.7	21.9	24.2	26.8	29.8	38.8	48.2	57.8	67.8	78.2	83.4	88.9	94.8	101.0	107.6	15.9	10.9	21.3	6.6	13.5
Duri	(GWh)	0.8	1.2	1.7	1.9	2.2	2.5	2.9	3.4	3.8	4.4	5.0	5.6	6.4	7.3	8.5	9.8	11.2	12.7	14.4	15.7	17.1	18.6	20.3	22.1	14.9	13.9	14.6	8.9	13.1
Minas	(GWh)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.8	1.1	18.3	35.6	53.2	71.0	89.4	95.4	101.9	108.8	116.3	124.6		40.6	141.0	6.9	
B.Siapi-api	(GWh)	3.1	3.1	3.3	3.7	4.2	4.8	5.4	6.1	6.9	7.7	8.6	9.7	10.8	12.1	13.3	14.7	16.3	18.0	19.9	22.0	24.4	26.9	29.6	32.5	13.3	11.9	10.5	10.3	11.5
Rengat	(GWh)	1.9	2.2	2.4	3.6	4.8	6.0	7.4	8.9	10.6	12.6	14.9	17.3	20.0	23.0	25.7	28.6	31.9	35.6	39.8	46.8	54.2	62.1	70.4	79.3	24.1	16.8	11.6	14.8	16.7
Tembilahan	(GWh)	2.3	2.6	2.7	3.2	3.8	4.5	5.4	6.4	7.6	8.9	10.4	12.1	14.1	16.5	18.8	21.6	24.6	28.2	32.2	37.1	42.4	48.2	54.6	61.6	18.9	16.8	14.3	13.9	15.9
Teluk Kuantan	(GWh)	0.4	0.5	0.5	0.6	0.7	0.9	1.2	1.5	1.9	2.4	2.9	3.6	4.4	5.4	6.3	7.4	8.8	10.3	12.2	14.1	16.2	18.5	21.2	24.2	25.9	23.2	17.7	14.7	20.3
Cerenti	(GWh)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.5	1.8	2.4	3.1	3.8	4.7	5.7	14.9	24.6	24.6	25.9	22.4
Ujungbatu	(GWh)	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.7	0.8	1.1	1.4	1.7	2.1	2.7	3.3	4.2	5.5	7.1	8.9	10.9	13.3	32.0	28.5	24.6	25.9	27.7
Others (R)	(GWh)	2.3	0.9	4.3	4.9	5.5	6.3	7.1	8.0	9.1	11.2	13.7	16.8	20.6	25.3	30.5	36.8	44.3	53.5	64.5	75.7	88.8	104.2	122.3	143.6	13.2	22.7	20.6	17.4	18.4
RIAU	(GWh)	51.3	60.7	65.8	79.1	93.0	107.9	124.1	141.4	160.3	181.3	205.1	303.9	351.7	383.1	439.5	499.6	563.6	632.0	706.4	769.3	837.7	911.8	992.8	1081.6	15.2	19.0	13.0	8.9	14.0
<1> WILAYAH III	(GWh)	144.8	165.5	177.8	215.3	263.8	324.8	377.8	433.6	488.8	537.9	592.4	725.1	810.6	883.5	987.7	1099.4	1219.0	1348.1	1488.8	1610.2	1741.7	1884.0	2038.9	2208.0	17.8	12.6	11.0	8.2	12.3
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)														96.0	209.0	235.0	261.0	289.0	318.0	348.0	381.0	414.0	450.0	486.0			27.1	8.9	
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	311.3	370.8	442.8	508.8	579.6	649.8	716.9	790.4	945.1	1054.6	1249.5	1480.7	1632.4	1793.0	1965.1	2151.8	2320.2	2502.7	2697.0	2907.9	3134.0	15.9	14.0	11.5	7.8	12.2

Table 3.3 - 6 POWER DEMAND FORECAST OF 150kV SYSTEM (SALES) : WILAYAH III High Case (incld. PERTAMINA)

Location	Year / Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86- -90/91	90/91- -95/96	95/96- -00/01	00/01- -05/06	85/86- -05/06
Padang	(GWh)	51.2	56.2	65.3	78.8	91.6	105.2	119.7	135.1	151.7	164.1	177.3	191.6	206.9	223.3	239.0	255.6	273.3	292.0	312.0	330.6	350.1	370.8	392.8	416.0	14.0	8.0	6.9	5.9	8.7
Bukittinggi	(GWh)	18.3	16.5	16.8	18.2	19.7	21.3	23.0	24.9	26.8	28.6	30.5	32.4	34.6	36.8	38.9	41.1	43.3	45.7	48.3	50.4	52.6	54.9	57.3	59.8	8.0	6.5	5.6	4.4	6.1
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	20.2	39.2	49.7	59.9	66.9	70.2	73.8	77.8	82.3	87.4	94.4	101.9	109.9	118.5	127.7	136.7	146.1	156.1	166.6	177.7	50.4	5.5	7.9	6.8	16.3
Batusangkar	(GWh)	2.7	3.3	3.4	3.8	4.3	4.8	5.4	6.0	6.7	7.4	8.2	9.0	9.9	10.9	11.8	12.8	13.9	15.0	16.3	17.4	18.6	19.8	21.2	22.6	12.0	10.2	8.4	6.8	9.3
Padang Panjang	(GWh)	3.5	3.3	3.6	4.5	5.2	6.0	6.9	7.9	8.9	9.7	10.6	11.6	12.6	13.8	15.0	16.2	17.5	18.9	20.5	21.8	23.2	24.7	26.3	28.0	14.6	9.2	8.2	6.4	9.6
Pariaman	(GWh)	1.6	3.6	3.3	4.5	7.6	12.0	15.0	18.0	20.5	22.0	23.7	25.6	27.8	30.3	33.4	36.8	40.5	44.6	49.2	53.6	58.3	63.5	69.0	75.1	35.4	8.1	10.2	8.8	15.1
Solok	(GWh)	3.5	4.0	4.1		6.4	7.5	8.8	10.2	11.9	13.7	15.7	18.1	20.7	23.7	29.2	35.0	41.1	47.7	54.7	59.1	63.8	68.8	74.2	80.0		14.8	18.2	7.9	
Sawah Lunto	(GWh)	0.6	0.8	0.9		3.0	5.7	7.3	9.0	10.1	11.2	12.3	13.6	15.0	16.6	19.6	22.7	26.0	29.5	33.3	35.8	38.5	41.3	44.3	47.5		10.4	14.9	7.4	
Painan	(GWh)	1.5	1.7	1.9																17.0	18.6	20.4	22.3	24.4	26.7				9.4	
Lubuk Sikaping	(GWh)	1.0	1.1	1.2																21.2	23.3	25.6	28.1	30.9	34.0				9.9	
Surantih	(GWh)	0.0	0.0	0.2																										
Sungaidareh	(GWh)	0.0	0.0	0.1																										
Sungai Penuh	(GWh)	2.5	2.8	3.2																										
Others(W.S)	(GWh)	2.2	6.5	2.2																										
WEST SUMATRA	(GWh)	93.5	104.8	112.0	118.5	158.0	201.7	235.8	271.0	303.5	326.9	352.1	379.7	409.8	442.8	481.3	522.1	565.5	611.9	700.2	747.3	797.2	850.3	907.0	967.4	20.7	7.8	9.6	6.7	11.1
Pekanbaru	(GWh)	33.1	40.8	40.7									134.1	229.8	241.9	255.8	270.2	285.1	300.4	316.4	334.4	352.9	372.1	391.9	412.3			5.5	5.4	
Bangkinang	(GWh)	1.2	1.5	2.1									7.4	16.4	18.7	21.0	23.6	26.5	29.7	33.4	36.8	40.7	44.9	49.6	54.8			12.3	10.4	
Dumai	(GWh)	6.1	7.7	7.9											29.8	38.8	48.2	57.8	67.8	78.2	83.4	88.9	94.8	101.0	107.6			21.3	6.6	
Duri	(GWh)	0.8	1.2	1.7											7.3	8.5	9.8	11.2	12.7	14.4	15.7	17.1	18.6	20.3	22.1			14.6	8.9	
Minas	(GWh)	0.0	0.0	0.0												18.3	35.6	53.2	71.0	89.4	95.4	101.9	108.8	116.3	124.6				6.9	
B.Siapi-api	(GWh)	3.1	3.1	3.3																19.9	22.0	24.4	26.9	29.6	32.5				10.3	
Rengat	(GWh)	1.9	2.2	2.4																39.8	46.8	54.2	62.1	70.4	79.3				14.8	
Tembilahan	(GWh)	2.3	2.6	2.7																32.2	37.1	42.4	48.2	54.6	61.6				13.9	
Teluk Kuantan	(GWh)	0.4	0.5	0.5																12.2	14.1	16.2	18.5	21.2	24.2				14.7	
Cerenti	(GWh)	0.0	0.1	0.1																										
Ujungbatu	(GWh)	0.1	0.1	0.1																										
Others(R)	(GWh)	2.3	0.9	4.3																										
RIAU	(GWh)	51.3	60.7	65.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	141.5	246.2	297.7	342.4	387.4	433.8	481.6	635.9	685.7	738.7	794.9	854.9	919.0			16.4	7.6	
<1> WILAYAH III 150kV SYSTEM	(GWh)	144.8	165.5	177.8	118.5	158.0	201.7	235.8	271.0	303.5	326.9	352.1	521.2	656.0	740.5	823.7	909.5	999.3	1093.5	1336.1	1433.0	1535.9	1645.2	1761.9	1886.4	20.7	19.5	12.5	7.1	14.8
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)														96.0	209.0	235.0	261.0	289.0	318.0	348.0	381.0	414.0	450.0	486.0			27.1	8.9	
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	214.5	265.0	319.7	366.8	417.0	464.5	505.9	550.1	741.2	900.0	1106.5	1316.7	1442.5	1573.3	1710.5	1999.1	2143.0	2296.9	2458.2	2630.9	2812.4	16.7	19.0	12.6	7.1	13.7

Table 3.3 - 7 POWER DEMAND FORECAST (SALES) : WILAYAH III High Case (excld. PERTAMINA)

Location	Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86- -90/91	00/91- -95/96	95/96- -00/01	00/01- -05/06	85/86- -05/06
Padang	(GWh)	51.2	56.2	65.3	78.8	91.6	105.2	119.7	135.1	151.7	164.1	177.3	191.6	206.9	223.3	239.0	255.6	273.3	292.0	312.0	330.6	350.1	370.8	392.8	416.0	14.0	8.0	6.9	5.9	8.7
Bukittinggi	(GWh)	18.3	16.5	16.8	18.2	19.7	21.3	23.0	24.9	26.8	28.6	30.5	32.4	34.6	36.8	38.9	41.1	43.3	45.7	48.3	50.4	52.6	54.9	57.3	59.8	8.0	6.5	5.6	4.4	6.1
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	20.2	39.2	49.7	59.9	66.9	70.2	73.8	77.8	82.3	87.4	94.4	101.9	109.9	118.5	127.7	136.7	146.1	156.1	166.6	177.7	50.4	5.5	7.9	6.8	16.3
Batusangkar	(GWh)	2.7	3.3	3.4	3.8	4.3	4.8	5.4	6.0	6.7	7.4	8.2	9.0	9.9	10.9	11.8	12.8	13.9	15.0	16.3	17.4	18.6	19.8	21.2	22.6	12.0	10.2	8.4	6.8	9.3
Padang Panjang	(GWh)	3.5	3.3	3.6	4.5	5.2	6.0	6.9	7.9	8.9	9.7	10.6	11.6	12.6	13.8	15.0	16.2	17.5	18.9	20.5	21.8	23.2	24.7	26.3	28.0	14.6	9.2	8.2	6.4	9.6
Pariaman	(GWh)	1.6	3.6	3.3	4.5	7.6	12.0	15.0	18.0	20.5	22.0	23.7	25.6	27.8	30.3	33.4	36.8	40.5	44.6	49.2	53.6	58.3	63.5	69.0	75.1	35.4	8.1	10.2	8.8	15.1
Solok	(GWh)	3.5	4.0	4.1	5.4	6.4	7.5	8.8	10.2	11.9	13.7	15.7	18.1	20.7	23.7	29.2	35.0	41.1	47.7	54.7	59.1	63.8	68.8	74.2	80.0	17.1	14.8	18.2	7.9	11.4
Sawah Lunto	(GWh)	0.6	0.8	0.9	1.3	3.0	5.7	7.3	9.0	10.1	11.2	12.3	13.6	15.0	16.6	19.6	22.7	26.0	29.5	33.3	35.8	38.5	41.3	44.3	47.5	50.7	10.4	14.9	7.4	19.7
Painan	(GWh)	1.5	1.7	1.9	2.2	2.5	2.9	3.3	3.8	4.4	5.1	5.8	6.6	7.6	8.7	10.0	11.5	13.2	15.0	17.0	18.6	20.4	22.3	24.4	26.7	14.9	14.6	14.3	9.4	13.3
Lubuk Sikaping	(GWh)	1.0	1.1	1.2	1.9	2.2	2.7	3.2	3.9	4.6	5.4	6.3	7.4	8.6	10.0	11.8	13.8	16.0	18.5	21.2	23.3	25.6	28.1	30.9	34.0	19.3	16.8	16.2	9.9	15.5
Surantih	(GWh)	0.0	0.0	0.2	0.5	0.6	0.7	0.8	1.0	1.1	1.3	1.5	1.7	2.0	2.4	2.7	3.1	3.5	4.1	4.7	5.2	5.9	6.7	7.5	8.4	17.1	16.9	14.4	12.3	15.2
Sungaidareh	(GWh)	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.7	0.8	1.0	1.3	1.5	1.9	2.3	2.8	3.3	3.9	4.6	5.5	24.6	21.7	23.5	19.0	22.2
Sungai Penuh	(GWh)	2.5	2.8	3.2	3.6	4.2	4.9	5.7	6.6	7.7	9.2	10.9	12.8	14.9	17.1	19.1	21.2	23.6	26.3	29.2	32.0	35.1	38.5	42.2	46.3	16.4	17.3	11.3	9.7	13.6
Others(W.S)	(GWh)	2.2	6.5	2.2	2.7	3.2	3.9	4.7	5.7	6.9	8.4	10.3	12.5	15.3	18.6	22.3	26.8	32.1	38.4	46.0	53.6	62.5	72.8	84.8	98.8	20.6	21.9	19.9	16.5	19.7
WEST SUMATRA	(GWh)	93.5	104.8	112.0	136.2	170.8	216.9	253.7	292.2	328.5	356.6	387.3	421.2	458.9	500.4	548.2	599.8	655.4	716.1	782.4	840.9	904.0	972.2	1046.1	1126.4	19.3	8.8	9.4	7.6	11.1
Pekanbaru	(GWh)	33.1	40.8	40.7	49.5	57.4	65.6	74.1	83.0	92.4	102.5	113.8	198.6	229.8	241.9	255.8	270.2	285.1	300.4	316.4	334.4	352.9	372.1	391.9	412.3	13.3	21.2	5.5	5.4	11.2
Bangkinang	(GWh)	1.2	1.5	2.1	3.0	4.1	5.2	6.5	7.9	9.4	10.9	12.5	14.3	16.4	18.7	21.0	23.6	26.5	29.7	33.4	36.8	40.7	44.9	49.6	54.8	25.7	14.7	12.3	10.4	15.6
Dumai	(GWh)	6.1	7.7	7.9	8.5	10.0	11.7	13.6	15.6	17.8	19.7	21.9	24.2	26.8	29.8	38.8	48.2	57.8	67.8	78.2	83.4	88.9	94.8	101.0	107.6	15.9	10.9	21.3	6.6	13.5
Duri	(GWh)	0.8	1.2	1.7	1.9	2.2	2.5	2.9	3.4	3.8	4.4	5.0	5.6	6.4	7.3	8.5	9.8	11.2	12.7	14.4	15.7	17.1	18.6	20.3	22.1	14.9	13.9	14.6	8.9	13.1
Minas	(GWh)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.8	1.1	18.3	35.6	53.2	71.0	89.4	95.4	101.9	108.8	116.3	124.6		40.6	141.0	6.9	
B.Siapi-api	(GWh)	3.1	3.1	3.3	3.7	4.2	4.8	5.4	6.1	6.9	7.7	8.6	9.7	10.8	12.1	13.3	14.7	16.3	18.0	19.9	22.0	24.4	26.9	29.6	32.5	13.3	11.9	10.5	10.3	11.5
Rengat	(GWh)	1.9	2.2	2.4	3.6	4.8	6.0	7.4	8.9	10.6	12.6	14.9	17.3	20.0	23.0	25.7	28.6	31.9	35.6	39.8	46.8	54.2	62.1	70.4	79.3	24.1	16.8	11.6	14.8	16.7
Tembilahan	(GWh)	2.3	2.6	2.7	3.2	3.8	4.5	5.4	6.4	7.6	8.9	10.4	12.1	14.1	16.5	18.8	21.6	24.6	28.2	32.2	37.1	42.4	48.2	54.6	61.6	18.9	16.8	14.3	13.9	15.9
Teluk Kuantan	(GWh)	0.4	0.5	0.5	0.6	0.7	0.9	1.2	1.5	1.9	2.4	2.9	3.6	4.4	5.4	6.3	7.4	8.8	10.3	12.2	14.1	16.2	18.5	21.2	24.2	25.9	23.2	17.7	14.7	20.3
Cerenti	(GWh)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.5	1.8	2.4	3.1	3.8	4.7	5.7	14.9	24.6	24.6	25.9	22.4
Ujungbatu	(GWh)	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.7	0.8	1.1	1.4	1.7	2.1	2.7	3.3	4.2	5.5	7.1	8.9	10.9	13.3	32.0	28.5	24.6	25.9	27.7
Others(R)	(GWh)	2.3	0.9	4.3	4.9	5.5	6.3	7.1	8.0	9.1	11.2	13.7	16.8	20.6	25.3	30.5	36.8	44.3	53.5	64.5	75.7	88.8	104.2	122.3	143.6	13.2	22.7	20.6	17.4	18.4
RIAU	(GWh)	51.3	60.7	65.8	79.1	93.0	107.9	124.1	141.4	160.3	181.3	205.1	303.9	351.7	383.1	439.5	499.6	563.6	632.0	706.4	769.3	837.7	911.8	992.8	1081.6	15.2	19.0	13.0	8.9	14.0
<1> WILAYAH III	(GWh)	144.8	165.5	177.8	215.3	263.8	324.8	377.8	433.6	488.8	537.9	592.4	725.1	810.6	883.5	987.7	1099.4	1219.0	1348.1	1488.8	1610.2	1741.7	1884.0	2038.9	2208.0	17.8	12.6	11.0	8.2	12.3
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)																													
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	311.3	370.8	442.8	508.8	579.6	649.8	716.9	790.4	945.1	1054.6	1153.5	1271.7	1397.4	1532.0	1676.1	1833.8	1972.2	2121.7	2283.0	2457.9	2648.0	15.9	12.2	9.7	7.6	11.3

Table 3.3 - 8 POWER DEMAND FORECAST OF 150kV SYSTEM (SALES) : WILAYAH III High Case (excld. PERTAMINA)

Location	Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86- -90/91	90/91- -95/96	95/96- -00/01	00/01- -05/06	85/86- -05/06
Padang	(GWh)	51.2	56.2	65.3	78.8	91.6	105.2	119.7	135.1	151.7	164.1	177.3	191.6	206.9	223.3	239.0	255.6	273.3	292.0	312.0	330.6	350.1	370.8	392.8	416.0	14.0	8.0	6.9	5.9	8.7
Bukittinggi	(GWh)	18.3	16.5	16.8	18.2	19.7	21.3	23.0	24.9	26.8	28.6	30.5	32.4	34.6	36.8	38.9	41.1	43.3	45.7	48.3	50.4	52.6	54.9	57.3	59.8	8.0	6.5	5.6	4.4	6.1
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	20.2	39.2	49.7	59.9	66.9	70.2	73.8	77.8	82.3	87.4	94.4	101.9	109.9	118.5	127.7	136.7	146.1	156.1	166.6	177.7	50.4	5.5	7.9	6.8	16.3
Batusangkar	(GWh)	2.7	3.3	3.4	3.8	4.3	4.8	5.4	6.0	6.7	7.4	8.2	9.0	9.9	10.9	11.8	12.8	13.9	15.0	16.3	17.4	18.6	19.8	21.2	22.6	12.0	10.2	8.4	6.8	9.3
Padang Panjang	(GWh)	3.5	3.3	3.6	4.5	5.2	6.0	6.9	7.9	8.9	9.7	10.6	11.6	12.6	13.8	15.0	16.2	17.5	18.9	20.5	21.8	23.2	24.7	26.3	28.0	14.6	9.2	8.2	6.4	9.6
Pariaman	(GWh)	1.6	3.6	3.3	4.5	7.6	12.0	15.0	18.0	20.5	22.0	23.7	25.6	27.8	30.3	33.4	36.8	40.5	44.6	49.2	53.6	58.3	63.5	69.0	75.1	35.4	8.1	10.2	8.8	15.1
Solok	(GWh)	3.5	4.0	4.1		6.4	7.5	8.8	10.2	11.9	13.7	15.7	18.1	20.7	23.7	29.2	35.0	41.1	47.7	54.7	59.1	63.8	68.8	74.2	80.0		14.8	18.2	7.9	
Sawah Lunto	(GWh)	0.6	0.8	0.9		3.0	5.7	7.3	9.0	10.1	11.2	12.3	13.6	15.0	16.6	19.6	22.7	26.0	29.5	33.3	35.8	38.5	41.3	44.3	47.5		10.4	14.9	7.4	
Painan	(GWh)	1.5	1.7	1.9																17.0	18.6	20.4	22.3	24.4	26.7				9.4	
Lubuk Sikaping	(GWh)	1.0	1.1	1.2																21.2	23.3	25.6	28.1	30.9	34.0				9.9	
Surantih	(GWh)	0.0	0.0	0.2																										
Sungaidareh	(GWh)	0.0	0.0	0.1																										
Sungai Penuh	(GWh)	2.5	2.8	3.2																										
Others(W.S)	(GWh)	2.2	6.5	2.2																										
WEST SUMATRA	(GWh)	93.5	104.8	112.0	118.5	158.0	201.7	235.8	271.0	303.5	326.9	352.1	379.7	409.8	442.8	481.3	522.1	565.5	611.9	700.2	747.3	797.2	850.3	907.0	967.4	20.7	7.8	9.6	6.7	11.1
Pekanbaru	(GWh)	33.1	40.8	40.7									134.1	229.8	241.9	255.8	270.2	285.1	300.4	316.4	334.4	352.9	372.1	391.9	412.3			5.5	5.4	
Bangkinang	(GWh)	1.2	1.5	2.1									7.4	16.4	18.7	21.0	23.6	26.5	29.7	33.4	36.8	40.7	44.9	49.6	54.8			12.3	10.4	
Dumai	(GWh)	6.1	7.7	7.9											29.8	38.8	48.2	57.8	67.8	78.2	83.4	88.9	94.8	101.0	107.6			21.3	6.6	
Duri	(GWh)	0.8	1.2	1.7											7.3	8.5	9.8	11.2	12.7	14.4	15.7	17.1	18.6	20.3	22.1			14.6	8.9	
Minas	(GWh)	0.0	0.0	0.0												18.3	35.6	53.2	71.0	89.4	95.4	101.9	108.8	116.3	124.6				6.9	
B.Siapi-api	(GWh)	3.1	3.1	3.3																19.9	22.0	24.4	26.9	29.6	32.5				10.3	
Rengat	(GWh)	1.9	2.2	2.4																39.8	46.8	54.2	62.1	70.4	79.3				14.8	
Tembilahan	(GWh)	2.3	2.6	2.7																32.2	37.1	42.4	48.2	54.6	61.6				13.9	
Teluk Kuantan	(GWh)	0.4	0.5	0.5																12.2	14.1	16.2	18.5	21.2	24.2				14.7	
Cerenti	(GWh)	0.0	0.1	0.1																										
Ujungbatu	(GWh)	0.1	0.1	0.1																										
Others(R)	(GWh)	2.3	0.9	4.3																										
RIAU	(GWh)	51.3	60.7	65.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	141.5	246.2	297.7	342.4	387.4	433.8	481.6	635.9	685.7	738.7	794.9	854.9	919.0			16.4	7.6	
<1> WILAYAH III 150kV SYSTEM	(GWh)	144.8	165.5	177.8	118.5	158.0	201.7	235.8	271.0	303.5	326.9	352.1	521.2	656.0	740.5	823.7	909.5	999.3	1093.5	1336.1	1433.0	1535.9	1645.2	1761.9	1886.4	20.7	19.5	12.5	7.1	14.8
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)																													
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	214.5	265.0	319.7	366.8	417.0	464.5	505.9	550.1	741.2	900.0	1010.5	1107.7	1207.5	1312.3	1421.5	1681.1	1795.0	1915.9	2044.2	2180.9	2326.4	16.7	16.8	10.7	6.7	12.7

Table 3.3 - 9 POWER DEMAND FORECAST (SALES) : WILAYAH III Low Case (incld. PERTAMINA)

Location	Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86--90/91	00/91--95/96	95/96--00/01	00/01--05/06	85/86--05/06
Padang	(GWh)	51.2	56.2	65.3	77.9	89.6	101.9	114.8	128.4	142.8	153.8	165.4	177.8	191.0	205.2	219.5	234.7	250.8	268.0	286.2	303.9	322.7	342.6	363.7	386.1	12.9	7.5	6.9	6.2	8.3
Bukittinggi	(GWh)	18.3	16.5	16.8	18.0	19.2	20.6	21.9	23.4	24.9	26.4	27.9	29.6	31.3	33.1	34.9	36.8	38.9	41.0	43.2	45.1	47.1	49.3	51.5	53.9	6.7	5.9	5.5	4.5	5.6
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	19.6	38.3	48.3	58.1	64.3	66.9	69.6	72.6	75.8	79.3	85.1	91.2	97.6	104.4	111.5	119.2	127.2	135.6	144.5	153.8	49.2	4.3	7.1	6.6	15.4
Batusangkar	(GWh)	2.7	3.3	3.4	3.7	4.1	4.4	4.8	5.2	5.7	6.2	6.7	7.2	7.8	8.4	9.0	9.7	10.4	11.1	12.0	12.7	13.6	14.5	15.4	16.4	9.0	8.1	7.4	6.4	7.7
Padang Panjang	(GWh)	3.5	3.3	3.6	4.4	5.0	5.6	6.3	7.0	7.7	8.2	8.8	9.4	10.1	10.8	11.6	12.4	13.3	14.2	15.2	16.2	17.2	18.3	19.5	20.7	11.8	7.0	7.1	6.4	8.1
Pariaman	(GWh)	1.6	3.6	3.3	4.4	7.7	11.3	14.0	16.9	19.0	20.1	21.3	22.7	24.1	25.8	28.0	30.5	33.1	35.9	39.0	42.3	45.9	49.7	53.8	58.2	34.0	6.3	8.6	8.3	13.8
Solok	(GWh)	3.5	4.0	4.1	5.3	6.0	6.8	7.8	8.8	9.9	11.2	12.6	14.1	15.9	17.8	22.4	27.2	32.2	37.5	43.0	46.5	50.1	54.1	58.3	62.9	13.3	12.4	19.3	7.9	13.2
Sawah Lunto	(GWh)	0.6	0.8	0.9	1.3	2.9	5.5	7.1	8.8	9.7	10.6	11.5	12.5	13.6	14.8	17.5	20.2	23.0	26.0	29.1	31.3	33.6	36.0	38.6	41.4	49.5	8.8	14.5	7.3	18.9
Painan	(GWh)	1.5	1.7	1.9	2.2	2.4	2.6	2.9	3.1	3.6	4.1	4.5	5.1	5.6	6.3	7.3	8.3	9.5	10.7	12.0	13.1	14.2	15.5	16.9	18.5	10.4	11.8	13.8	9.0	11.2
Lubuk Sikaping	(GWh)	1.0	1.1	1.2	1.8	2.1	2.4	2.8	3.2	3.7	4.3	4.8	5.5	6.3	7.2	8.4	9.8	11.3	12.9	14.7	16.1	17.6	19.3	21.2	23.3	15.5	14.2	15.3	9.6	13.7
Surantih	(GWh)	0.0	0.0	0.2	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.5	1.7	1.9	2.1	2.3	2.6	2.8	3.1	3.5	3.8	4.2	12.5	10.8	11.6	10.1	11.2
Sungaidareh	(GWh)	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.4	1.7	2.0	2.3	2.8	14.9	20.1	19.1	18.5	18.1
Sungai Penuh	(GWh)	2.5	2.8	3.2	3.5	3.9	4.4	5.0	5.6	6.3	7.6	8.8	10.2	11.7	13.3	14.7	16.1	17.7	19.5	21.4	23.3	25.4	27.6	30.1	32.8	12.5	16.1	10.0	8.9	11.8
Others(W.S)	(GWh)	2.2	6.5	2.2	2.4	2.7	3.0	3.3	3.6	4.0	4.8	5.8	7.0	8.5	10.2	12.3	14.8	17.7	21.3	25.6	30.3	35.9	42.5	50.3	59.5	10.8	20.6	20.2	18.4	17.4
WEST SUMATRA	(GWh)	93.5	104.8	112.0	134.2	165.9	207.5	239.9	273.1	302.7	325.5	349.1	375.3	403.4	434.2	473.0	514.3	558.5	605.8	656.7	704.2	755.3	810.5	869.9	934.5	17.7	7.5	8.6	7.3	10.2
Pekanbaru	(GWh)	33.1	40.8	40.7	49.0	56.3	63.8	71.6	79.7	88.0	98.9	111.2	189.3	220.5	233.1	246.3	259.8	273.8	288.2	303.2	320.5	338.3	356.7	375.7	395.3	12.4	21.5	5.4	5.4	11.0
Bangkinang	(GWh)	1.2	1.5	2.1	2.9	3.9	4.9	6.0	7.1	8.4	9.5	10.7	12.1	13.6	15.2	16.8	18.6	20.5	22.7	25.1	27.5	30.1	33.1	36.3	39.8	23.7	12.6	10.6	9.7	14.0
Dumai	(GWh)	6.1	7.7	7.9	8.3	9.6	10.9	12.4	14.0	15.6	17.0	18.5	20.1	21.9	23.8	32.0	40.5	49.0	57.8	66.9	71.0	75.5	80.1	85.0	90.2	13.5	8.8	23.0	6.2	12.7
Duri	(GWh)	0.8	1.2	1.7	1.9	2.1	2.3	2.6	2.9	3.2	3.6	4.0	4.4	4.9	5.5	6.4	7.4	8.5	9.6	10.9	11.8	12.9	14.0	15.2	16.6	11.0	11.4	14.7	8.8	11.4
Minas	(GWh)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.7	17.7	34.8	52.1	69.4	87.1	92.7	98.5	104.7	111.4	118.7		47.6	162.4	6.4	
B.Siapi-api	(GWh)	3.1	3.1	3.3	3.6	4.0	4.4	4.8	5.3	5.8	6.3	6.9	7.6	8.3	9.0	9.8	10.7	11.6	12.7	13.8	15.3	17.0	18.7	20.6	22.5	10.0	9.2	8.9	10.3	9.6
Rengat	(GWh)	1.9	2.2	2.4	3.5	4.6	5.6	6.8	8.1	9.4	11.1	12.8	14.7	16.7	18.9	20.8	22.9	25.1	27.6	30.3	36.2	42.4	48.9	55.7	62.8	21.8	15.0	9.9	15.7	15.5
Tembilahan	(GWh)	2.3	2.6	2.7	3.1	3.6	4.1	4.7	5.4	6.3	7.1	8.1	9.3	10.5	12.0	13.5	15.3	17.2	19.4	21.9	25.5	29.4	33.6	38.2	43.1	15.2	13.8	12.8	14.5	14.1
Teluk Kuantan	(GWh)	0.4	0.5	0.5	0.6	0.7	0.8	1.0	1.3	1.5	1.9	2.3	2.8	3.3	3.9	4.5	5.2	6.1	7.1	8.2	9.5	11.0	12.7	14.6	16.7	20.1	21.1	16.0	15.3	18.1
Cerenti	(GWh)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.4	1.8	2.3	2.8	3.4		32.0	20.1	27.7	19.3
Ujungbatu	(GWh)	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.5	1.8	2.2	3.2	4.2	5.3	6.6	7.9	24.6	21.7	22.4	29.1	24.4
Others(R)	(GWh)	2.3	0.9	4.3	4.7	5.2	5.7	6.2	6.8	7.5	8.8	10.4	12.2	14.4	16.9	19.8	23.2	27.1	31.8	37.2	43.0	49.7	57.5	66.5	76.9	9.8	17.6	17.1	15.6	15.0
RIAU	(GWh)	51.3	60.7	65.8	77.8	90.3	102.9	116.5	131.1	146.2	165.0	185.9	273.8	315.6	340.2	389.1	440.2	493.2	548.9	607.8	657.6	710.8	767.6	828.6	893.9	13.4	18.4	12.3	8.0	13.0
<1> WILAYAH III	(GWh)	144.8	165.5	177.8	212.0	256.2	310.4	356.4	404.2	448.9	490.5	535.0	649.1	719.0	774.4	862.1	954.5	1051.7	1154.7	1264.5	1361.8	1466.1	1578.1	1698.5	1828.4	16.2	11.5	10.3	7.7	11.4
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)														96.0	209.0	235.0	261.0	289.0	318.0	348.0	381.0	414.0	450.0	486.0			27.1	8.9	
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	308.0	363.2	428.4	487.4	550.2	609.9	669.5	733.0	869.1	963.0	1140.4	1355.1	1487.5	1625.7	1771.7	1927.5	2071.8	2227.1	2391.1	2567.5	2754.4	14.6	13.3	11.1	7.4	11.6

Table 3.3 - 10 POWER DEMAND FORECAST OF 150kV SYSTEM (SALES) : WILAYAH III Low Case (incld. PERTAMINA)

Location	Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86-90/91	90/91-95/96	95/96-00/01	00/01-05/06	85/86-05/06
Padang	(GWh)	51.2	56.2	65.3	77.9	89.6	101.9	114.8	128.4	142.8	153.8	165.4	177.8	191.0	205.2	219.5	234.7	250.8	268.0	286.2	303.9	322.7	342.6	363.7	386.1	12.9	7.5	6.9	6.2	8.3
Bukittinggi	(GWh)	18.3	16.5	16.8	18.0	19.2	20.6	21.9	23.4	24.9	26.4	27.9	29.6	31.3	33.1	34.9	36.8	38.9	41.0	43.2	45.1	47.1	49.3	51.5	53.9	6.7	5.9	5.5	4.5	5.6
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	19.6	38.3	48.3	58.1	64.3	66.9	69.6	72.6	75.8	79.3	85.1	91.2	97.6	104.4	111.5	119.2	127.2	135.6	144.5	153.8	49.2	4.3	7.1	6.6	15.4
Batusangkar	(GWh)	2.7	3.3	3.4	3.7	4.1	4.4	4.8	5.2	5.7	6.2	6.7	7.2	7.8	8.4	9.0	9.7	10.4	11.1	12.0	12.7	13.6	14.5	15.4	16.4	9.0	8.1	7.4	6.4	7.7
Padang Panjang	(GWh)	3.5	3.3	3.6	4.4	5.0	5.6	6.3	7.0	7.7	8.2	8.8	9.4	10.1	10.8	11.6	12.4	13.3	14.2	15.2	16.2	17.2	18.3	19.5	20.7	11.8	7.0	7.1	6.4	8.1
Pariaman	(GWh)	1.6	3.6	3.3	4.4	7.7	11.3	14.0	16.9	19.0	20.1	21.3	22.7	24.1	25.8	28.0	30.5	33.1	35.9	39.0	42.3	45.9	49.7	53.8	58.2	34.0	6.3	8.6	8.3	13.8
Solok	(GWh)	3.5	4.0	4.1		6.0	6.8	7.8	8.8	9.9	11.2	12.6	14.1	15.9	17.8	22.4	27.2	32.2	37.5	43.0	46.5	50.1	54.1	58.3	62.9		12.4	19.3	7.9	
Sawah Lunto	(GWh)	0.6	0.8	0.9		2.9	5.5	7.1	8.8	9.7	10.6	11.5	12.5	13.6	14.8	17.5	20.2	23.0	26.0	29.1	31.3	33.6	36.0	38.6	41.4		8.8	14.5	7.3	
Painan	(GWh)	1.5	1.7	1.9																12.0	13.1	14.2	15.5	16.9	18.5				9.0	
Lubuk Sikaping	(GWh)	1.0	1.1	1.2																14.7	16.1	17.6	19.3	21.2	23.3				9.6	
Surantih	(GWh)	0.0	0.0	0.2																										
Sungaidareh	(GWh)	0.0	0.0	0.1																										
Sungai Penuh	(GWh)	2.5	2.8	3.2																										
Others(W.S)	(GWh)	2.2	6.5	2.2																										
WEST SUMATRA	(GWh)	93.5	104.8	112.0	117.1	154.1	194.4	225.0	256.6	284.0	303.4	323.8	345.9	369.6	395.2	428.0	462.7	499.3	538.1	605.9	646.4	689.2	734.9	783.4	835.2	19.4	6.8	8.9	6.6	10.3
Pekanbaru	(GWh)	33.1	40.8	40.7									126.8	220.5	233.1	246.3	259.8	273.8	288.2	303.2	320.5	338.3	356.7	375.7	395.3			5.4	5.4	
Bangkinang	(GWh)	1.2	1.5	2.1									6.2	13.6	15.2	16.8	18.6	20.5	22.7	25.1	27.5	30.1	33.1	36.3	39.8			10.6	9.7	
Dumai	(GWh)	6.1	7.7	7.9											23.8	32.0	40.5	49.0	57.8	66.9	71.0	75.5	80.1	85.0	90.2			23.0	6.2	
Duri	(GWh)	0.8	1.2	1.7											5.5	6.4	7.4	8.5	9.6	10.9	11.8	12.9	14.0	15.2	16.6			14.7	8.8	
Minas	(GWh)	0.0	0.0	0.0												17.7	34.8	52.1	69.4	87.1	92.7	98.5	104.7	111.4	118.7				6.4	
B.Siapi-api	(GWh)	3.1	3.1	3.3																13.8	15.3	17.0	18.7	20.6	22.5				10.3	
Rengat	(GWh)	1.9	2.2	2.4																30.3	36.2	42.4	48.9	55.7	62.8				15.7	
Tembilahan	(GWh)	2.3	2.6	2.7																21.9	25.5	29.4	33.6	38.2	43.1				14.5	
Teluk Kuantan	(GWh)	0.4	0.5	0.5																8.2	9.5	11.0	12.7	14.6	16.7				15.3	
Cerenti	(GWh)	0.0	0.1	0.1																										
Ujungbatu	(GWh)	0.1	0.1	0.1																										
Others(R)	(GWh)	2.3	0.9	4.3																										
RIAU	(GWh)	51.3	60.7	65.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	133.0	234.1	277.6	319.2	361.1	403.9	447.7	567.4	610.0	655.1	702.5	752.7	805.7			15.4	7.3	
<1> WILAYAH III 150kV SYSTEM	(GWh)	144.8	165.5	177.8	117.1	154.1	194.4	225.0	256.6	284.0	303.4	323.8	478.9	603.7	672.8	747.2	823.8	903.2	985.8	1173.3	1256.4	1344.3	1437.4	1536.1	1640.9	19.4	18.8	11.8	6.9	14.1
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)														96.0	209.0	235.0	261.0	289.0	318.0	348.0	381.0	414.0	450.0	486.0			27.1	8.9	
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	213.1	261.1	312.4	356.0	402.6	445.0	482.4	521.8	698.9	847.7	1038.8	1240.2	1356.8	1477.2	1602.8	1836.3	1966.4	2105.3	2250.4	2405.1	2566.9	15.9	18.5	12.1	6.9	13.3

Table 3.3 - 11 POWER DEMAND FORECAST (SALES) : WILAYAH III Low Case (excld. PERTAMINA)

Location	Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96
Padang	(GWh)	51.2	56.2	65.3	77.9	89.6	101.9	114.8	128.4	142.8	153.8	165.4	177.8	191.0	205.2
Bukittinggi	(GWh)	18.3	16.5	16.8	18.0	19.2	20.6	21.9	23.4	24.9	26.4	27.9	29.6	31.3	33.1
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	19.6	38.3	48.3	58.1	64.3	66.9	69.6	72.6	75.8	79.3
Batusangkar	(GWh)	2.7	3.3	3.4	3.7	4.1	4.4	4.8	5.2	5.7	6.2	6.7	7.2	7.8	8.4
Padang Panjang	(GWh)	3.5	3.3	3.6	4.4	5.0	5.6	6.3	7.0	7.7	8.2	8.8	9.4	10.1	10.8
Pariaman	(GWh)	1.6	3.6	3.3	4.4	7.7	11.3	14.0	16.9	19.0	20.1	21.3	22.7	24.1	25.8
Solok	(GWh)	3.5	4.0	4.1	5.3	6.0	6.8	7.8	8.8	9.9	11.2	12.6	14.1	15.9	17.8
Sawah Lunto	(GWh)	0.6	0.8	0.9	1.3	2.9	5.5	7.1	8.8	9.7	10.6	11.5	12.5	13.6	14.8
Painan	(GWh)	1.5	1.7	1.9	2.2	2.4	2.6	2.9	3.1	3.6	4.1	4.5	5.1	5.6	6.3
Lubuk Sikaping	(GWh)	1.0	1.1	1.2	1.8	2.1	2.4	2.8	3.2	3.7	4.3	4.8	5.5	6.3	7.2
Surantih	(GWh)	0.0	0.0	0.2	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.5
Sungaidareh	(GWh)	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5
Sungai Penuh	(GWh)	2.5	2.8	3.2	3.5	3.9	4.4	5.0	5.6	6.3	7.6	8.8	10.2	11.7	13.3
Others(W.S)	(GWh)	2.2	6.5	2.2	2.4	2.7	3.0	3.3	3.6	4.0	4.8	5.8	7.0	8.5	10.2
WEST SUMATRA	(GWh)	93.5	104.8	112.0	134.2	165.9	207.5	239.9	273.1	302.7	325.5	349.1	375.3	403.4	434.2
Pekanbaru	(GWh)	33.1	40.8	40.7	49.0	56.3	63.8	71.6	79.7	88.0	98.9	111.2	189.3	220.5	233.1
Bangkinang	(GWh)	1.2	1.5	2.1	2.9	3.9	4.9	6.0	7.1	8.4	9.5	10.7	12.1	13.6	15.2
Dumai	(GWh)	6.1	7.7	7.9	8.3	9.6	10.9	12.4	14.0	15.6	17.0	18.5	20.1	21.9	23.8
Duri	(GWh)	0.8	1.2	1.7	1.9	2.1	2.3	2.6	2.9	3.2	3.6	4.0	4.4	4.9	5.5
Minas	(GWh)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.7
B.Siapi-api	(GWh)	3.1	3.1	3.3	3.6	4.0	4.4	4.8	5.3	5.8	6.3	6.9	7.6	8.3	9.0
Rengat	(GWh)	1.9	2.2	2.4	3.5	4.6	5.6	6.8	8.1	9.4	11.1	12.8	14.7	16.7	18.9
Tembilahan	(GWh)	2.3	2.6	2.7	3.1	3.6	4.1	4.7	5.4	6.3	7.1	8.1	9.3	10.5	12.0
Teluk Kuantan	(GWh)	0.4	0.5	0.5	0.6	0.7	0.8	1.0	1.3	1.5	1.9	2.3	2.8	3.3	3.9
Cerenti	(GWh)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4
Ujungbatu	(GWh)	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8
Others(R)	(GWh)	2.3	0.9	4.3	4.7	5.2	5.7	6.2	6.8	7.5	8.8	10.4	12.2	14.4	16.9
RIAU	(GWh)	51.3	60.7	65.8	77.8	90.3	102.9	116.5	131.1	146.2	165.0	185.9	273.8	315.6	340.2
<1> WILAYAH III	(GWh)	144.8	165.5	177.8	212.0	256.2	310.4	356.4	404.2	448.9	490.5	535.0	649.1	719.0	774.4
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0
<3> PERTAMINA	(GWh)														
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	308.0	363.2	428.4	487.4	550.2	609.9	669.5	733.0	869.1	963.0	1044.4

Location	Unit	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86--90/91	90/91--95/96	95/96--00/01	00/01--05/06	85/86--05/06
Padang	(GWh)	219.5	234.7	250.8	268.0	286.2	303.9	322.7	342.6	363.7	386.1	12.9	7.5	6.9	6.2	8.3
Bukittinggi	(GWh)	34.9	36.8	38.9	41.0	43.2	45.1	47.1	49.3	51.5	53.9	6.7	5.9	5.5	4.5	5.6
Payakumbuh	(GWh)	85.1	91.2	97.6	104.4	111.5	119.2	127.2	135.6	144.5	153.8	49.2	4.3	7.1	6.6	15.4
Batusangkar	(GWh)	9.0	9.7	10.4	11.1	12.0	12.7	13.6	14.5	15.4	16.4	9.0	8.1	7.4	6.4	7.7
Padang Panjang	(GWh)	11.6	12.4	13.3	14.2	15.2	16.2	17.2	18.3	19.5	20.7	11.8	7.0	7.1	6.4	8.1
Pariaman	(GWh)	28.0	30.5	33.1	35.9	39.0	42.3	45.9	49.7	53.8	58.2	31.0	6.3	8.6	8.3	13.8
Solok	(GWh)	22.4	27.2	32.2	37.5	43.0	46.5	50.1	54.1	58.3	62.9	13.3	12.4	19.3	7.9	13.2
Sawah Lunto	(GWh)	17.5	20.2	23.0	26.0	29.1	31.3	33.6	36.0	38.6	41.4	49.5	8.8	14.5	7.3	18.9
Painan	(GWh)	7.3	8.3	9.5	10.7	12.0	13.1	14.2	15.5	16.9	18.5	10.4	11.8	13.8	9.0	11.2
Lubuk Sikaping	(GWh)	8.4	9.8	11.3	12.9	14.7	16.1	17.6	19.3	21.2	23.3	15.5	14.2	15.3	9.6	13.7
Surantih	(GWh)	1.7	1.9	2.1	2.3	2.6	2.8	3.1	3.5	3.8	4.2	12.5	10.8	11.6	10.1	11.2
Sungaidareh	(GWh)	0.6	0.7	0.9	1.0	1.2	1.4	1.7	2.0	2.3	2.8	14.9	20.1	19.1	18.5	18.1
Sungai Penuh	(GWh)	14.7	16.1	17.7	19.5	21.4	23.3	25.4	27.6	30.1	32.8	12.5	16.1	10.0	8.9	11.8
Others(W.S)	(GWh)	12.3	14.8	17.7	21.3	25.6	30.3	35.9	42.5	50.3	59.5	10.8	20.6	20.2	18.4	17.4
WEST SUMATRA	(GWh)	473.0	514.3	558.5	605.8	656.7	704.2	755.3	810.5	869.9	934.5	17.7	7.5	8.6	7.3	10.2
Pekanbaru	(GWh)	246.3	259.8	273.8	288.2	303.2	320.5	338.3	356.7	375.7	395.3	12.4	21.5	5.4	5.4	11.0
Bangkinang	(GWh)	16.8	18.6	20.5	22.7	25.1	27.5	30.1	33.1	36.3	39.8	23.7	12.6	10.6	9.7	14.0
Dumai	(GWh)	32.0	40.5	49.0	57.8	66.9	71.0	75.5	80.1	85.0	90.2	13.5	8.8	23.0	6.2	12.7
Duri	(GWh)	6.4	7.4	8.5	9.6	10.9	11.8	12.9	14.0	15.2	16.6	11.0	11.4	14.7	8.8	11.4
Minas	(GWh)	17.7	34.8	52.1	69.4	87.1	92.7	98.5	104.7	111.4	118.7		47.6	162.4	6.4	
B.Siapi-api	(GWh)	9.8	10.7	11.6	12.7	13.8	15.3	17.0	18.7	20.6	22.5	10.0	9.2	8.9	10.3	9.6
Rengat	(GWh)	20.8	22.9	25.1	27.6	30.3	36.2	42.4	48.9	55.7	62.8	21.8	15.0	9.9	15.7	15.5
Tembilahan	(GWh)	13.5	15.3	17.2	19.4	21.9	25.5	29.4	33.6	38.2	43.1	15.2	13.8	12.8	14.5	14.1
Teluk Kuantan	(GWh)	4.5	5.2	6.1	7.1	8.2	9.5	11.0	12.7	14.6	16.7	20.1	21.1	16.0	15.3	18.1
Cerenti	(GWh)	0.5	0.6	0.7	0.8	1.0	1.4	1.8	2.3	2.8	3.4		32.0	20.1	27.7	19.3
Ujungbatu	(GWh)	1.0	1.2	1.5	1.8	2.2	3.2	4.2	5.3	6.6	7.9	24.6	21.7	22.4	29.1	24.4
Others(R)	(GWh)	19.8	23.2	27.1	31.8	37.2	43.0	49.7	57.5	66.5	76.9	9.8	17.6	17.1	15.6	15.0
RIAU	(GWh)	389.1	440.2	493.2	548.9	607.8	657.6	710.8	767.6	828.6	893.9	13.4	18.4	12.3	8.0	13.0
<1> WILAYAH III	(GWh)	862.1	954.5	1051.7	1154.7	1264.5	1361.8	1466.1	1578.1	1698.5	1828.4	16.2	11.5	10.3	7.7	11.4
<2> SEMEN PADANG	(GWh)	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA	(GWh)															
<4> <1>+<2>+<3>	(GWh)	1146.1	1252.5	1364.7	1482.7	1609.5	1723.8	1846.1	1977.1	2117.5	2268.4	14.6	11.4	9.0	7.1	10.5

Table 3.3 - 12 POWER DEMAND FORECAST OF 150kV SYSTEM (SALES) : WILAYAH III Low Case (excld. PERTAMINA)

Location	Unit	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96
Padang	(GWh)	51.2	56.2	65.3	77.9	89.6	101.9	114.8	128.4	142.8	153.8	165.4	177.8	191.0	205.2
Bukittinggi	(GWh)	18.3	16.5	16.8	18.0	19.2	20.6	21.9	23.4	24.9	26.4	27.9	29.6	31.3	33.1
Payakumbuh	(GWh)	4.9	5.0	5.8	8.7	19.6	38.3	48.3	58.1	64.3	66.9	69.6	72.6	75.8	79.3
Batusangkar	(GWh)	2.7	3.3	3.4	3.7	4.1	4.4	4.8	5.2	5.7	6.2	6.7	7.2	7.8	8.4
Padang Panjang	(GWh)	3.5	3.3	3.6	4.4	5.0	5.6	6.3	7.0	7.7	8.2	8.8	9.4	10.1	10.8
Pariaman	(GWh)	1.6	3.6	3.3	4.4	7.7	11.3	14.0	16.9	19.0	20.1	21.3	22.7	24.1	25.8
Solok	(GWh)	3.5	4.0	4.1		6.0	6.8	7.8	8.8	9.9	11.2	12.6	14.1	15.9	17.8
Sawah Lunto	(GWh)	0.6	0.8	0.9		2.9	5.5	7.1	8.8	9.7	10.6	11.5	12.5	13.6	14.8
Painan	(GWh)	1.5	1.7	1.9											
Lubuk Sikaping	(GWh)	1.0	1.1	1.2											
Surantih	(GWh)	0.0	0.0	0.2											
Sungaidareh	(GWh)	0.0	0.0	0.1											
Sungai Penuh	(GWh)	2.5	2.8	3.2											
Others(W.S)	(GWh)	2.2	6.5	2.2											
WEST SUMATRA	(GWh)	93.5	104.8	112.0	117.1	154.1	194.4	225.0	256.6	284.0	303.4	323.8	345.9	369.6	395.2
Pekanbaru	(GWh)	33.1	40.8	40.7									126.8	220.5	233.1
Bangkinang	(GWh)	1.2	1.5	2.1									6.2	13.6	15.2
Dumai	(GWh)	6.1	7.7	7.9											23.8
Duri	(GWh)	0.8	1.2	1.7											5.5
Minas	(GWh)	0.0	0.0	0.0											
B.Siapi-api	(GWh)	3.1	3.1	3.3											
Rengat	(GWh)	1.9	2.2	2.4											
Tembilahan	(GWh)	2.3	2.6	2.7											
Teluk Kuantan	(GWh)	0.4	0.5	0.5											
Cerenti	(GWh)	0.0	0.1	0.1											
Ujungbatu	(GWh)	0.1	0.1	0.1											
Others(R)	(GWh)	2.3	0.9	4.3											
RIAU	(GWh)	51.3	60.7	65.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	133.0	234.1	277.6
<1> WILAYAH III 150kV SYSTEM	(GWh)	144.8	165.5	177.8	117.1	154.1	194.4	225.0	256.6	284.0	303.4	323.8	478.9	603.7	672.8
<2> SEMEN PADANG	(GWh)		59.0	87.0	96.0	107.0	118.0	131.0	146.0	161.0	179.0	198.0	220.0	244.0	270.0
<3> PERTAMINA	(GWh)														
<4> <1>+<2>+<3>	(GWh)	144.8	224.5	264.8	213.1	261.1	312.4	356.0	402.6	445.0	482.4	521.8	698.9	847.7	942.8

Location	96/97	97/98	98/99	99/2000	2000/01	01/02	02/03	03/04	04/05	05/06	Annual Growth Rate (%) 85/86- -90/91	00/91- -95/96	95/96- -00/01	00/01- -05/06	85/86- -05/06
Padang	219.5	234.7	250.8	268.0	286.2	303.9	322.7	342.6	363.7	386.1	12.9	7.5	6.9	6.2	8.3
Bukittinggi	34.9	36.8	38.9	41.0	43.2	45.1	47.1	49.3	51.5	53.9	6.7	5.9	5.5	4.5	5.6
Payakumbuh	85.1	91.2	97.6	104.4	111.5	119.2	127.2	135.6	144.5	153.8	49.2	4.3	7.1	6.6	15.4
Batusangkar	9.0	9.7	10.4	11.1	12.0	12.7	13.6	14.5	15.4	16.4	9.0	8.1	7.4	6.4	7.7
Padang Panjang	11.6	12.4	13.3	14.2	15.2	16.2	17.2	18.3	19.5	20.7	11.8	7.0	7.1	6.4	8.1
Pariaman	28.0	30.5	33.1	35.9	39.0	42.3	45.9	49.7	53.8	58.2	34.0	6.3	8.6	8.3	13.8
Solok	22.4	27.2	32.2	37.5	43.0	46.5	50.1	54.1	58.3	62.9		12.4	19.3	7.9	
Sawah Lunto	17.5	20.2	23.0	26.0	29.1	31.3	33.6	36.0	38.6	41.4		8.8	14.5	7.3	
Painan					12.0	13.1	14.2	15.5	16.9	18.5				9.0	
Lubuk Sikaping					14.7	16.1	17.6	19.3	21.2	23.3				9.6	
Surantih															
Sungaidareh															
Sungai Penuh															
Others(W.S)															
WEST SUMATRA	428.0	462.7	499.3	538.1	605.9	646.4	689.2	731.9	783.4	835.2	19.4	6.8	8.9	6.6	10.3
Pekanbaru	246.3	259.8	273.8	288.2	303.2	320.5	338.3	356.7	375.7	395.3			5.4	5.4	
Bangkinang	16.8	18.6	20.5	22.7	25.1	27.5	30.1	33.1	36.3	39.8			10.6	9.7	
Dumai	32.0	40.5	49.0	57.8	66.9	71.0	75.5	80.1	85.0	90.2			23.0	6.2	
Duri	6.4	7.4	8.5	9.6	10.9	11.8	12.9	14.0	15.2	16.6			14.7	8.8	
Minas	17.7	34.8	52.1	69.4	87.1	92.7	98.5	104.7	111.4	118.7				6.4	
B.Siapi-api					13.8	15.3	17.0	18.7	20.6	22.5				10.3	
Rengat					30.3	36.2	42.4	48.9	55.7	62.8				15.7	
Tembilahan					21.9	25.5	29.4	33.6	38.2	43.1				14.5	
Teluk Kuantan					8.2	9.5	11.0	12.7	14.6	16.7				15.3	
Cerenti															
Ujungbatu															
Others(R)															
RIAU	319.2	361.1	403.9	447.7	567.4	610.0	655.1	702.5	752.7	805.7			15.4	7.3	
<1> WILAYAH III 150kV SYSTEM	747.2	823.8	903.2	985.8	1173.3	1256.4	1344.3	1437.4	1536.1	1640.9	19.4	18.8	11.8	6.9	14.1
<2> SEMEN PADANG	284.0	298.0	313.0	328.0	345.0	362.0	380.0	399.0	419.0	440.0	10.9	10.9	5.0	5.0	7.9
<3> PERTAMINA															
<4> <1>+<2>+<3>	1031.2	1121.8	1216.2	1313.8	1518.3	1618.4	1724.3	1836.4	1955.1	2080.9	15.9	16.2	10.0	6.5	12.1

Table 3.4 - 1 Growth Rate of Sold Energy & GDP/GRDP

Growth rate of sold energy of Whole Indonesia (%)

Year	1978	1979	1980	1981	1982
1979	24.63				
1980	23.35	22.08			
1981	22.32	21.17	20.27		
1982	20.71	19.43	18.12	16.01	
1983	18.46	16.96	15.30	12.90	9.87

Growth rate of sold energy of Wilayah III (%)

Year	1975	1976	1977	1978	1979
1976	8.33				
1977	10.87	13.46			
1978	13.40	16.02	18.64		
1979	16.36	19.17	22.13	25.71	
1980	18.47	21.14	23.82	26.49	27.27

Growth rate of GDP of Whole Indonesia (%)

Year	1978	1979	1980	1981	1982
1979	6.25				
1980	8.05	9.88			
1981	8.01	8.90	7.93		
1982	6.54	6.63	5.05	2.24	
1983	6.06	6.02	4.76	3.21	4.19

Growth rate of GRDP of Wilayah III (%)

Year	1975	1976	1977	1978	1979
1976	4.48				
1977	6.64	8.85			
1978	6.64	7.74	6.65		
1979	6.72	7.47	6.79	6.93	
1980	7.27	7.98	7.69	8.21	9.50

Table 3.4 - 2 Elasticity of Sold Energy to GDP/GRDP

Whole Indonesia

Year	1978	1979	1980	1981	1982
1979	3.93				
1980	2.50	2.23			
1981	2.79	2.38	2.56		
1982	3.17	2.93	3.59	7.12	
1983	3.04	2.82	3.21	4.01	2.35

Wilayah III

Year	1975	1976	1977	1978	1979
1976	1.86				
1977	1.64	1.52			
1978	2.02	2.07	2.8		
1979	2.43	2.57	3.26	3.71	
1980	2.54	2.65	3.1	3.23	2.87

Table 3.4 - 3(1) Power Demand Forecast by Macro Scopic Method - 1

Year	1978	1979	1980	1981	1982	1983		1985	1990	1995	2000	2005	
INDONESIA GDP	9,567	10,165	11,169	12,055	12,325	(12,842) a/	Basic	14,470	18,920	24,720	31,550	40,270	$\times 10^9$ Rp
							High	14,600	19,350	25,650	33,210	42,990	
							Low	14,350	18,490	23,820	30,120	38,070	
INDONESIA Sold ene.	4,287	5,343	6,523	7,845	9,101	(9,999) a/	Bc	13,400	25,510	48,580	78,240	126,000	GWh
							Hi	13,660	26,890	52,910	87,570	144,910	
							Lw	13,130	24,190	44,580	70,500	111,480	
Wilayah III Sold ene.	70.0	87.6	112.1	140.6	158.4	(237.8) a/	Bc	228	435	828	1,333	2,147	GWh
							Hi	233	458	902	1,492	2,469	
							Lw	224	412	760	1,201	1,900	
W.III/W.IND	1.63	1.64	1.72	1.79	1.74	(2.38) a/							

Note:
1) GDP is based on the constant price at 1973.
2) Padang Cement & PERTAMINA are excluded on account of special consumer.
3) Actual data in 1983 is not considered for forecast because of the start year of receiving power to Padang Cement.
4) a/: Interim data : Biro Pusat Statistik, PLN Wilayah III

Table 3.4 - 3(2) Power Demand Forecast by Macro Scopic Method - 2

Year	1975	1976	1977	1978	1979	1980		1985	1990	1995	2000	2005	
GRDP													
Wilayah III	357	373	406	433	463	507	Basic	663	866	1,132	1,445	1,800	$x10^9$ Rp
Riau	168	175	191	202	212	227	High	672	891	1,181	1,529	1,980	
W.Sumatra	189	198	215	231	251	280	Low	653	842	1,085	1,371	1,733	
Sales GWh													
Wilayah III	47	52	59	70	88	112	Bc	218	426	831	1,340	2,160	GWh
Riau	19	20	23	28	35	47	Hi	226	460	920	1,530	2,530	
W.Sumatra	28	32	36	42	53	65	Lw	211	400	750	1,180	1,870	
Sales GWh/ Year			1981	82	83	84							
Wilayah III			140	159	232	282							
Riau			57	65	76	83							
W.Sumatra			83	94	166	199							

Note:
1) Constant price at 1975 for GDRP.
2) Source: West Sumatra BAPPEDA & Riau BAPPEDA, PLN Wilayah III

3.6 Analysis of Daily Load Characteristics

Subsequent to analysis and statistical processing of the collected daily load curve data in Padang and Pekanbaru, the future daily load curves were forecasted/assumed according to an inferential statistics. Therefore, with respect to the collected data,

(1) The test of significance between hourly means of daily load curves on week days and holidays was conducted.

(2) Whether or not it is possible to treat the present load data on week days and holidays as a same population was checked.

(3) Based on the results of (1) and (2) above, it was clarified whether it is necessary to handle the hourly load separately for estimating the daily load curves on week days and holidays.

3.6.1 Test of significance between hourly means of load curves on week days and holidays

a) Padang area

The load curve data on July 15 (Sun.) and 18 (Wed.), Dec. 16 (Sun.) and 19 (Wed.) 1984, March 17 (Sun.) and 20 (Wed.) 1985 were collected. As a result of testing of significance between the hourly means of these days, the significant difference on each day was concluded to be "not significant", namely, there was concluded to be no difference between the hourly means on these days (Refer to Annex 3-2(1), (2), (3).

b) Pekanbaru area

Since either the data in the same year or those in the lastest years in Pekanbaru were not available as in the case of Padang, the load curves only on Dec. 20 (Mon.) 1982 and April 17 (Wed.) 1985 were collected.

With respect to these load curves, the significant difference between the load characteristics was checked according to the same procedures as in the case of Padang as the results are shown in Annex 3-3.

Since there is as many as three years of difference, there is naturally a difference between the means. Namely, the value of 1985 is higher than that of 1982. However, there is a strong correlation between both of the load curves, which indicate that there is little change in the configuration of power demand even after elapse of three years.

3.6.2 Monthly fluctuation of daily power consumption on week days and holidays

Generally, the monthly power consumption in a year will (a) continue to increase followed by the growth of economy, (b) fluctuate seasonally due to seasonal change, or (c) may not grow nor fluctuate seasonally depending upon the situations.

In the case of (c), the power demand will indicate a same pattern in whichever month or on whichever day throughout the year. Therefore, it is possible to manage the data by statistical method as samples extracted from the same population.

In the case of (a) or (b), however, it is impossible to equally handle monthly or seasonal data respectively if the power demand fluctuates extensively.

Now, the data of Padang pertain to the two days within the respective months, namely, July and December 1984 and March 1985. Since the load curves on Sundays and week days as well as resultant daily power demand have been clarified, it was assumed as to whether these data belong to the pattern (c) or not. If it does not belong to the pattern, it would be permissible to consider that the data belong to the pattern (a) (In Indonesia, the demand is not particularly considered to fluctuate seasonally).

Since there is concluded to be no significant difference between the mean power demand on Sunday and week day in the same month according to Annex 3-2(1), (2), (3), the mean of these two days is assumed to be a representive pattern of the month. Then, the monthly changes in July, December and subsequent three months were analyzed.

As a result, the hypothesis that all data were extracted from the same population was rejected, and the power consumption was proved to fluctuate extensively in each month (Refer to Annex 3-4).

Here, it would be no problem that the power consumption increases toward the end of a fiscal year.

3.6.3 Separate handling of load curves on holiday and week day

As described in 3.6.1 above and as a result of analysis in Annex 3-2 (1), (2), (3), there was concluded to be no significant difference between the means of power demand on holidays and week days in Padang.

In an industrialized area, the power demand for industrial consumers generally increases and therefore there is generally a large difference between the power demand on holidays and week days due to operation of factories on week days.

At present, there is Padang Cement, a large industrial consumer. However, since this cement plant is in regular operation at all times regardless of holidays and week days, there is no difference in the power demand for this consumer between holidays and week days. Moreover, the fact that there are only a few industrial consumers would also be one of the major reasons that there is not so remarkable difference in power demand between week days and holidays.

As a result of the correlation analysis of hourly transition of demand between week days and holidays based upon the model load curve, however, there was concluded to be no correlation in the case of July 1984 as shown in Annex 3-2(1). Although there was a correlation between December 1984 and March 1985, it is considered desirable to separately handle the load curves on week days and holidays in order to estimate hourly axial fluctuation, namely, load curve on week days and holidays.

The model load curves were grouped into eight hour zones in order to make clear the pattern of load changes and obtain accurate results of analysis.

3.6.4 Linear regression of daily power consumption

As studied in 3.6.2, Annex 3-4, there is a big difference in the power consumption respectively between July, December 1984 and March 1985, and it seems likely that the consumption increases gradually toward the end of the fiscal year.

On the assumption that the energy consumption increases linearly, a regression line is applied in analysis. As calculated in Annex 3-5, the daily energy consumption is obtained as follows:

$$Y = 21.8x + 484.1 \text{ MWh}$$

where Y: Daily energy consumption, MWh

x: Monthly number where April is 1.

As a result of regression analysis of this regression line, the linear regression was proved to be perfectly correct.

Applying this regression line to the estimation of daily energy consumption, the daily mean energy consumption in April 1984 is assumed to be 506 MWh/day.

3.7 Selection of Model Load Curve

In analyzing the daily load curves in 3.6, the load curve was modelled into each eight hour zone per day. This is because it is desirable to obtain precise nature and information of energy demand characteristics to classify the load curve into some hourly groups. This procedure is considered appropriate for forecasting future load curves. Therefore, the pattern of daily power consumption according to the types of consumers, namely, general residential, public, commercial and industrial consumers constituting the load curve was forecasted based upon the eight hour zone load curves.

The patterns of the load according to various category-wise demand were determined with reference to those in other provinces and countries where electrification ratio is higher than Central Sumatra, for example, those in East Java as well as those in other ASEAN member nations. For determining the final pattern of loads, the applicability of the patterns was sufficiently checked on a trial and error basis, and the patterns were theoretically proved conducting the test of goodness of fit, to be applicable not only for the present but also future power system. (Refer to 3.9).

Various types of model load curves where the power demand during maximum demand time zone is 100 are prepared as shown in Table 3.7-1 and Fig. 3.7-1.

Needless to say, the total of these load curves during the respective time zones is called a tolalized load curve.

In addition, special load curves were prepared separately for the big industrial consumers, Padang Cement and PERTAMINA Dumai.

Table 3.7-1 Patterns of load curves according to the respective types of consumers

Unit: %

Time	Type / Time zone	Residential	Commercial	Public	Small Industries	Medium Industries	Padang Cement or PERTAMINA
1 - 3	1	50	50	70	50	50	90
4 - 6	2	60	50	70	50	50	90
7 - 9	3	40	80	60	80	90	80
10 - 12	4	30	100	60	100	100	80
13 - 15	5	30	90	50	95	95	80
16 - 18	6	40	100	80	100	100	80
19 - 21	7	100	80	100	65	65	100
22 - 24	8	80	50	70	50	50	90

Note: The load of Padang Cement or PERTAMINA is low during day time zone due to operation of their captive power plants.

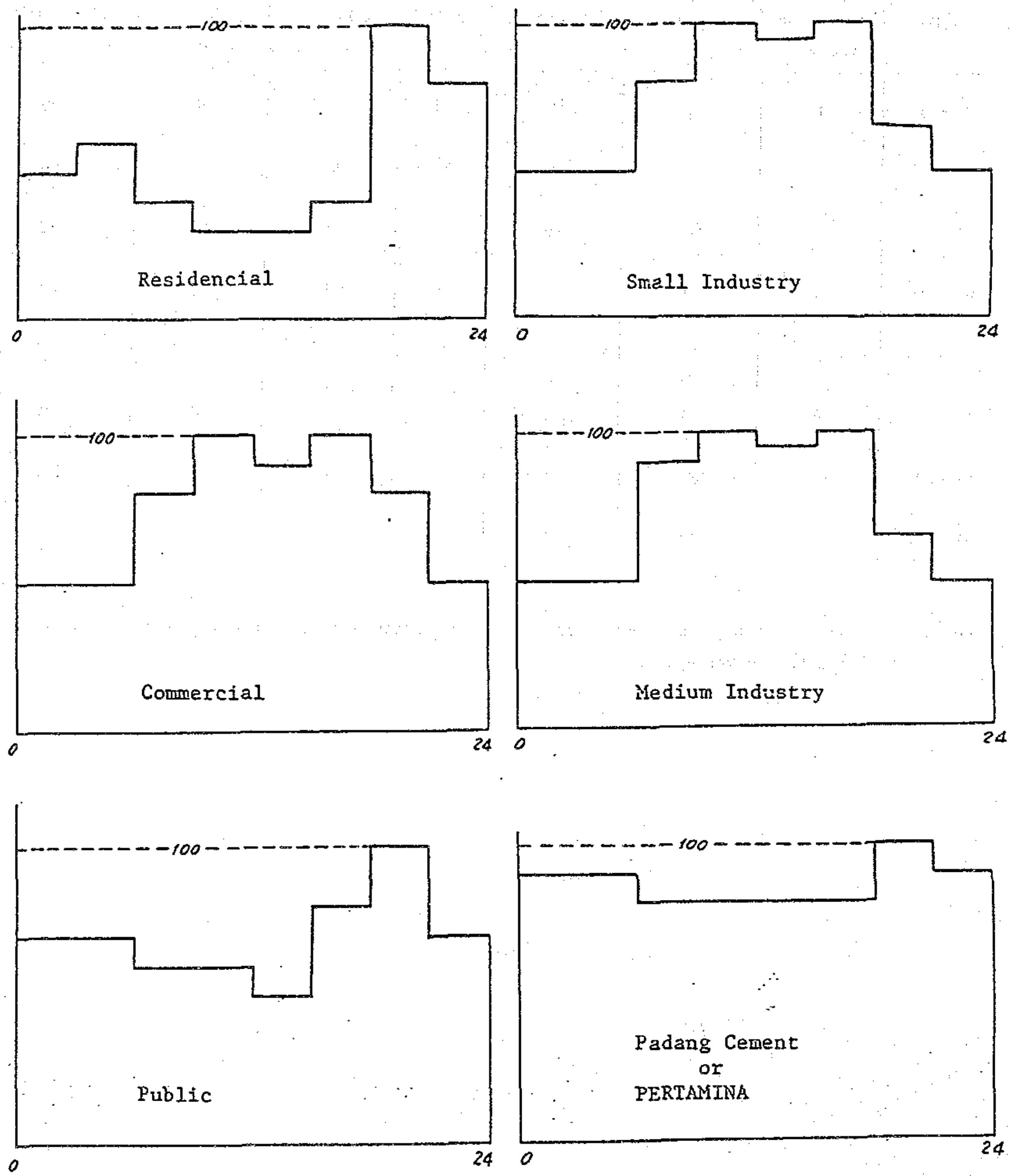


Fig. 3.7 - 1 Patterns of Load Curves According to the Types of Consumers

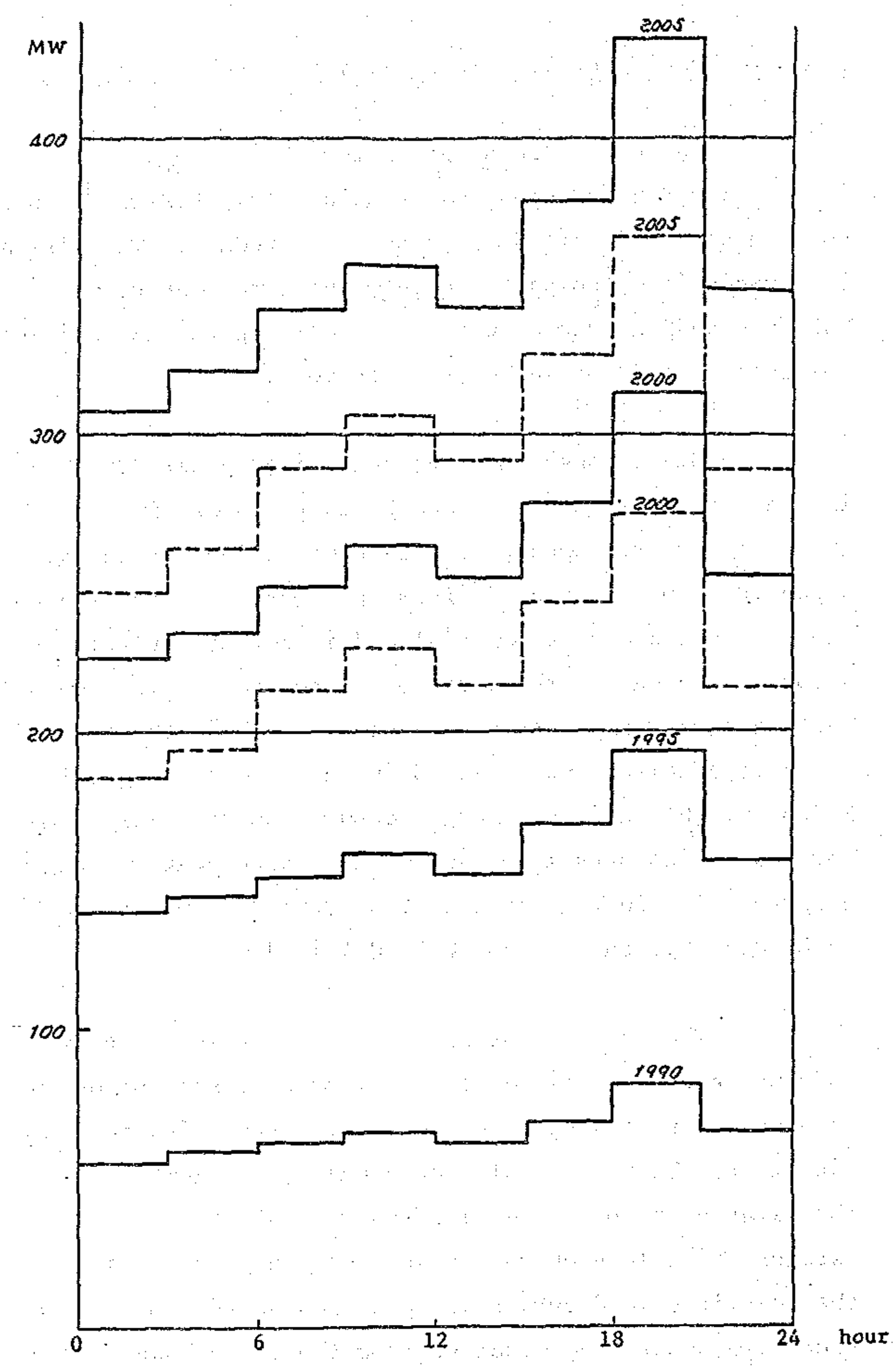
3.8 Preparation of Totalized Daily Load Curves

The energy consumption for the respective types of consumer is forecasted based upon yearly sold energy forecast, which is sometimes simply called power demand forecast. The forecasted value is devided into two parts, namely the resultant value of the sum of holidays and the sum of weekdays according to the ratio of number of holidays to that of weekdays in an year.

Since commercial and industrial power demand is small even in the big cities such as Padang and Pekanbaru in Central Sumatra, there is no difference of energy consumption between holidays and weekdays. However, the difference is expected to be clear along with the progress of the commercial and industrial sectors as mentioned before. Meanwhile, the ratio of energy consumption on holidays to that on weekdays is assumed to be 0.9: 1.0 in the case of commercial and public demand and 0.7: 1.0 in the case of industrial demand. Moreover, the ratio of energy consumption for small industry to that for medium industry is estimated to change yearly along with the progress of industrialization from 0.9: 0.1 in 1985 to 0.8: 0.2 in 1990, 0.7: 0.3 in 1995 and 0.6: 0.4 in 2000.

The energy consumption for the respective types of consumers obtained above is calculated in terms of transmission end energy consumption by taking into account the transmission and distribution line loss. Then, the calculated energy consumption is alloted into the eight hour zone model load curves selected in 3.7, and the category-wise load curves on week days and holidays are prepared. And the totalized load curves are prepared based upon the total values in each eight hour zone obtained from the above load curves (Refer to Annex 3-7(1), (2)).

The eight hour zone load curves of the total demand incorporated into the 150 kV system estimated as above are shown in Fig. 3.8-1. In this case, the basic demand is adopted.



Note; ------ Excld. PERTAMINA

Fig. 3.8-1 Forecasted load curves of 150 kV system

3.9 Test of Goodness of Fit of Estimated Load Curves

Prior to executing future load forecast, it is required to check whether the totalized load curves prepared based on Clause 3.8 are fit sufficiently for the present actual load curves.

The eight hour zone load curves were estimated as shown in Annex 3-8 (1), (2), (3) according to the examples of totalized load curves in Annex 3-7 (1), (2) based upon the records of consumer-type-wise yearly sold electrical energy in 'fiscal 1984/85' in Padang. As a matter of fact, the demand for Padang Cement, the present big industrial consumer is also included in this demand.

Since the yearly average transmission end energy demand constitutes a basis for load forecast, the actual load curves in the corresponding year are required to comply with the daily energy demand to ensure the goodness of fit of the estimated load curves. The results of comparing the load curves in July and December 1984 and March 1985 according to test indicated satisfactory goodness of fit without any question as shown in the latter half of Annex 3-8 (1), (2), (3).

Also, the results of test of goodness of both of fit of the two load curves in Pekanbaru with many years of time interval match sufficiently with the estimated values. (Refer to Annex 3-9 (1), (2), (3).

3.10 Forecast of Daily Maximum and Minimum Power Demand

3.10.1 Analysis for Estimating Maximum and Minimum Power Demand per Hour from Model Load Curves (Eight Hour Zone)

The noteworthy time zone in eight hour zone is the time zone when minimum or maximum demand appears. Therefore, the following five time zones, namely, 1-3, 4-6, 7-9, 19-21 and 22-24 are selected for study.

As described in checking the difference of means, it is possible to handle the power demand on holidays and week days within the same month as a same population. However, since it is impossible to handle the data extending to July, December and March as the same population in the case of Padang, the hourly dispersion of power demand in each time zone is calculated in terms of percentage as shown in Annex 3-10.

In this case, the mean of % $\bar{\sigma}$ is calculated as follows:

$$\% \bar{\sigma} = \frac{1}{5} (\bar{\sigma}_1 + \bar{\sigma}_2 + \bar{\sigma}_3 + \bar{\sigma}_7 + \bar{\sigma}_8)$$
$$= 7.08 = 7\%$$

Note: $\sigma_1, \sigma_2, \ldots,$ refer to standard deviations of power demand in the 1-3, 4-6,....., 22-24 time zones.

Therefore, the standard deviation of the dispersion of hourly maximum power demand and minimum power demand within the respective three time zones in the model load curves is clarified to be 7% of the average power demand.

3.10.2 Daily Maximum and Minimum Power Demand Forecast

In case the upper or lower limit of dispersion of forecast demand is considered, it would be sufficient if a range of 2 is adopted. Therefore, it is possible to obtain an hourly maximum or minimum value of demand by adding or deducting a portion of 14% of the above to or from the eight hour zone maximum or minimum demand on week days and holidays obtained from Annex 3.7-(1), (2) (Refer to Annex 3-11).

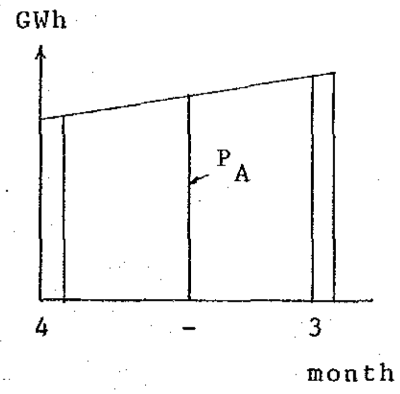
3.10.3 Yearly Maximum and Minimum Power Demand Forecast

The yearly (fiscal year in this case) maximum power demand necessary for the power development plan and the yearly minimum power demand are introduced from the calculation chart in Annex 3.7-(1), (2) considering the annual growth rate of energy demand.

The yearly minimum demand refers to a minimum value on holidays at the beginning (April) of the fiscal year, while the yearly maximum demand refers to the maximum value on week days at the end of the fiscal year (March of the next year). For calculation examples, refer to Annex 3-12.

3.10.4 Allocation of Monthly Sending End Energy Demand

When it is intended to specially calculate monthly energy demand, a monthly average energy demand is obtained from the yearly sending end sales energy by taking into account the yearly growth rate of energy demand as calculation examples are shown in Annex 3-13. Since energy demand does not fluctuate seasonally and grows regularly at a constant rate, it is possible to calculate the monthly energy demand.



P_A : Refer to Annex 3-13

SECTION 4

POWER SYSTEM PLAN

SECTION 4 POWER SYSTEM PLANNING

To meet the increase of future power demand in both West Sumatra and Riau Provinces, construction projects of large scale hydro-electric and thermal power plants are promoted by PLN at present. This study is intended to study a construction plan of an interconnected power transmission system being planned to ensure effective utilization of the power sources from these power plants, increase power supply and promote power supply reliability. In other words, the main power plants under planning stage by PLN include Ombilin Steam Power Plant (50 MW x 4) scheduled for commissioning in 1991, Singkarak Hydro-Power Plant (50 MW x 4) intended to utilize the head of Singkarak Lake toward the Indian Ocean, Kotapanjang Hydro-Power Plant (37 MW x 3) being planned upstream of Bangkinang along the Kampar Kanan River originating from the Barisan Mountain Ranges, Kuantan Hydro-Power Plant considered to be sited by developing Indiragiri River. When the power sources at these sites have been developed, it is expected possible to obtain 700 or 900 MW of power sources in Central Sumatra by early 2000. Although the existing hydropower stations are only the Maninjau Hydro-Power Station (17 MW x 4) and the Batan Agam Hydro-Power Station (3.5 MW x 3), there are abundant hydropower sources which can be utilized in the future.

For regional development and improvement of the living circumstances of the people in both West Sumatra and Riau Provinces, it is highly important to promote expansion of power supply networks chiefly in Padang, the capital of West Sumatra and Pekanbaru, the capital of Riau as well as in Bukittinggi, Payakumbuh, Dumai, Rengat and other main cities and surrounding areas while bearing these power source sites in mind.

This section is intended to work out a power transmission plan to the respective areas by 1995 and carry out various studies for the purpose of efficient integrated operation of the respective power plants and stable operation of the power system.

4.1 Reliability of Power System and System Configuration Policy

4.1.1 System Configuration Policy

(1) On the basis of demand forecast described in Section 3, an appropriate power system development plan has been prepared by taking into account the following policy:

a) A stable interconnected power system shall be established throughout entire Central Sumatra by interconnecting the power systems in both West Sumatra and Riau Provinces.

b) In consideration of the simplification of the number of voltage gradings, coordination with the existing power systems, scale of demand and other conditions, the standard voltage gradings shall, in principle, be 150/20 kV, and 70 kV will be applied locally as required in view of economy, etc.

c) Study is also carried out in case 275 kV system is partly introduced in the main power system.

d) The power system will be of such a configuration as to ensure coordination in view of power supply reliability taking into account the regional service requirements and effect of system troubles as explained below.

i) Countermeasures at the time of single contingency

① The main transmission line will be of a two-circuit configuration or a loop configuration and free from interruption of power supply at the time of one circuit shutdown or single contingency (or it will be possible to recover power supply in short time depending on regions).

② Main substations will, in principle, be of a double bus configuration, and application of a single bus system will be taken into account for local substations. In this case, the single bus system substations will be so designed as to enable modification into double bus system to meet the increase of power demand and improvement of reliability in future. Moreover, a system which would make it possible to separate buses will also be applied.

③ Even though main substations will tentatively be of one bank transformer configuration, such substations will be so designed as to eliminate interruption of power supply for short time due to changeover of load between banks even at the time of one bank fault by taking into account adoption of two or more banks in the future.

For small scale substations of one transformer bank, one spare bank shall be considered each in West Sumatra and Riau Provinces.

④ In consideration of regional service requirements and balance of equipment investment for local power system, the local transmission line will be of one circuit configuration, and effective utilization of existing diesel power plants will also be taken into account as a standby power source.

Along with the increase of power demand in future, expansion to two circuit transmission line or adoption of a loop system will be studied and incorporated into the design of transmission lines.

ii) Prevention of wide range power supply failure
To prevent wide range power supply failure, under frequency relaying system, load shedding system, separated operation of respective systems, etc. will be applied.

e) To ensure efficient maintenance, operation and inspection, the equipment and materials to be used will be standardized.

f) Restriction of short circuit capacity, easy separation of faulty section, easy system operation and other requirements will be incorporated in the system configuration.

4.1.2 Power Demand Based in Studying Power System Configuration

For determining the size of conductor of transmission lines, capacity of transformers, etc. constituting a power system, the power demand has been studied on the basis of the high estimation values among those assumed in Section 3. In view of the characteristics of power system, it is difficult to change the scale of equipment for a long period after construction particularly in the case of transmission line.

4.1.3 Power Source Development Plan

The Central Sumatra Power System Development Plan should be studied based on the presentation of official power source development plan of PLN in accordance with the SCOPE OF WORK (7th Feb. 1985) exchanged between PLN of Indonesia and JICA of Japan. However, since the development plan has not been fixed as in April 1986, the study team proceeded the preliminary study on the power system development plan.

As in April 1986, the following three large scale power plant construction sites have been proposed to be constructed in Central Sumatra roughly by 2000. Namely, these are Ombilin Steam Power Plant (50 MW x 2 respectively in the first and second term) using coal available around Sawahlunto, Singkarak Hydro-Power Plant (50 MW x 2 respectively in the first and second term) using the head of water from Singkarak Lake toward the Indian Ocean, and Kotapanjang Hydro-Power Plant (37 MW x 3) upstream of Bangkinang utilizing the water source from Kampar Kanan River.

Although the Ombilin Steam Power Plant is reportedly scheduled to be commissioned in 1991, the scheduled commissioning period of the other two hydro-power plants has not been determined.

Further in 1995, an additional supply capacity of 100 MW is required in this system. In view of power system development plan, whether to construct the Singkarak Hydro-Power Plant (first term) or Kotapanjang Hydro-Power Plant at first constitutes a problem.

According to the results of economic comparison in the preliminary study, it is considered advantageous to construct the Singkarak hydro-power plant in advance.

However, prior construction of either of two power plants is not always determined according to economic priority.

Under this power system study, therefore, a plan for constructing the Singkarak Hydro-Power Plant in advance and that for constructing the Kotapanjang Hydro-Power Plant in advance were studied at the same time. According to the results of this study, there was no technical difference between both of the plans in view of preferential order and period of power system extension.

4.2 Comparison of Various System Configuration Plans of Trunk Transmission Line

Various system configuration plans have been compared on the basis of 150 kV system configuration by taking into account the scale of power system in Central Sumatra and coordination with existing facilities. As a result, it has been evaluated to be appropriate to construct a 150 kV transmission line along the route from Ombilin - Payakumbuh through to Pekanbaru.
(Refer to Figs. 4.1-1, 4.1-2 and 4.1-3)

4.2.1 Comparison with Alternative 150 kV System Plan *

On the basis of this basic plan, a route around Kuantan was studied as an alternative 150 kV plan, this plan was concluded to be not advantageous because of long transmission line route and large initial investment.
(Refer to Fig. 4.2-1 and Table 4.2-1 and 4.2-2)

4.2.2 Comparison with 275 kV Power System Plan *

Among the long term plans of PLN, there is a plan to introduce a 275 kV transmission line from South Sumatra to Ombilin. Although a 275 kV transmission line configuration can also be considered under this project taking into account the long term plan of PLN, this plan is not economically advantageous because of high construction cost either along the Payakumbuh or Kuantan route.

(Refer to Fig. 4.2-2 and Table 4.2-3).

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*: Refer to Annex 4-1, "Effect of transmission loss against the economic comparative study of trunk transmission line."

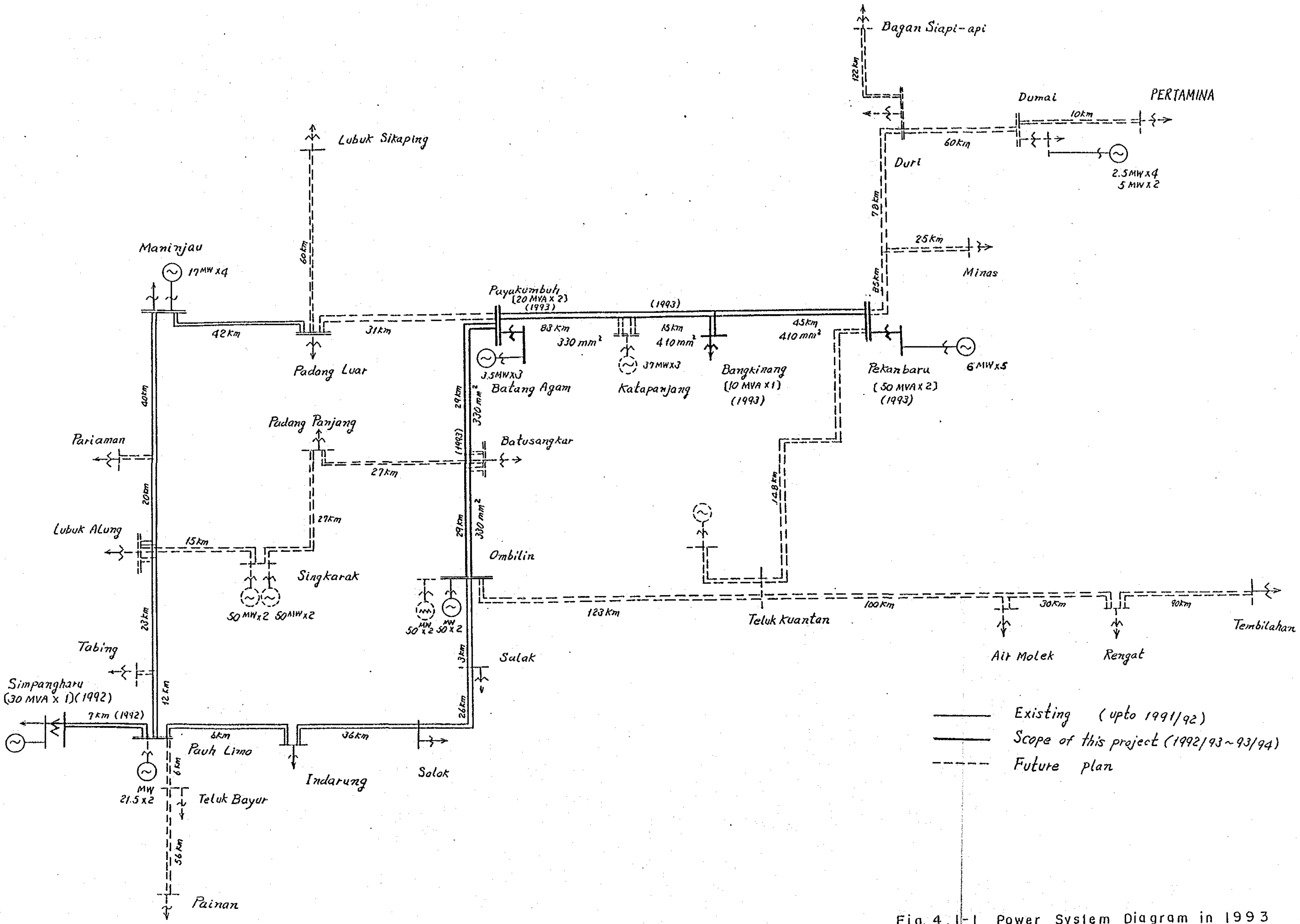


Fig. 4.1-1 Power System Diagram in 1993

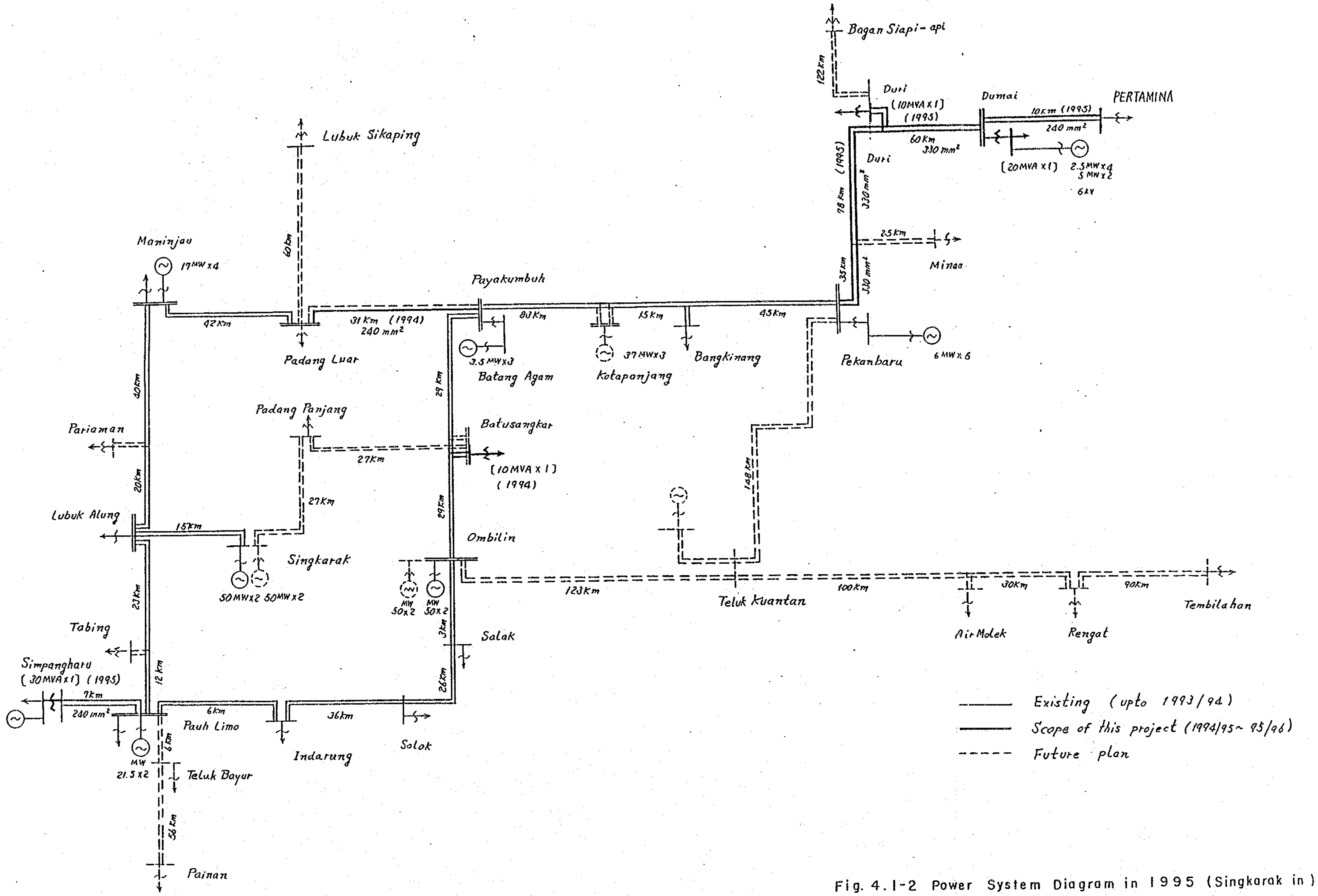


Fig. 4.1-2 Power System Diagram in 1995 (Singkarak in)

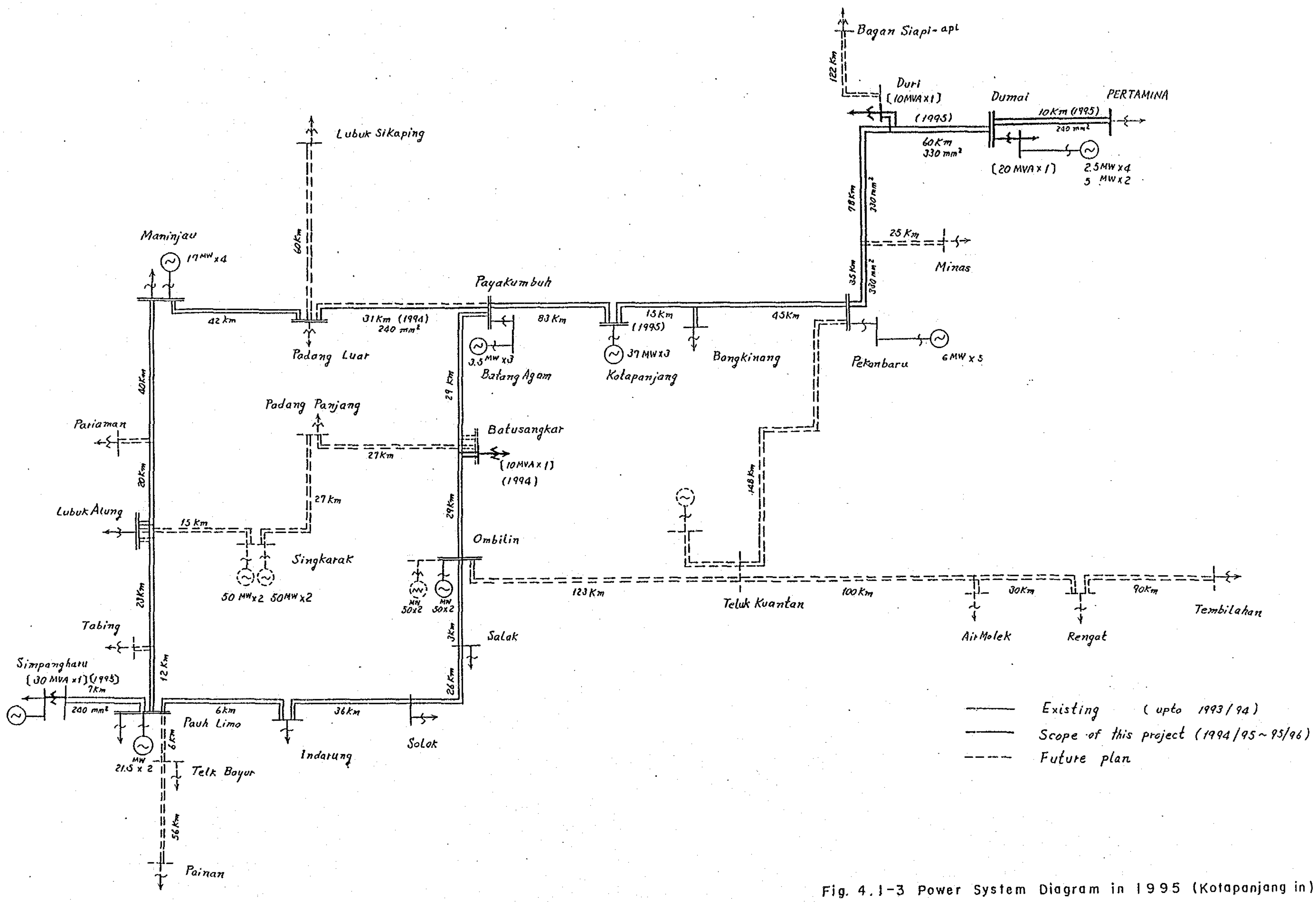


Fig. 4.1-3 Power System Diagram in 1995 (Kotapanjang in)

4.2.3 Study of Preferential Formation of Loop System in West Sumatra

(1) With respect to the transmission line up to Payakumbuh constituting a key system interconnection point with Riau Province, study was carried out as to which route, ⓐ a route from Maninjau power source or ⓑ a route from Ombilin power source should be constructed in advance.

ⓐ In case the Maninjau side is constructed in advance Construction of about 31 km line between Padang Luar and Payakumbuh is necessary.

ⓑ In case the Ombilin side is constructed in advance. Construction of about 58 km line between Ombilin and Payakumbuh is necessary.

(i) Study of power system in 1993

As the power flow is assumed in Fig. 4.2-3, the transmission loss of the system ⓑ is smaller than the system ⓐ. Moreover, the system ⓐ requires condensers with a capacity of about 6 MW to maintain the voltage. Thus, the system ⓑ is advantageous over the system ⓐ. (Refer to Table 4.2-4).

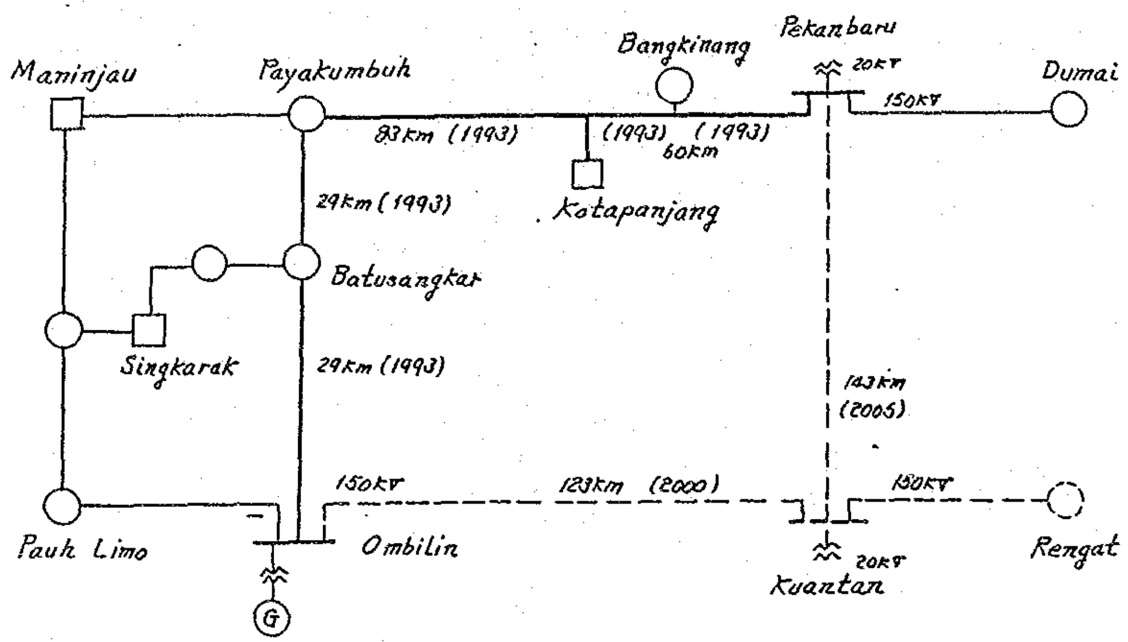
(ii) Study of power system in 1995

Judging from increase in transmission loss and the number of condensers required for voltage regulation as shown in Fig. 4.2-4, the loop system configuration is advantageous. Unless the system ⓑ is not provided, moreover, the transmission loss will become about 3 MW and the number of condensers equivalent to approx. 20 MVA will additionally be required when compared with the loop system.

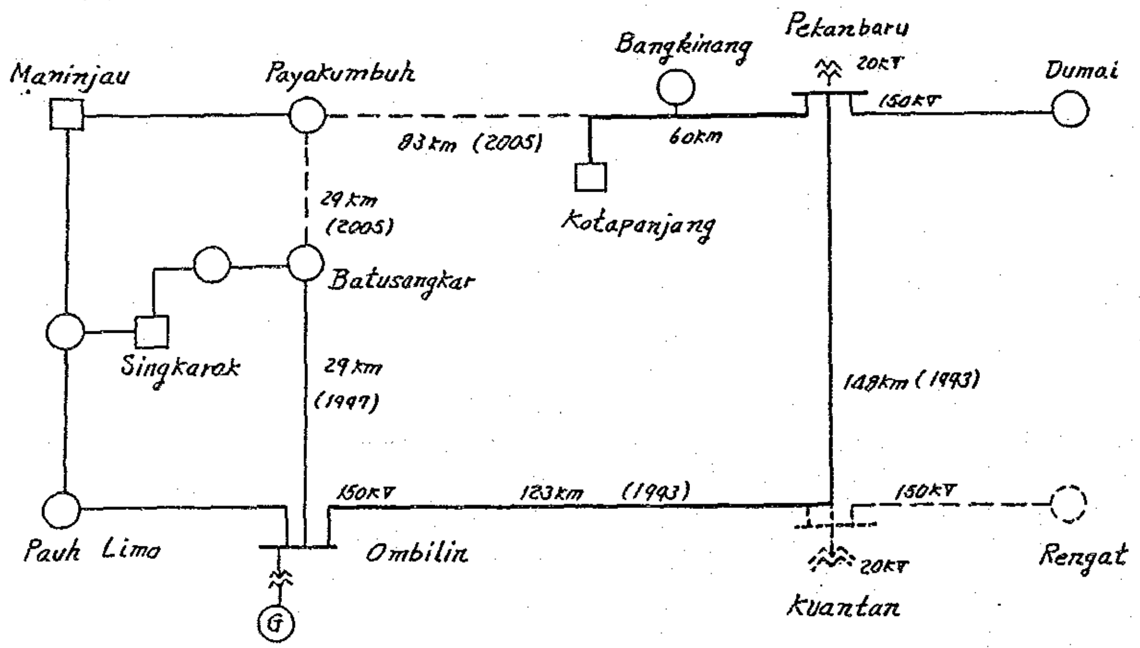
Meanwhile, when the loop system is adopted, the difference of transmission loss in case the system ⓐ is of one-circuit configuration and two-circuit configuration is very small (approx. 200 kW). However, adoption of one circuit configuration for the system ⓑ will cause a trouble in future since this system will be interconnected to the Ombilin, Singkarak and other large power sources.

(iii) Judging from the above studies, the system ⓑ of two circuit configuration will be constructed between Ombilin and Payakumbuh in 1993 and the system ⓐ of one circuit configuration (two circuit design) will be constructed before 1995.

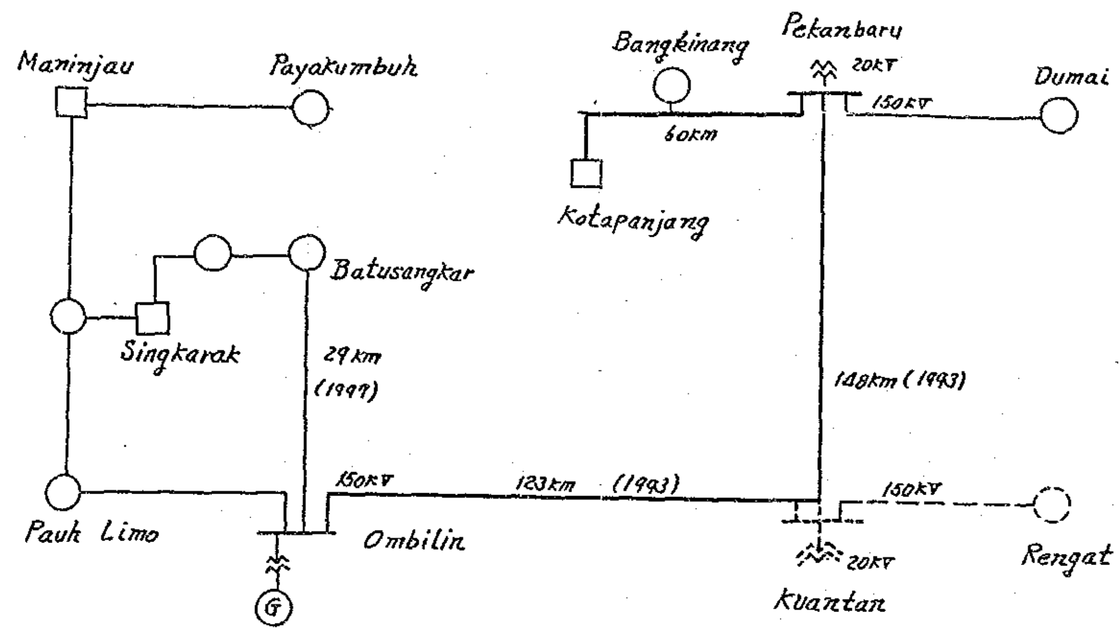
(A) : Basic Plan



(B) : Alternative 150 kV Plan



(C) : Alternative 150 kV Plan
In case of no investment in 2005



1) (A) and (B) Plans are the same system configuration after 2005.

2) (C) Plan is the system configuration omitting the transmission lines from Payakumbuh to Batusangkar and branch of Kotapanjang H.P.P. ,which the investment in 2005 is cut. Then, it is needless to say, that the system reliability is lower than Plan(B).

Fig. 4.2-1 Comparison with Alternative Plans for 150 kV System Design

Table 4.2-1 Comparison between the Basic 150 kV Plan and Alternative Plan

Unit: 10^6 Yen

Year	(A): Basic plan Construction plan	Construction cost	Present value	(B): Alternatived 150 kV plan Construction plan	Construction cost	Present value	(C): Alternative 150 kV Plan In case of no investment in 2005 Construction plan	Construction cost	Present value
1993	Ombilin - Payakumbuh - Pekanbaru 201 km CB x 8	3,768 660 4,428	4,428	Ombilin - Kuantan - Pekanbaru 271 km Padang Luar - Payakumbuh CB x 8	4,774 475 660 5,909	5,909	Ombilin - Kuantan - Pekanbaru 271 km Padang Luar - Payakumbuh CB x 8	4,774 475 660 5,909	5,909
1994	Padang Luar - Payakumbuh 31 km CB x 2	380 186 566	505						
1997	Batusangkar CB x 4	330	210	Batusangkar - Ombilin 29 km CB x 4	530 330 860	547	Batusangkar - Ombilin 29 km CB x 4	530 330 860	547
2000	Ombilin - Kuantan 123 km CB x 4 + Kotapanjang CB x 4	2,074 660 2,734	1,237	Kotapanjang - Pekanbaru 60 km CB x 4 + Kuantan CB x 4	1,147 660 1,807	817	Kotapanjang - Pekanbaru 60 km CB x 4 + Kuantan CB x 4	1,147 660 1,807	817
2005	Kuantan - Pekanbaru 148 km CB x 4	2,700 330 3,030	778	Batusangkar - Payakumbuh - Kotapanjang 112 km CB x 8	2,091 660 2,751	706			
	Total	11,088	7,158	Total	11,327	7,979	Total	8,576	7,273
	Total present value of annual expenditure		5,949	Total present value of annual expenditures		6,851	Total present value of annual expenditures		6,615
	10 years' (1993-2002) total of the above		4,388	10 years' (1993-2002) total of the above		5,230	10 years' (1993-2002) total of the above		5,230

Although the Plan (C) is economically expensible comparing to the Basic Plan (A), the system reliability is low.

Table 4.2-2 Break down of Figures in Table 4.2-1

(Unit: 10^6 Yen)

(A): Basic Plan

PLAN: **COST COMPARISON

YEAR	C.COST	YEREXP	PYEXP	PCOST
1993	4428.0	549.9	549.9	4428.0
94	566.0	620.2	553.7	505.3
95	0.0	620.2	494.4	0.0
96	0.0	620.2	441.4	0.0
97	330.0	661.2	420.2	209.7
98	0.0	661.2	375.2	0.0
99	0.0	661.2	335.0	0.0
2000	2734.0	1000.8	452.7	1236.7
1	0.0	1000.8	404.2	0.0
2	0.0	1000.8	360.8	0.0
3	0.0	1000.8	322.2	0.0
4	0.0	1000.8	287.7	0.0
5	3030.0	1377.1	353.4	777.7
6	0.0	1377.1	315.6	0.0
7	0.0	1377.1	281.7	0.0
TTL	11088.0	13529.9	5948.8	7157.5
T10	8058.0	7396.9	4388.0	6379.8

(B): Alternative 150 kV Plan

PLAN: **COST COMPARISON

YEAR	C.COST	YEREXP	PYEXP	PCOST
1993	5909.0	733.8	733.8	5909.0
94	0.0	733.8	655.2	0.0
95	0.0	733.8	585.0	0.0
96	0.0	733.8	522.3	0.0
97	860.0	840.7	534.2	546.5
98	0.0	840.7	477.0	0.0
99	0.0	840.7	425.9	0.0
2000	1807.0	1065.1	481.8	817.3
1	0.0	1065.1	430.1	0.0
2	0.0	1065.1	384.0	0.0
3	0.0	1065.1	342.9	0.0
4	0.0	1065.1	306.2	0.0
5	2751.0	1406.8	361.0	706.1
6	0.0	1406.8	322.4	0.0
7	0.0	1406.8	287.8	0.0
TTL	11327.0	15003.9	6850.5	7979.1
T10	8576.0	8653.1	5230.0	7272.9

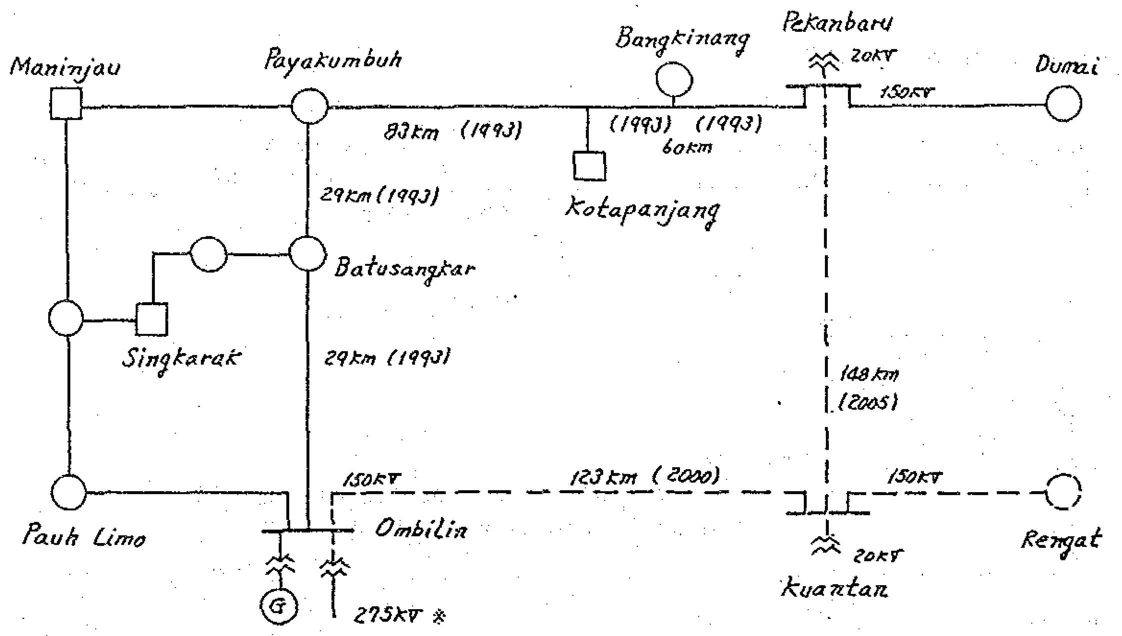
(C): Alternative 150 kV Plan
In case of no investment in 2005

PLAN: **COST COMPARISON

YEAR	C.COST	YEREXP	PYEXP	PCOST
1993	5909.0	733.8	733.8	5909.0
94	0.0	733.8	655.2	0.0
95	0.0	733.8	585.0	0.0
96	0.0	733.8	522.3	0.0
97	860.0	840.7	534.2	546.5
98	0.0	840.7	477.0	0.0
99	0.0	840.7	425.9	0.0
2000	1807.0	1065.1	481.8	817.3
1	0.0	1065.1	430.1	0.0
2	0.0	1065.1	384.0	0.0
3	0.0	1065.1	342.9	0.0
4	0.0	1065.1	306.2	0.0
5	0.0	1065.1	273.3	0.0
6	0.0	1065.1	244.1	0.0
7	0.0	1065.1	217.9	0.0
TTL	8576.0	13978.8	6614.6	7272.9
T10	8576.0	8653.1	5230.0	7272.9

Note:
C.COST: Construction Cost
YEREXP: Yearly Expenditure
PVYEXP: Present Value of Yearly Expenditure
PVCOST: Present Value of Construction Cost (1993)
TTL : Total
T10 : 10 Years (from 1993 to 2002) Total Cost Expenditure

Plan : A Basic 150 kV Plan



※ The above comparison is made on the assumption that 275 kV system will be introduced to Ombilin in 2005.

Plan : B 275 kV Plan

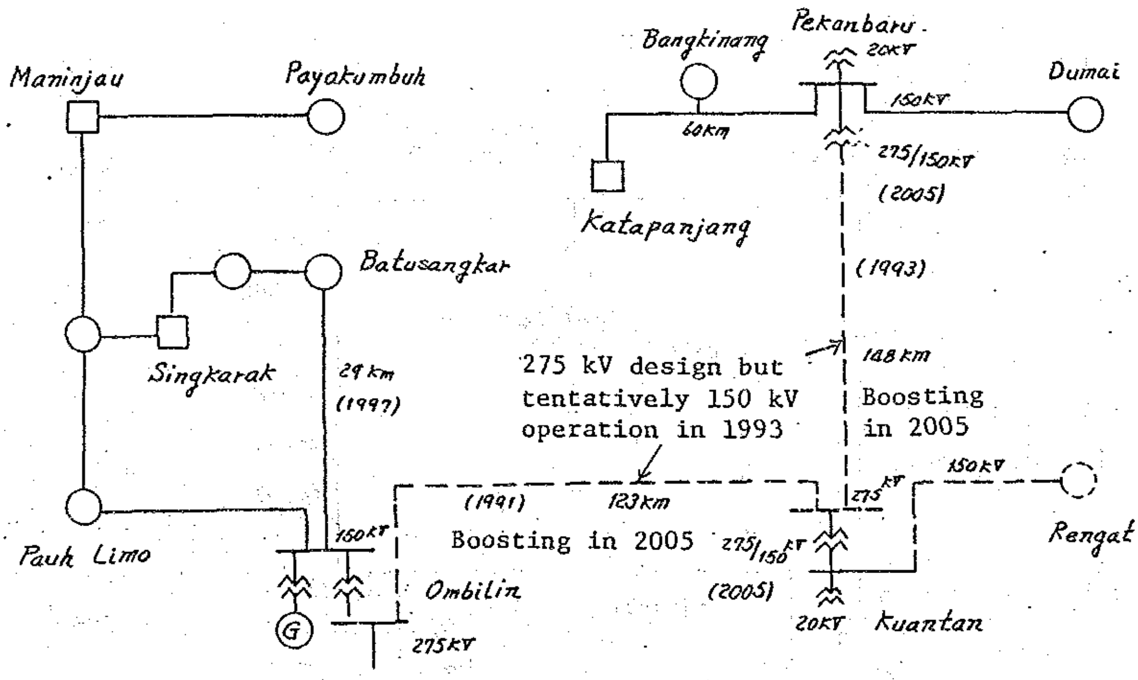
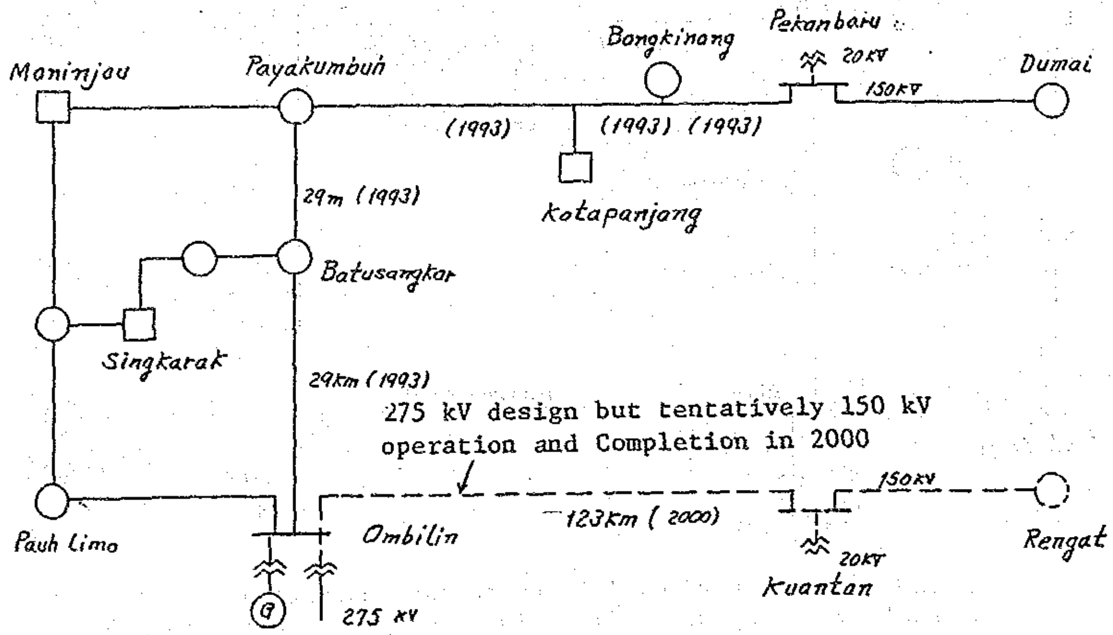


Fig. 4.2-2 (1) Comparison with between 150 kV System Plan and 275 kV System Introduction Plan (1)

Plan : C 150 kV Plan and later introduction of 275 kV

(1) Power System in 2000



(2) Power System in 2005

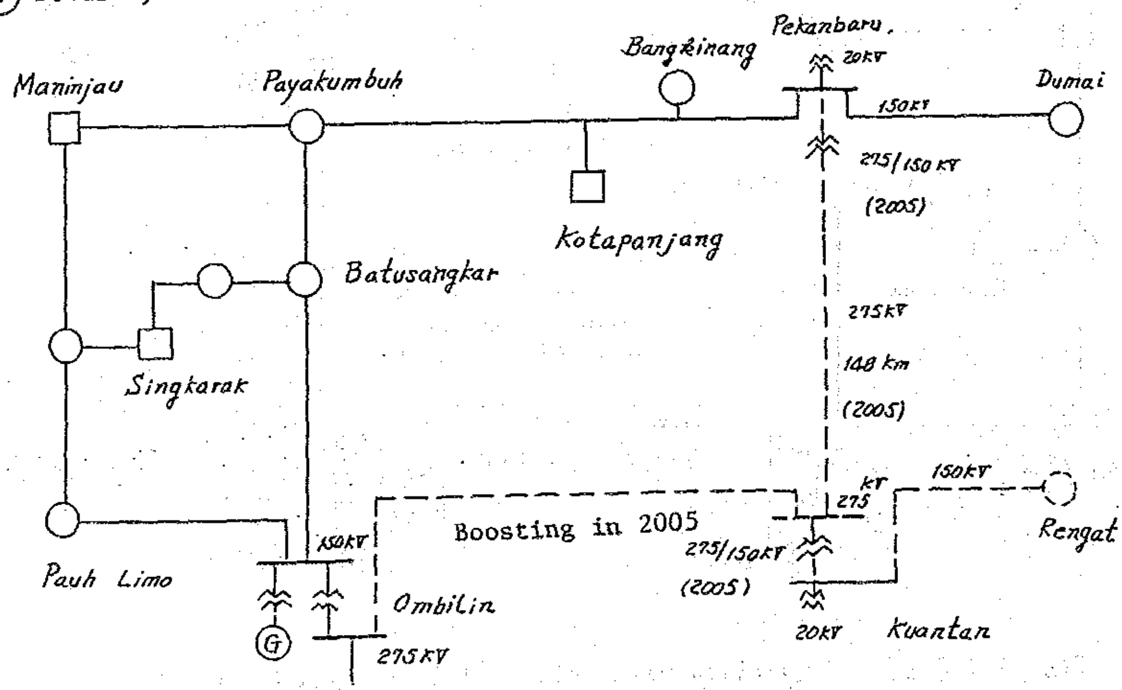


Fig. 4.2-2 (2) Comparison with between 150 kV System Plan and 275 kV System Introduction Plan (2)

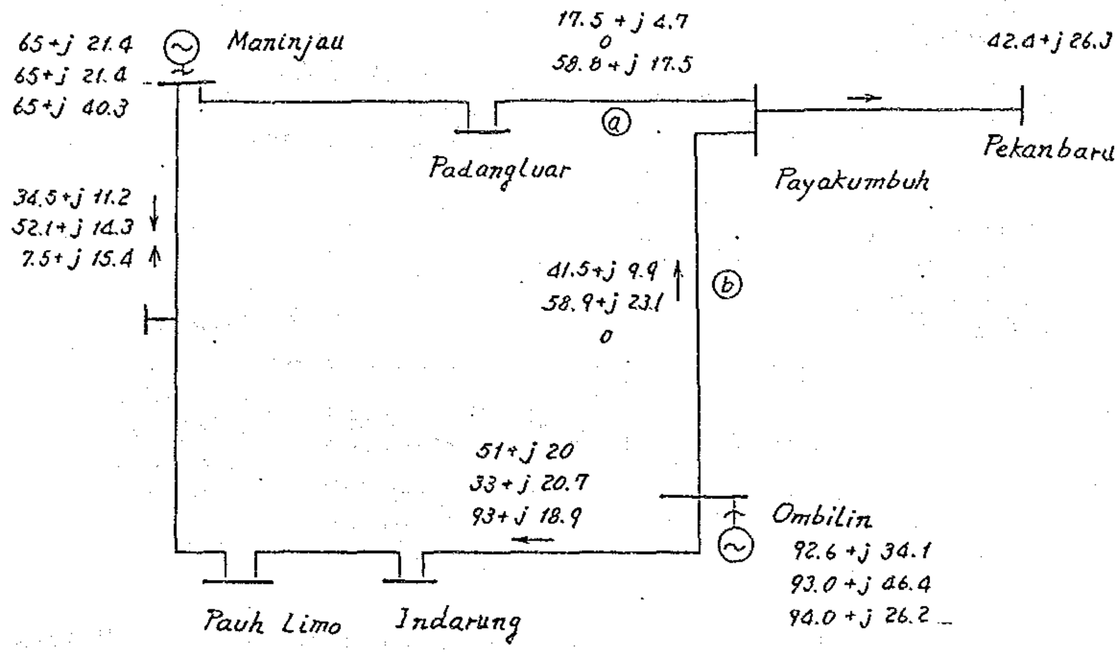
Table 4.2-3 Comparison between the Basic 150 kV Plan and 275 kV Introduction Plan

Unit: 10^6 Yen

Year	A: Basic 150 kV plan			B: 275 kV plan			C: 150 kV plan and later introduction of 275 kV		
	Construction plan	Construction cost	Present value	Construction plan	Construction cost	Present value	Construction plan	Construction cost	Present value
1993	Ombilin - Payakumbuh - Pekanbaru 201 km (150 kV)	3,768	3,768	Ombilin - Kuantan - Pekanbaru 271 km (275 kV design)	9,494	9,494	Ombilin - Payakumbuh - Pekanbaru 201 km (150 kV) Same as Plan A.	3,768	3,768
1997				Ombilin - Batusangkar 29 km (150 kV)	530	337			
2000	Ombilin - Kuantan 123 km (150 kV)	2,074	938	Kotapanjang - Pekanbaru 60 km (150 kV)	1,147	519	Ombilin - Kuantan 123 km (275 kV design)	4,251	1,923
2005	Kuantan - Pekanbaru 148 km (150 kV)	2,700	693	Kuantan 275/150 200 MVA x 2	2,500	642	Kuantan - Pekanbaru 148 km (275 KV)	5,243	1,346
				Pekanbaru " "	2,500	642			
	Ombilin 275/150 200 MVA x 2	2,500	642	*275 kV power source is assumed to be interconnected to Ombilin.			Kuantan - 275/150 200 MVA x 2	2,500	642
	*On the assumption that 275 kV power source will be connected to Ombilin, this additional portion is alloted			Ombilin - Kuantan - Pekanbaru Boosting to 275 kV			Pekanbaru " "	2,500	642
							Ombilin - Kuantan Boosting to 275 kV		
	Total	11,042	6,041	Total	16,171	11,634	Total	18,262	8,321

The system configuration of Plan (C) is same as the system of Plan (A) before 2000 and planned assumed if the necessity of introduction of 275 kV transmission line to Pekanbaru is occured according to the change of circumstances.

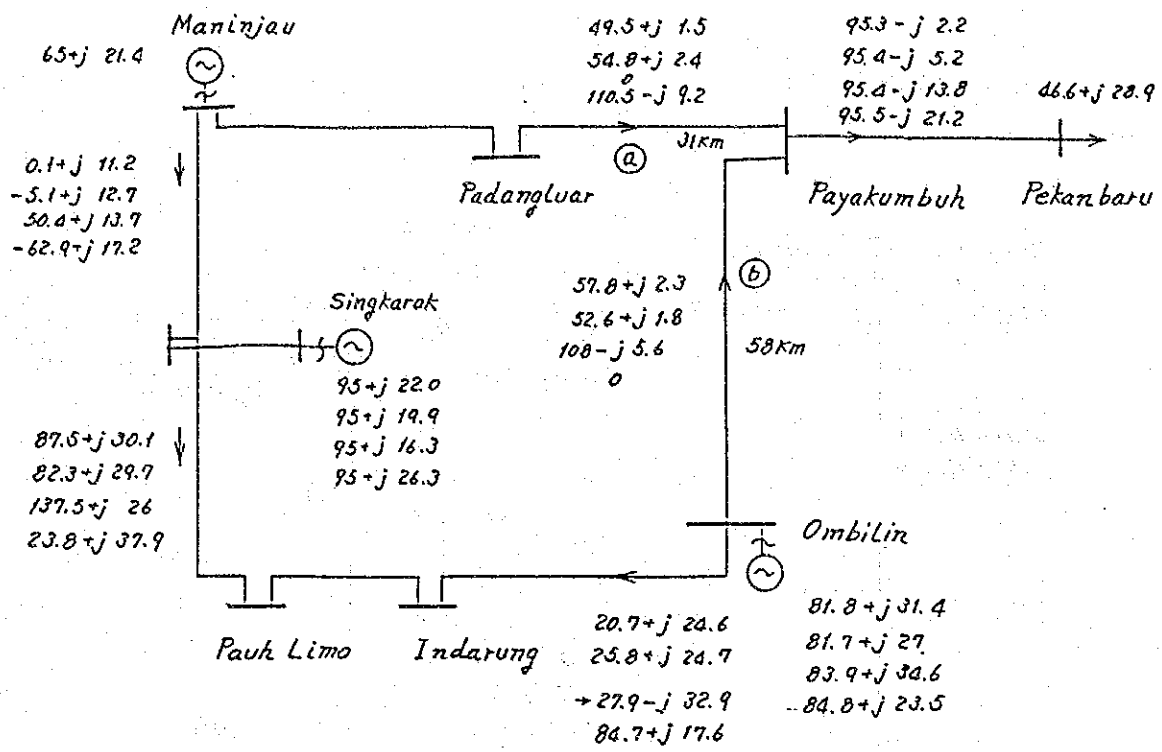
Power Flow at Peak



Case	Pekanbaru SC	T/L Loss
(1) Loop	0	1.87 MW
(2) Line ⓐ off	0	2.27
(3) Line ⓑ off	6	3.35

Results of study: In case there is no line ⓑ, the transmission loss will increase, and condensers will also be needed to maintain the voltage.

Fig. 4.2-3 Study of System Configuration up to Payakumbuh in 1993



Case	Required Condenser	T/L Loss
(1) Loop line (a) 1cct	31 MVA	5.80
(2) Loop line (a) 2cct	31	5.70
(3) Line (a) off	43	7.94
(4) Line (b) off	53	8.78

Results of study: In case there is no line (b), the transmission loss with increase by about 3 MW, and it will be necessary to install condensers of about 20 MVA capacity.

Fig. 4.2-4 Study of System Configuration up to Payakumbuh in 1995

Table 4.2-4 Preferential Order of Loop System Formation in West Sumatra

Unit : 10^6 Yen

	Maninjau side prior execution plan			Ombilin side prior execution plan		
	Outline of construction work	Construction cost	Present value	Outline of construction work	Construction cost	Present value
1993	Construction of 31 km line between Padang Luar and Payakumbuh, 2 circuits	475 330 805	805	Construction of 58 km line between Ombilin and Payakumbuh, circuits	1,059 330 1,389	1,389
	Outgoing from both ends			Outgoing from both ends		
1995	Construction of 58 km between Ombilin and Payakumbuh	1,059 330 1,389	1,107	Construction of 31 km line between Padangluar and Payakumbuh, 1 circuit	380 186 566	451
	Outgoing from both ends			Outgoing from both ends		
	Total	2,194	1,912		1,956	1,840

In addition to the values compared above, the transmission loss will increase by about 1 MW, and a number of condensers equivalent to about 6 MVA will additionally be required for voltage regulation.

4.2.4 Study of Other Systems

The systems between:

Ombilin - Rengat - Tembilahan;
Duri - Bagan Siapi-api;
Pauh Limo - Painan; and
Padaug Luar - Lubuk Sikaping

were studied respectively. As a result, it is evaluated to be appropriate to construct these systems in 1996 or after, and therefore these systems are excluded from the scope of the work under this project.

Meanwhile, it is judged to be appropriate that the transmission line to Bagan Siapi-api should be branched from Duri Substation as a starting point judging from the results of routing investigation.

Although 70 kV transmission system to Bagan Siapi-api was also studied and has a little economical advantage over 150 kV system, adoption of this voltage class was not taken into account since the equipment would become complex and insufficient to meet the changes of situations in the future and considering that 150 kV system configuration will be promoted entirely in Central Sumatra.

4.2.5 Substation Expansion Plan

The substation expansion plan was worked out as the results are described in Section 6, and countermeasures will be taken at the respective substations as listed in Table 4.2-5.

Table 4.2-5 List of Substation Construction and Expansion Plans

Sites	Maximum power, MVA (PF: 0.85)				Countermeasures to be taken by 1995
	1993	1995	2000	2005	
Padang	54.0	61.8	83.0	106.4	Grading up to 150 kV and Expansion at Simpangharu 30 MVA x 1 (1992) 30 MVA x 1 (1995)
Bukittinggi*	10.7	11.9	14.7	17.5	Transmission from Padang Luar
Rayakumbuh	18.2	21.0	31.1	43.2	Installation of 20 MVA x 2 (1993)
Batusangkar	3.1	3.6	5.1	6.8	Installation of 10 MVA x 1 (1994)
Padang Panjang	3.5	4.2	6.0	7.9	20 kV transmission from Padang Luar
Pariaman (Lubuk Alung)	7.2	8.4	15.8	22.8	20 kV transmission from Lubuk Alung
Solok*	6.3	8.0	13.0	19.2	
Sawalunto	1.7	4.3	8.0	11.5	
Painan			5.4	8.3	
Lubuk Sikaping			7.2	11.1	
Pekanbaru	49.9	54.9	69.7	87.1	Installation of 50 MVA x 2 (1993)**
Bangkinang	4.4	5.8	10.1	16.4	Installation of 10 MVA x 1 (1993)
Dumai	7.4	9.5	19.3	26.0	Installation of 20 MVA x 1 (1995)
Duri		2.5	4.4	6.5	Installation of 10 MVA x 1 + (1) (1995)
Minas			16.9	24.3	
Bagan Siapi-api			6.2	9.6	
Rengat			10.4	19.0	
Tembilahan			9.7	17.1	
Teluk Kuantan			3.7	7.1	

* The expansion plan in Padang Luar and Solok Substations is excluded from this project since this plan will be taken under other project.

** Attention to Table 6.3-4

4.3 System Analysis

4.3.1 Study of Power Flow and System Voltage

In parallel with study of system configuration, the power flow was studied to confirm whether it is possible or not to properly maintain the voltage and current in the respective power plants, substations and transmission lines.

To maintain the voltage within 105% - 95% regularly at generator end and 150 kV substation bus, installation of condenser were studied.

As a result of system analysis and taking into account the scale of substations, it was determined to install 30 MVA condensers (5 MVA x 3 x 2 groups) in Pekanbaru Substation and 6 MVA condensers (3 MVA x 2) in Dumai Substation.

(1) Characteristics of power flow and voltage

(a) Power flow and voltage in 1993

(i) The major power plants, namely, 68 MW Maninjau Power Plant and 100 MW Ombilin Power Plant will be interconnected, and the Pekanbaru Substation will constitute a terminal of 150 kV system.

The 150 kV loop system in West Sumatra will not be completed by 1993. Under these conditions, stable system voltage can be maintained without any condensers (SC) and reactors (SR) (Refer to Fig. 4.3-1).

(ii) At the time of one circuit shutdown

Should the one circuit between Payakumbuh and Pekanbaru which would exert the most serious effect, the voltage at Pekanbaru will drop to an 80% level. To regulate this voltage drop within 90%, the capacity of the SC required at Pekanbaru becomes 12 MVA (Refer to Fig. 4.3-6).

(b) Power flow and voltage in 1995

(i) Under the conditions where the Singkarak power source (50 MW x 2) or Kotapanjang power source (37 MW x 3) is interconnected to the power system, the 150 kV power system will be extended to Dumai and electric power be supplied to PERTAMINA from Dumai.

By this year, the loop system in West Sumatra will have already been formed.

In case the Singkarak Hydro-Power Plant is to be interconnected, SC with a capacity of about 31 MVA will be required for voltage regulation because of remote distance transmission (Refer to Fig. 4.3-2).

In case the Kotapanjang Hydro-Power Plant is to be interconnected, voltage regulation will be possible without any SC (Refer to Fig. 4.3-3).

The transmission loss will also be smaller in case the Kotapanjang Plant is interconnected.

Inter-connected Hydro Power Plant	Peak load of the system in 1995 (MW)	Required capacity of SC (MVA)	Transmission loss (MW)
Singkarak H.P.P.	242	31	5.8
Kotapanjang H.P.P.	242	0	3.2

(ii) Effect at the time of one circuit shutdown of transmission line

In case one circuit between Pekanbaru and Dumai is shut down, the voltage at Dumai will drop to 85%. To regulate this voltage drop within 95% SC of about 13 MVA are required to be installed at Dumai (Refer to Fig. 4.3-7).

(c) Power flow and voltage in 2000 through 2005

Because of the necessity to perform study from a long term perspective for working out a system plan by 1995, the future outlook of the system conditions five and ten years ahead was studied at the same time.

(i) System in the year 2000

As new power sources, the Singkarak HPP (50 MW x 2) and the Kotapanjang HPP (37 MW x 3) will be interconnected to the power system.

The 150 kV transmission line from Ombilin through Rengat to Tembilahan is assumed to have been completed by 2000.

Moreover, electric power is assumed to be transmitted to Painan, Bagan Siapi-api and other distant small cities.

As a result, SC of about 48 MW will be required normally at Pekanbaru and Dumai, and reactors (SR) of about 9 MVA will also be required at Rengat and Tembilahan to regulate the rise of voltage due to long distance transmission line (Refer to Fig. 4.3-4).

(ii) System in the year 2005

The power system in 2005 was studied on the assumption that the Ombilin Power Plant will be extended by 50 MW x 2 units. In this period, the power demand and supply conditions are expected to become tight and it will be necessary to develop a new power source before or after 2005.

As a result of study on the assumption that the scale of the power system is the same as that in the year 2000, it will become substantially difficult to regulate the voltage around Dumai due to increase of demand.

In view of power demand amounting to about 210 MW + j130 MVA in Pekanbaru and northern area, the number of SC equivalent to about 110 MVA capacity will become necessary. Therefore, it is necessary to further study on the efficient spreading and arrangement of SC (Refer to Fig. 4.3-5).

Judging from the conditions of power sources and power system, it is expected to be necessary to take another countermeasure for extending the power system.

(3) Conditions assumed for study

(a) Power Demand

Because of the necessity to study under severe system operation conditions, the peak load at the end of fiscal years and yearly average minimum load in midnight on holidays were adopted on the basis of the high estimation values among the values of power demand forecast in Section 3.

Considering that the power factor of load ranges roughly from 80% to 90% according to various past records, the power factor of load was estimated at 85% in anticipation that the factor will be improved at the respective positions (Refer to Table 4.3-1 and 4.3-2).

(b) In anticipation that the generated output of the major power plants is about 95% of the maximum capacity, the number or capacity of condensers was calculated as required for regulating the generator end voltage to 105% in maximum and 100% in minimum and for keeping the 150 kV bus voltage on the load side within a range of 105% to 95% of the rating.

In view of the necessity to study under severe system conditions, moreover, diesel power plants adjacent to system terminals were assumed to be shut down (Refer to Table 4.3-3 and 4.3-4).

4.3.2 Study of Short Circuit Capacity and System Stability

(1) Short circuit capacity

As a result of calculating the three-phase short circuit capacity at the respective positions of the assumed power system in the year 2005, the maximum value reached about 2,000 MVA at the bus of Ombilin Power Plant followed by about 1,780 MVA at Singkarak and 1,100 MVA at Pekanbaru (Refer to Fig. 4.3-8).

Since even a small scale 150 kV gas insulated circuit breaker has a capacity of 20 kA (5,200 MVA), such a circuit breaker has a surplus capacity.

(2) System stability

As a result of study, the system stability was confirmed to be sufficient.

For study under the severest conditions, the system stability at the time of three-phase short circuit at the near end of Pekanbaru Substation was calculated on the assumption that 27 MVA gas turbine power generators are synchronized with the system terminal at Dumai where the differential phase angle becomes large at peak hour and the load is also increased by as much as the portion of generated output. As the results are shown in Fig. 4.3-9, the system stability was confirmed to be sufficient since the respective power generators subjected to disturbance were restored to normal conditions immediately thereafter.

The system stability was calculated based on the duration of a fault is 0.3 sec.

In the preliminary study stage, the power generators at terminals were stepped out in case a fault continued for 0.5 sec. (Refer to Fig. 4.3-10 and 4.3-11).

As the fault interruption time is expected to be as short as approximately 0.1 sec. including the relay operation time, stable system operation will be possible.

4.3.3 Study of the Voltage Build-up at the time of No Load (Refer to Table 4.3-5)

To clarify the extent of voltage build-up at the time of no load in a long distance transmission line, study was carried out with respect to about 340 km transmission line between Ombilin and Tembilahan which is a typical long distance and light load transmission line.

Where the bus voltage of 150 kV system at Ombilin is assumed to be 150 kV, the terminal voltage was built-up to 160.6 kV (build-up ratio: 6.57%), and the charging current to 177.5 A/2 circuits.

Note: As a result of power flow calculation at the time of light load conducted on other occasion, it was confirmed necessary to install the number of shunt reactors equivalent to 9 MVA to maintain the terminal voltage within 105%.

CENTRAL SUMATRA POWER SYSTEM 1993 P+jQ [% at 100 MVA Base] V∠θ [%∠deg]

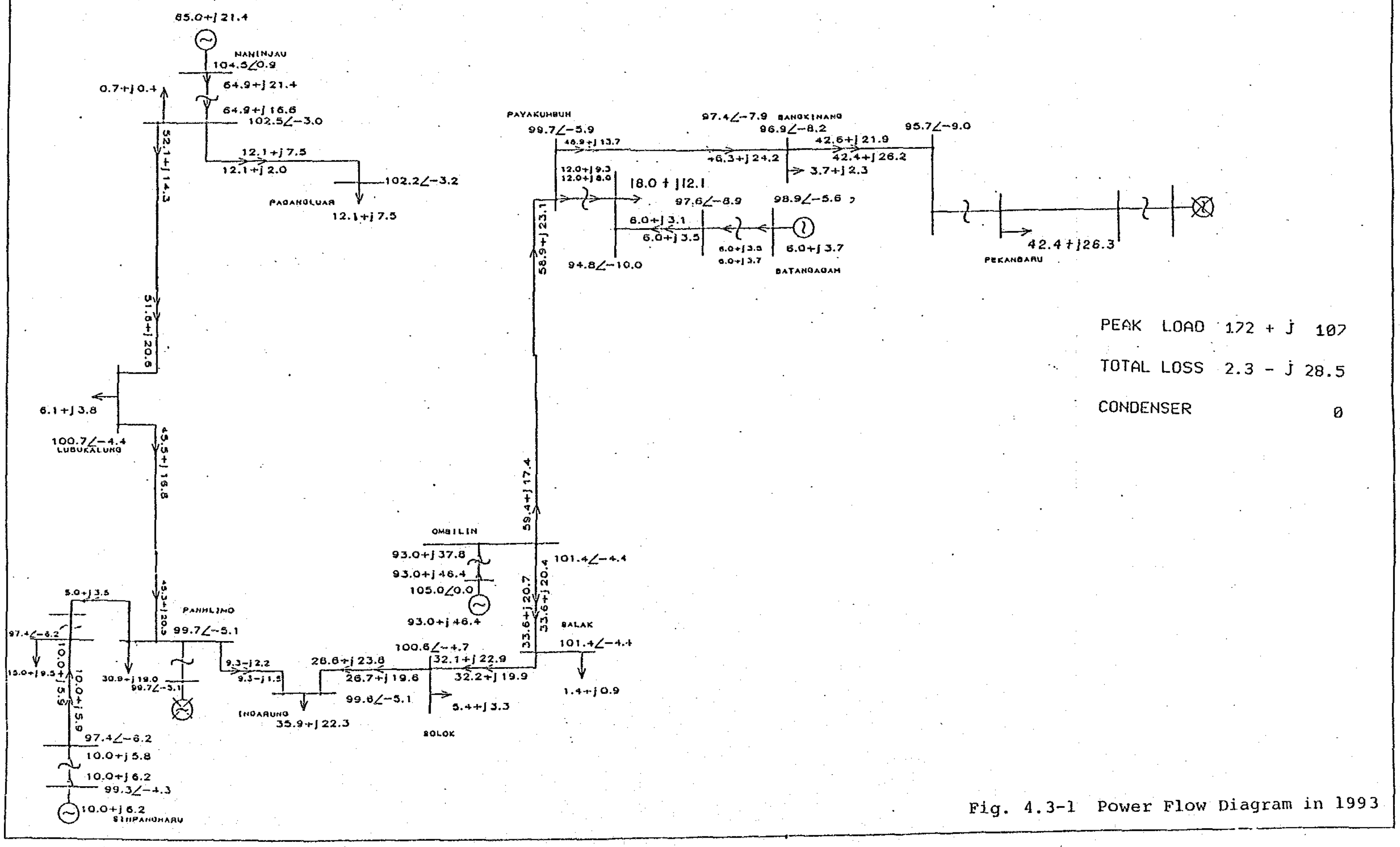


Fig. 4.3-1 Power Flow Diagram in 1993

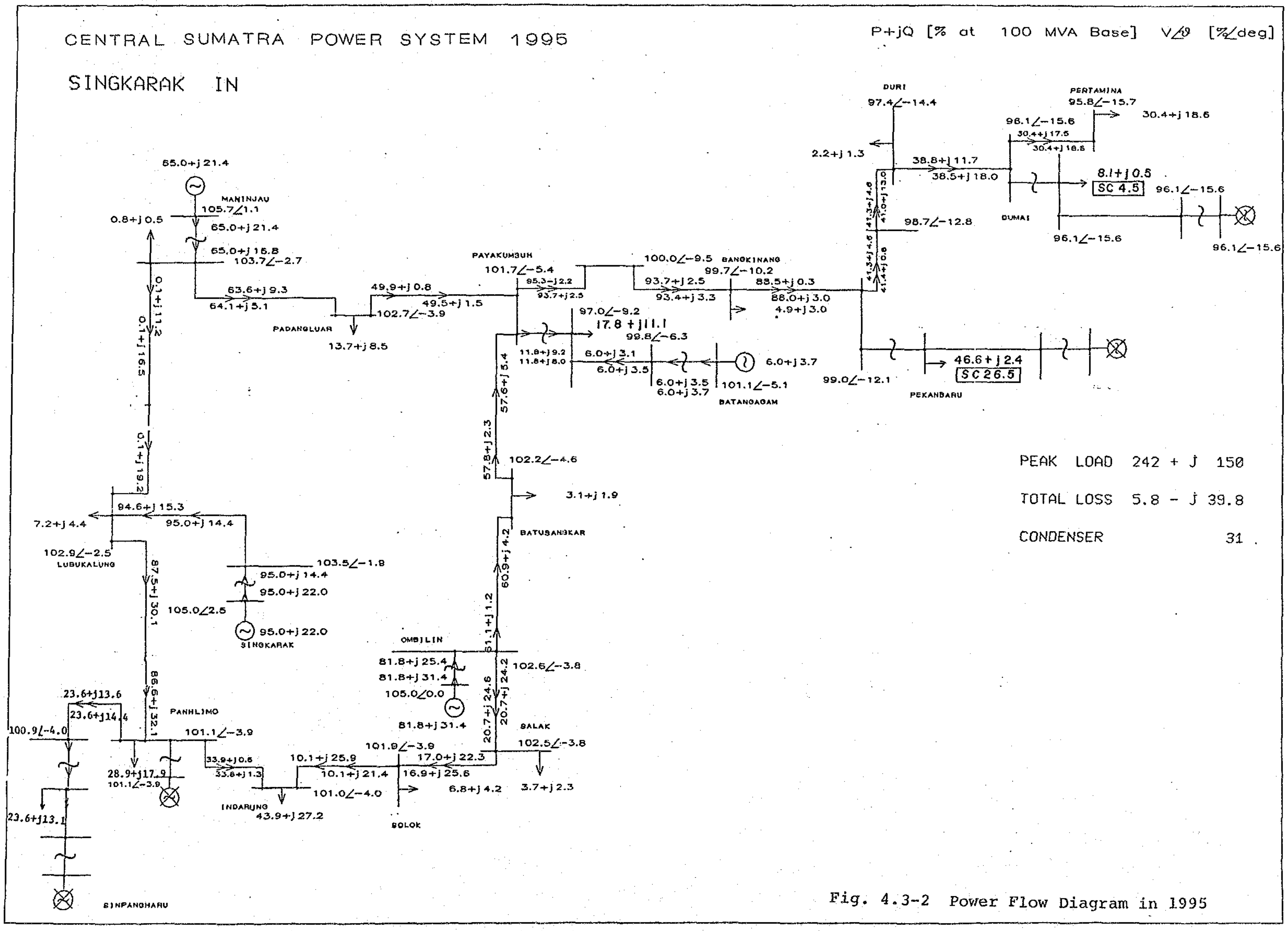


Fig. 4.3-2 Power Flow Diagram in 1995

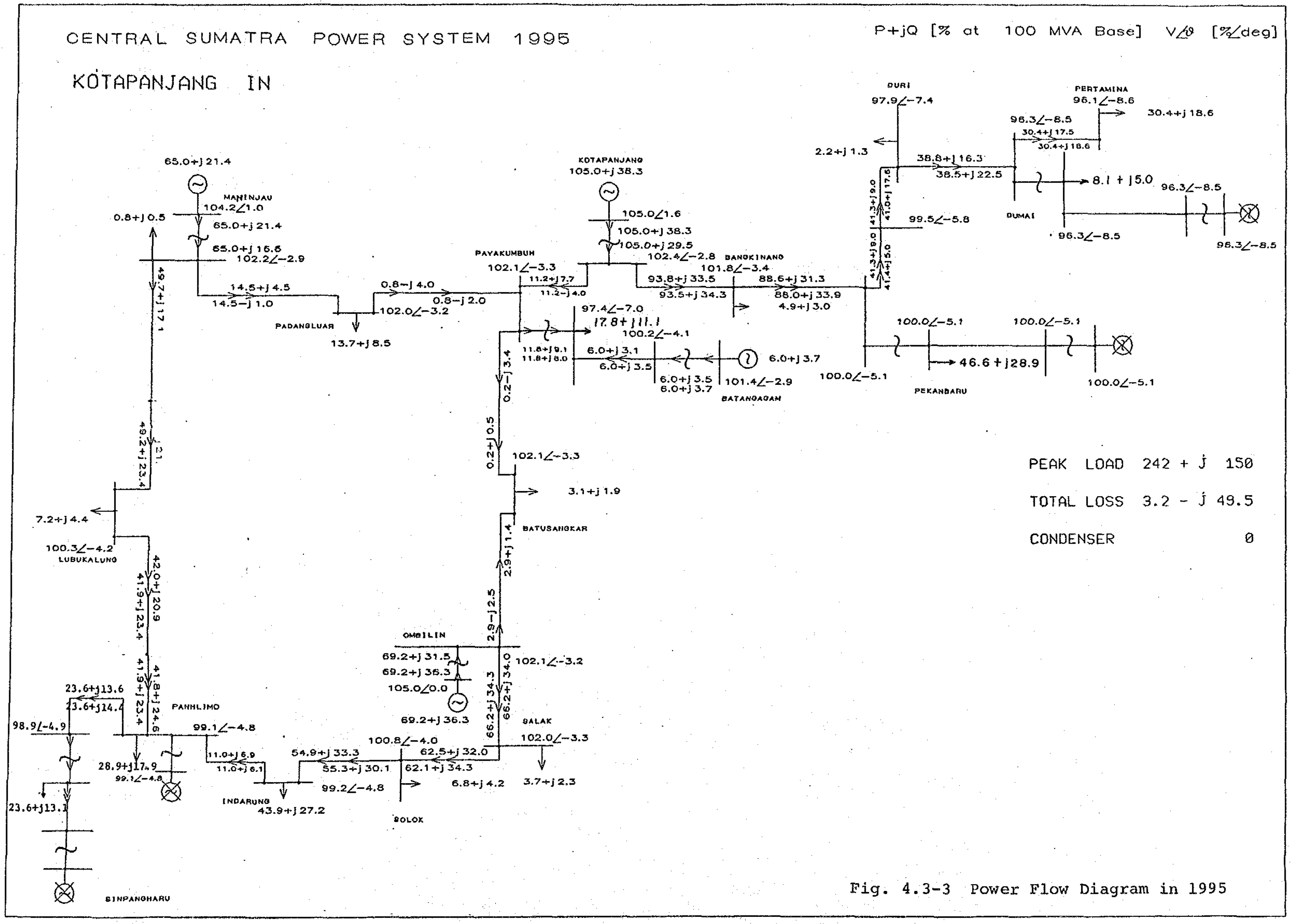


Fig. 4.3-3 Power Flow Diagram in 1995

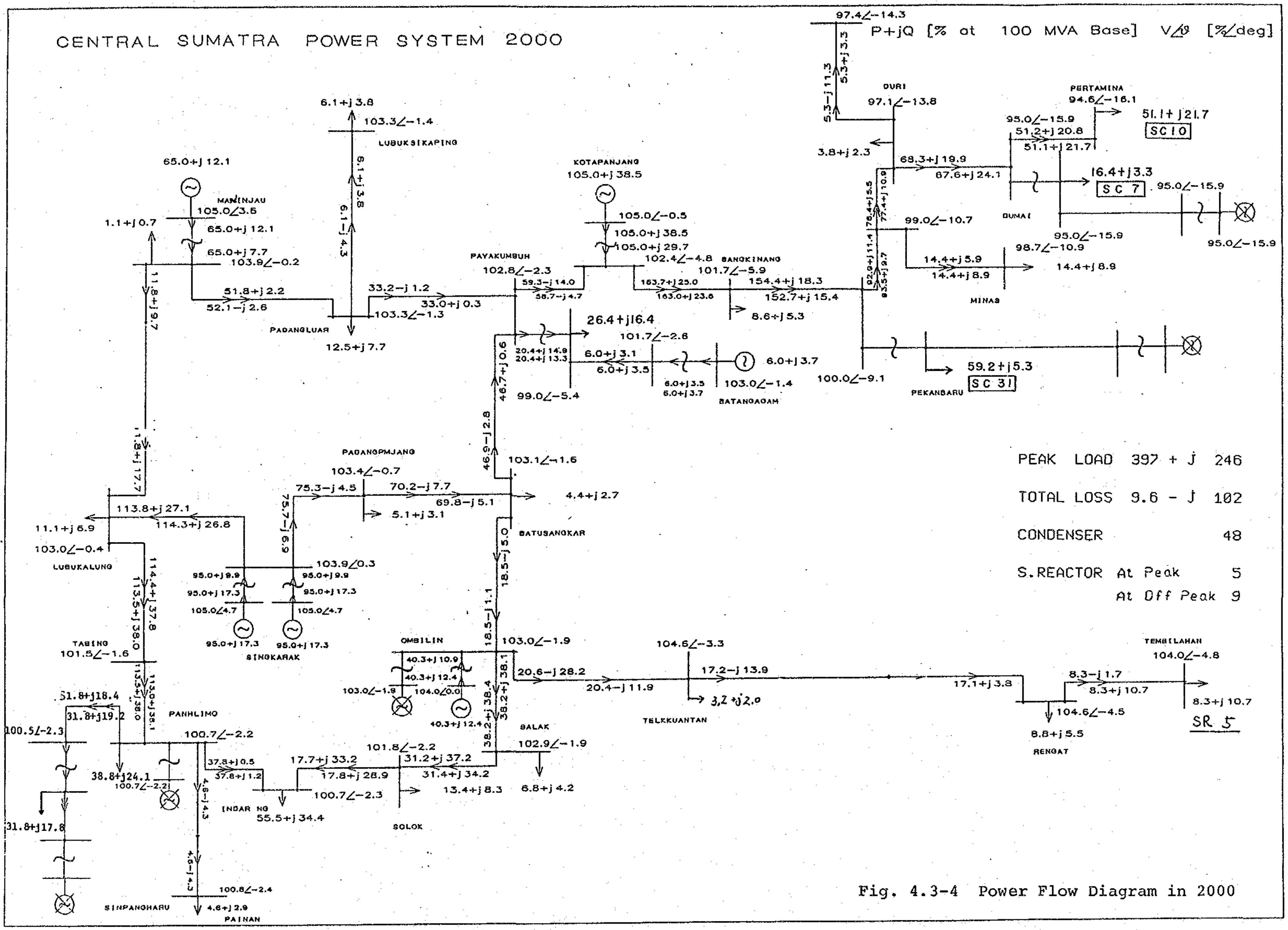


Fig. 4.3-4 Power Flow Diagram in 2000

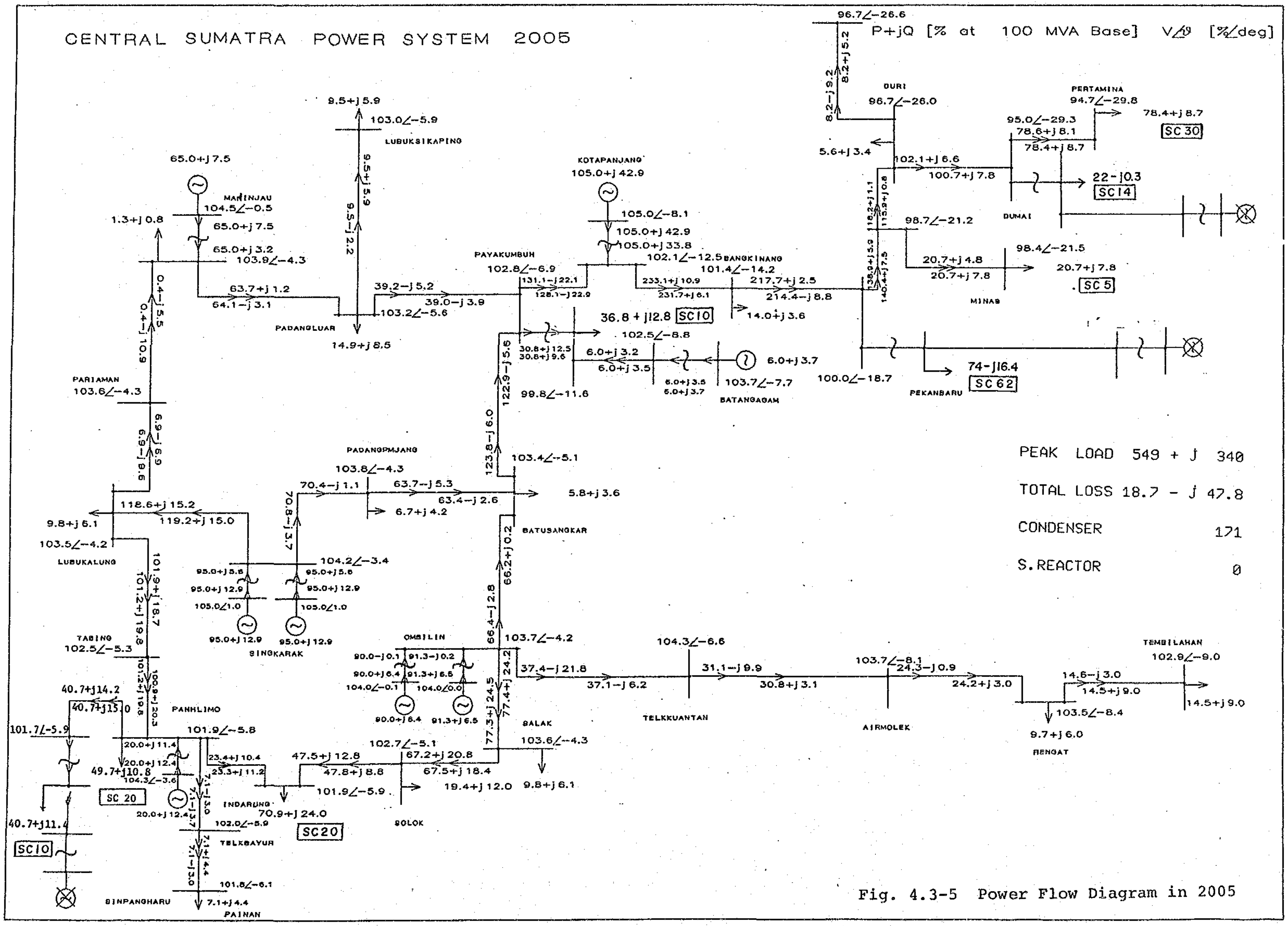
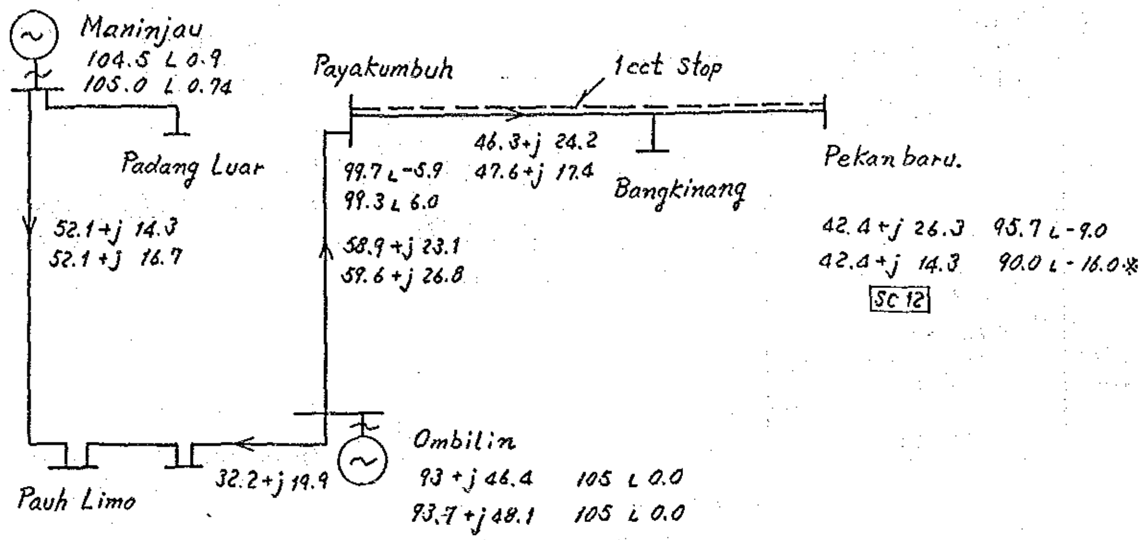


Fig. 4.3-5 Power Flow Diagram in 2005

Power system in 1993



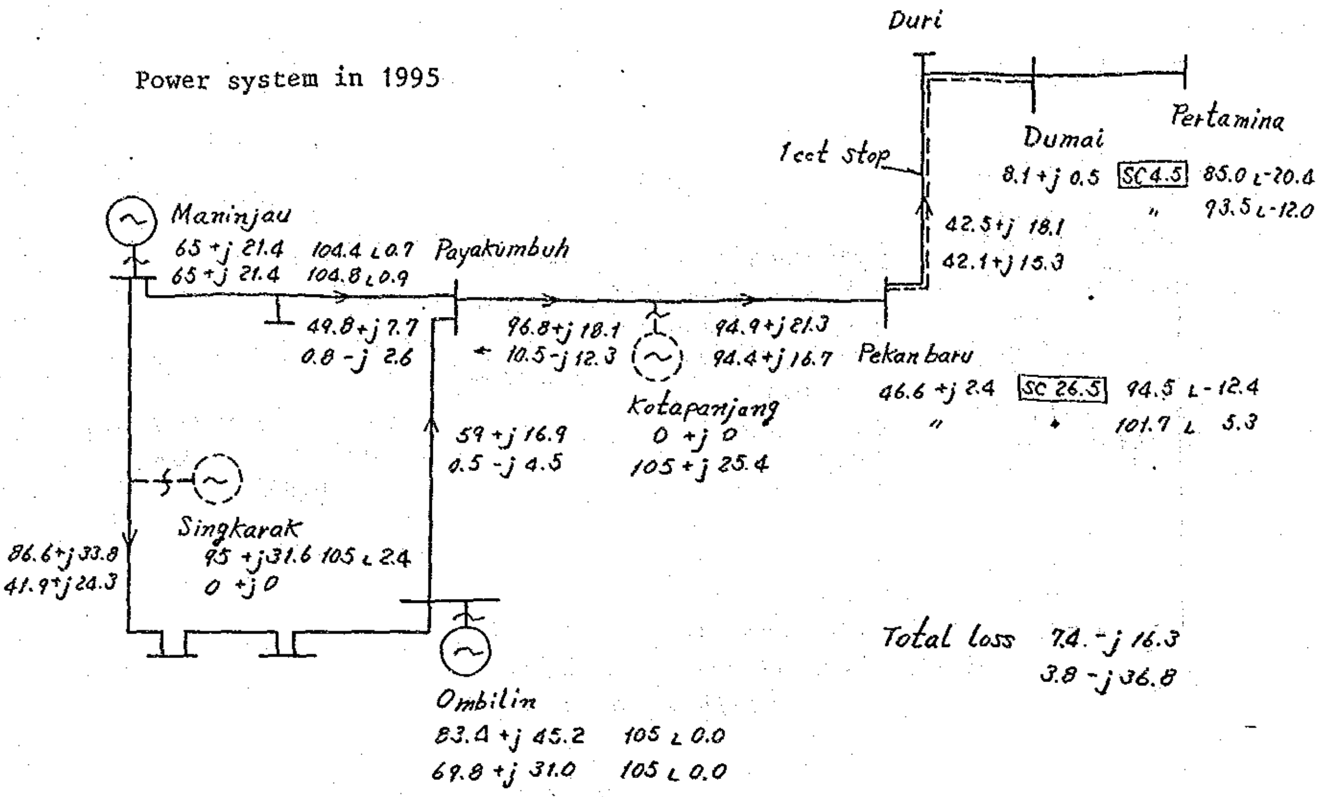
The upper values indicate those during normal operation, while the lower values indicate those at the time of one circuit shutdown.

Generator end voltage at Ombilin: 105%

In order to maintain the voltage within 90% at the time of one circuit shutdown between Payakumbuh and Pekanbaru, a total capacity of SC equivalent to 12 MVA is required at Pekanbaru. It would also be one of the methods to operate diesel power plants to maintain the voltage at the time of shutdown of the transmission line.

Fig. 4.3-6 Effect at the time of One Circuit Shutdown of Transmission Line

Power system in 1995



The upper values indicate those when Singkarak H.P.P. is in operation.
The voltage dropps to 85% at Dumai.

The lower values indicate those when Kotapanjang H.P.P. is in operation.
The voltage dropped to 93.5%.

The condensers with the same capacity are assumed to be installed.

(1) When Singkarak H.P.P. is in operation the voltage at Dumai drops to 85% In case diesel power plant at Dumai is operated (in case the power output is 8.1 MW + j6.0 MVAR), the voltage dropped to 85% is restored to 91%.

(2) To keep the voltage within 95% at Dumai, condensers with a total capacity of 13 MVA are required to be installed.

Fig. 4.3-7 Effect at the time of one circuit shutdown of transmission line

Table 4.3-1 Load at the Respective Stations during Peak Load (used for calculating power flow)

Unit : P MW, Q MVar

Node	Year / Stations	1993		1995		2000		2005	
		P	jQ	P	jQ	P	jQ	P	jQ
GB1	Maninjau	0.7	0.4	0.8	0.5	1.1	0.7	1.3	0.8
1	Pariaman							[6.5	4.0
2	Lubuk Alung	6.1	3.8	7.2	4.4	11.1	6.9	[9.8	6.1
3	Tabing]								
4	Pauh Limo]	45.9	28.5	52.5	32.6	70.6	43.8	90.4	56.1
5	Simpangharu]								
6	Teluk Bayur]								
7	Painan					4.6	2.9	7.1	4.4
8	Indarung	35.9	22.3	43.9	27.2	55.5	34.4	70.9	44.0
9	Solok	5.4	3.3	6.8	4.2	13.4	8.3	19.4	12.0
10	Salak	1.4	0.9	3.7	2.3	6.8	4.2	9.8	6.1
11	Padang Panjang					5.1	3.1	6.7	4.2
12	Batusangkar			[3.1	1.9	4.4	2.7	5.8	3.6
13	Payakumbuh	18.1	11.2	[17.8	11.1	26.4	16.4	36.8	22.8
14	Padang Luar	12.1	7.5	13.7	8.5	12.5	7.7	14.9	8.5
15	Lubuk Sikaping					6.1	3.8	9.5	5.9
31	Bangkinang	3.7	2.3	4.9	3.0	8.6	5.3	14.0	8.7
32	Pekanbaru	42.4	26.3	46.6	28.9	59.2	36.7	74.0	45.9
33	Duri			2.2	1.3	3.8	2.3	5.6	3.4
34	Dumai			8.1	5.0	16.4	10.1	22.1	13.7
35	Bagan Siapi-api					5.3	3.3	8.2	5.1
36	Teluk Kuantan					3.2	2.0	6.0	3.7
37	Airmolek							[6.5	4.0
38	Rengat					8.8	5.5	[9.7	6.0
39	Tembilahan					8.3	5.1	14.5	9.0
41	PERTAMINA			30.4	18.6	51.1	31.7	78.4	48.6
42	Minas					14.4	8.9	20.7	12.8
	Total	171.7	106.5	241.7	149.5	396.7	245.8	548.6	339.4

Notes 1. The node numbers refer to the numbers of the respective stations used in computer calculation.

2. The load of No. 11 Padang Panjang in 1993 and 1995 includes that of No. 14 Padang Luar.

3. The load of No. 12 Batusangkar in 1993 includes that of No. 13 Payakumbuh.

4. The mark [indicates that the load is divided.

5. The mark] indicates that the load is made together.

Table 4.3-2 Load at the Respective Stations during Light Load (used for calculating power flow)

Unit : P MW, Q MVar

Node	Stations \ Year	1993 P	1993 jQ	1995 P	1995 jQ	2000 P	2000 jQ
GB1	Maninjau	0.4	0.2	0.4	0.3	0.6	0.4
1	Pariaman						
2	Lubuk Alung	2.7	1.7	3.2	2.0	5.0	3.1
3	Tabing						
4	Pauh Limo	20.9	13.0	24.1	14.9	32.2	20.0
5	Simpangharu						
6	Teluk Bayur						
7	Painan					2.0	1.2
8	Indarung	27.0	16.7	33.2	20.6	42.4	26.3
9	Solok	2.4	1.5	3.0	1.9	6.1	3.8
10	Salak	0.6	0.4	1.6	1.0	3.1	1.9
11	Padang Panjang					2.3	1.4
12	Batusangkar			1.4	0.9	2.0	1.2
13	Payakumbuh	8.1	5.0	8.0	5.0	11.9	7.4
14	Padang Luar	5.3	3.3	6.1	3.8	5.6	3.5
15	Lubuk Sikaping					2.8	1.7
31	Bangkinang	1.6	1.0	2.1	1.3	3.8	2.4
32	Pekanbaru	16.6	10.3	21.3	13.2	27.0	16.7
33	Duri			0.9	0.6	1.6	1.0
34	Dumai			3.4	2.1	7.4	4.6
35	Bagan Siapi-api					2.4	1.5
36	Teluk Kuantan					1.4	0.9
37	Airmolek						
38	Rengat					2.4	1.5
39	Tembilahan					3.8	2.4
41	PERTAMINA			22.7	14.1	39.1	24.2
42	Minas					6.5	4.0
	Total	85.6	53.1	131.4	81.7	211.4	131.1

Notes: Refer to those in Table 4.3-1

Table 4.3-3 Output of the Respective Power Plants during Peak Hours (used in calculating power flow, etc.)

Unit : MW

Node No.	Name of power plants	Rated output MW x No. of units		Operation output used in calculating power flow, etc. 1993	1995	2000	2005	Remarks
G 1	Manjinjau	17	4	65	65	65	65	
G21	Singkarak	50	2		(95)	95	95	
G22	Singkarak	50	2			95	95	
G31	Ombilin	50	2	Free	Free	Free	Free	*The upper value
				(93)	(81.8)*	(40.3)	(91.3)	and lower value
					(69.2)*			in 1995 indicate
G32	Ombilin	50	2				90	the output
G 4	Kotapanjang	37	3		(105)	105	105	during operation
G 5	PERTAMINA	21.5	2					of Singkarak and
G 6								Kotapanjang,
G 7	Pauh Limo	21.5	2				20	respectively.
D 5	Simpangharu	6	2					
		4	1	10				
D13	Batang Agam	3.5	3	6	6	6	6	
D32	Pekanbaru	6	5					
D34	Dumai	2.5	4					
		5	2					
	Total			174	247.8	406.3	567.3	

1) To study under severe conditions, the diesel power plants, D.32 Pekanbaru and D.34 Dumai adjacent to system terminals are assumed to be shut down.
2) G.31 Ombilin was used for adjusting the balance of power demand and supply.
3) The output in 1995 was studied in two cases, namely, in case G. 21 Singkarak or G. 4 Kotapanjang is in operation.
4) G. 5 PERTAMINA was assumed to be interconnected to the power system based on the load equivalent to its output only in calculating the system stability.
5) D. 5 Simpangharu in 1993 and G. 7 Pauh Limo in 2005 are assumed to be operated to attain the balance between power demand and supply.
6) The operation output of G. 31 Ombilin was calculated based on the results of calculating the power flow.

Table 4.3-4 Operation Output of the Respective Power Plants during Light Load Hours

Unit : MW

Node No.	Name of power plan	Rated output MW x No. of units		Operation output used in calculating power flow, etc. 1993	1995	2000	Remarks
G 1	Maninjau	17	4	Free (43.1)	40	40	
G21	Singkarah	50	2		Free (50.4)	Free (42.3)	
G22	"	50	2			50	
G31	Ombilin	50	2	40	40	40	
G32	"	50	2				
G 4	Kotapanjang	37	3		(40)	40	
G 5	PERTAMINA	21.5	2				
G 6							
G 7	Pauh Limo	21.5	2				
D 5	Simpangharu	6	2				
		4	1				
D13	Batang Agam	3.5	3	3	3	3	
D32	Pekanbaru	6	5				
D34	Dumai	2.5	4				
		5	2				
	Total			86.1	133.4	215.3	

1) The Ombilin Power Plant was assumed to be operated constantly at 40% load, and power demand and supply be balanced by hydro-power plants.
2) The values denoted by "free" refer to those calculated based on the results of calculating power flow, etc.

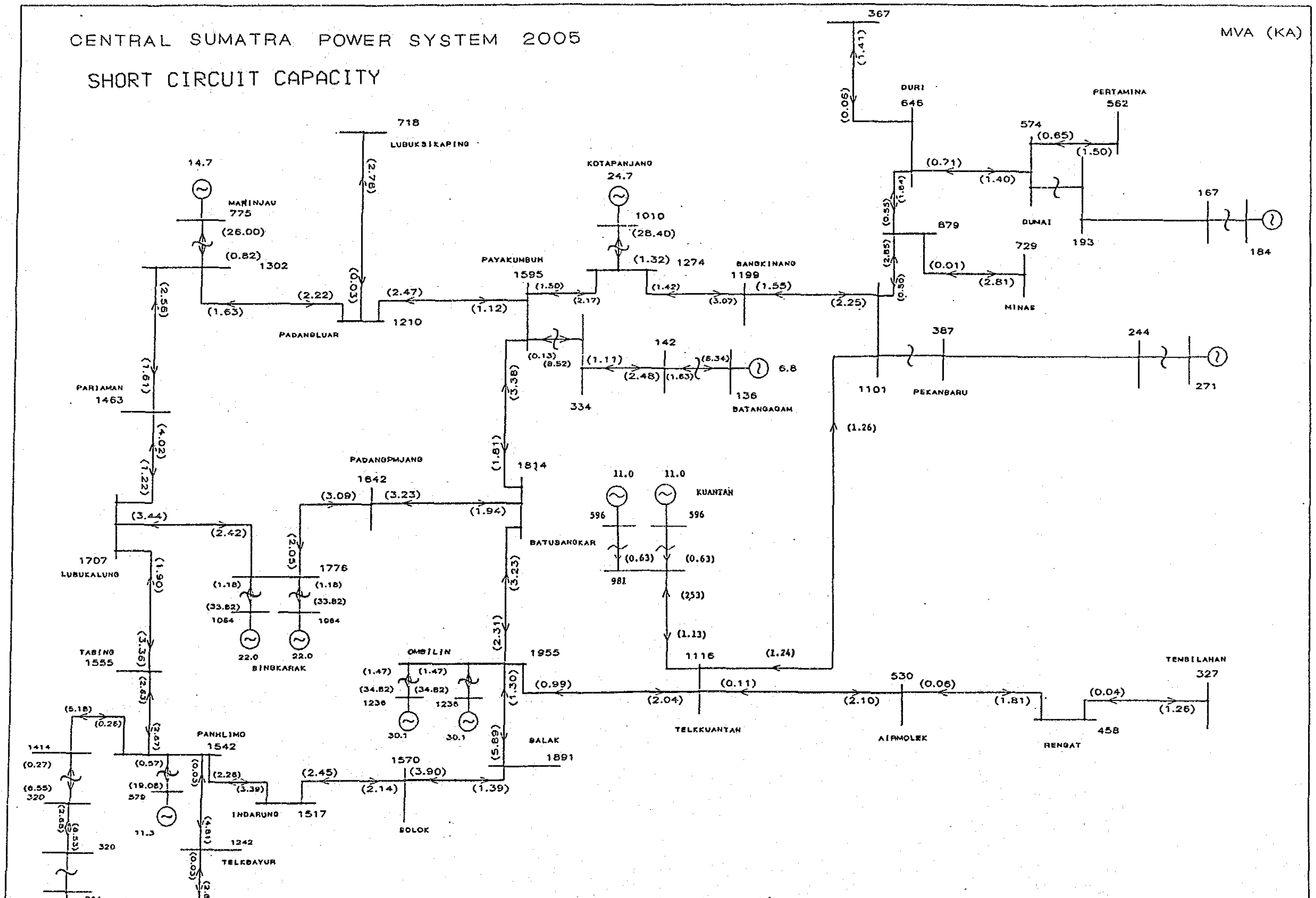
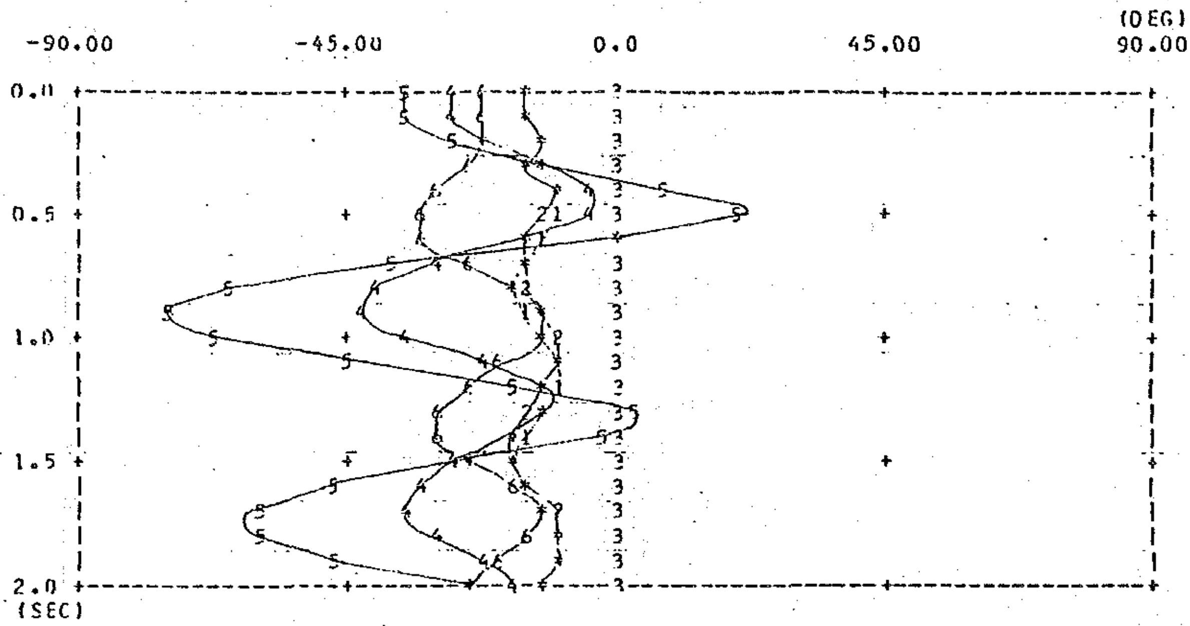


Fig. 4.3-8 Short Circuit Capacity Diagram in 2005

CASE-1 3LO=0.3 SEC

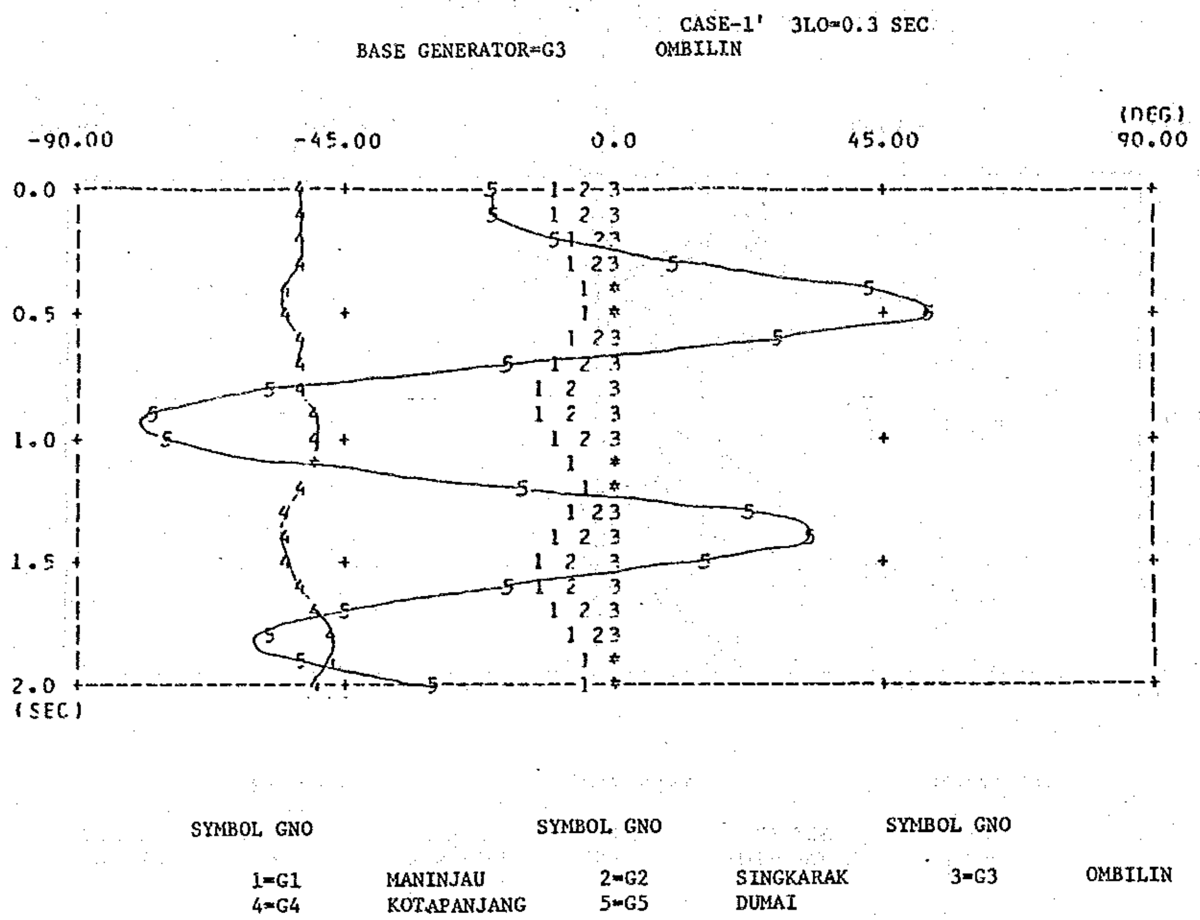
BASE GENERATOR=G31 OMBILIN



SYMBOL GNO		SYMBOL GNO		SYMBOL GNO	
1=G1	MANINJAU	2=G21	SINGKARA	3=G31	OMBILIN
4=G4	KOTAPANJANG	5=G5	PERTAMINA	6=G7	PAUHLIMO

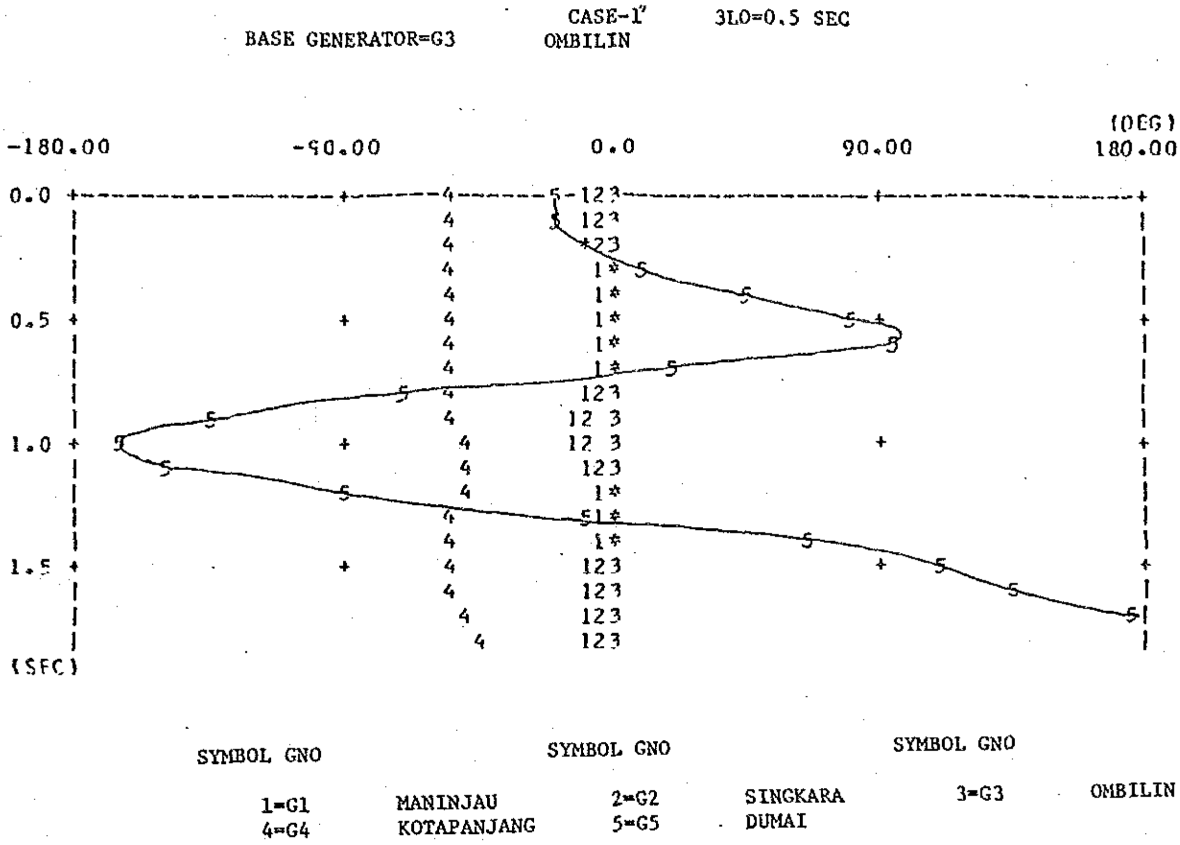
1	Maninjau	4 x 17 MW
2	Singkarak	2 x 50
3	Ombilin	2 x 50
4	Kotapanjang	3 x 37
5	PERTAMINA	2 x 21.5
6	Pauh Limo	2 x 21.5

Fig. 4.3-9 Results of Calculating System Stability



The system is stable for 0.3 sec of continuous fault at a load of 400 MW.

Fig. 4.3-10 Results at the Time of Preliminary Study

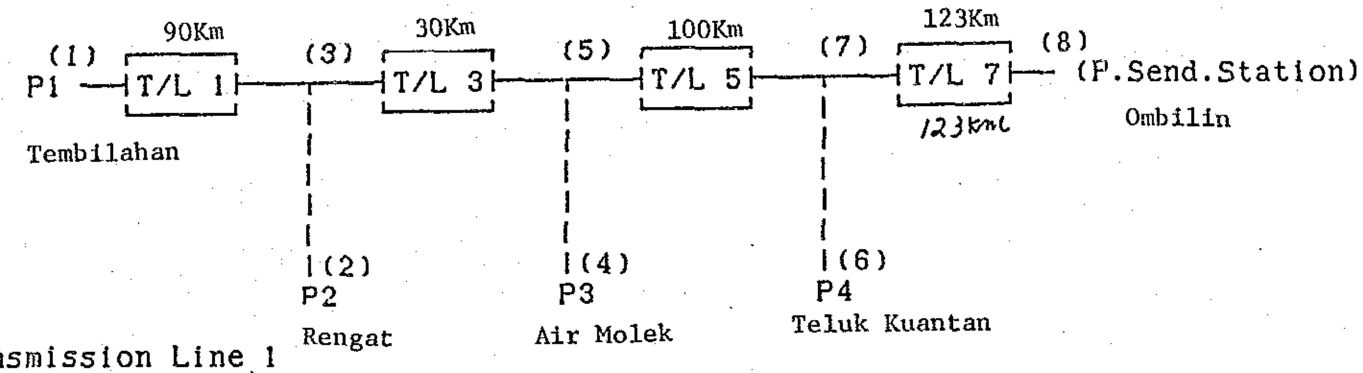


The system is stepped out for 0.5 sec of continuous fault at a load of 400 MW.

Fig. 4.3-11 Results at the Time of Preliminary Study

Table 4.3-5 Results of Calculating No-load Voltage

Line Voltage = 150 kv   Frequency = 50 Hz   Cond.Temp.= 40 °C



Transmission Line 1

ACSR 240 mm2 x 1 x 2cct x 90 km
Cond.Diameter = 22.4 mm   DC Resistance at 20°C = .12 ohm/km
Horizontal distance : C1 - C1'= 7 m   C2 - C2'= 7 m   C3 -C3'= 7 m
Vertical distance : C1 - C2 = 4.2 m   C2 - C3 = 4.2 m
Equivalent phase distance Deq= 5.292 m Equivalent radius of Cond.= 11.20 mm
L = 1.28160 mH/km   C = 0.0090217 uF/km   R = 0.12960 ohm/km

Four Terminal Constant
A = 0.99538200 + j 0.00148536   B = 5.81404000 + j18.09320000
C =-0.00000025 + j 0.00050938   D = 0.99538200 + j 0.00148536

Transmission Line 3

ACSR 240 mm2 x 1 x 2cct x 30 km
Cond.Diameter = 22.4 mm   DC Resistance at 20°C = .12 ohm/km
Horizontal distance : C1 - C1'= 7 m   C2 - C2'= 7 m   C3 -C3'= 7 m
Vertical distance : C1 - C2 = 4.2 m   C2 - C3 = 4.2 m
Equivalent phase distance Deq= 5.292 m Equivalent radius of Cond.= 11.20 mm
L = 1.28160 mH/km   C = 0.0090217 uF/km   R = 0.12960 ohm/km

Four Terminal Constant
A = 0.99948700 + j 0.00016527   B = 1.94333000 + j 6.03846000
C =-0.00000001 + j 0.00017003   D = 0.99948700 + j 0.00016527

Transmission Line 5

ACSR 240 mm2 x 1 x 2cct x 100 km
Cond.Diameter = 22.4 mm   DC Resistance at 20°C = .12 ohm/km
Horizontal distance : C1 - C1'= 7 m   C2 - C2'= 7 m   C3 -C3'= 7 m
Vertical distance   : C1 - C2 = 4.2 m   C2 - C3 = 4.2 m
Equivalent phase distance Deq= 5.292 m Equivalent radius of Cond.= 11.20 mm
L = 1.28160 mH/km   C = 0.0090217 uF/km   R = 0.12960 ohm/km

Four Terminal Constant
A = 0.99429900 + j 0.00183311   B = 6.45537000 + j20.09700000
C =-0.00000035 + j 0.00056578   D = 0.99429900 + j 0.00183311

Transmission Line 7

ACSR 330 mm2 x 1 x 2cct x 123 km
Cond.Diameter = 25.3 mm   DC Resistance at 20°C = .0888 ohm/km
Horizontal distance : C1 - C1'= 7 m   C2 - C2'= 7 m   C3 -C3'= 7 m
Vertical distance   : C1 - C2 = 4.2 m   C2 - C3 = 4.2 m
Equivalent phase distance Deq= 5.292 m Equivalent radius of Cond.= 12.65 mm
L = 1.25725 mH/km   C = 0.0092037 uF/km   R = 0.09590 ohm/km

Four Terminal Constant
A = 0.99137300 + j 0.00209159   B = 5.86417000 + j24.22530000
C =-0.00000050 + j 0.00070925   D = 0.99137300 + j 0.00209159

P1 = 0 MW   P2 = 0 MW   P3 = 0 MW   P4 = 0 MW

P.F. (%)	No.	V (kv)	E (kv)	I (A)	V.fluct (%)	I1 (A)	I2 (A)
	1	160.55	92.69 ◢ 0.00°	0.00 ◥ 90.00°	-6.57		
	2	159.81	92.26 ◢ 0.09°	0.00 ◥ 89.91°	-6.14		
	3	159.81	92.26 ◢ 0.09°	47.22 ◥ 89.97°	-6.14	47.22 ◥ 89.97°	0.00 ◢ 90.09°
	4	159.23	91.93 ◢ 0.15°	0.00 ◥ 89.85°	-5.80		
	5	159.23	91.93 ◢ 0.15°	62.88 ◥ 89.95°	-5.80	62.88 ◥ 89.95°	0.00 ◢ 90.15°
	6	156.14	90.15 ◢ 0.52°	0.00 ◥ 89.48°	-3.93		
	7	156.14	90.15 ◢ 0.52°	114.53 ◥ 89.83°	-3.93	114.53 ◥ 89.83°	0.00 ◢ 90.52°
	8	150.00	86.60 ◢ 1.10°	177.48 ◥ 89.61°	0.00	PS = -0.573 (MW)	

TRANSMISSION LOSS (MW)

T/L 1	T/L 3	T/L 5	T/L 7	TOTAL	Efficiency
-0.013	-0.018	-0.158	-0.384	-0.573	0.00%

4.4 Study of the Size of Conductors for Transmission Line

(a) Items taken into account in determining the size of conductors

(i) Judging from the power flow study in trannsmission line, the current should not exceed the allowable current for a long period, provided that the scale of equipment will not become excessively large.

(ii) In case one circuit out of two parallel circuits has been shut down in important line, the sound circuit should not be subjected to overload.

(iii) A conductor size with minimum yearly cost should be selected in view of economic point of view. Therefore, an optimum size should be selected by calculating the changes of construction cost, yearly expenditures and transmission loss due to the change of conductor size.

(iv) The conductor size should be selected by comprehensively taking into account the allowable current, cost and applicability to future change of situations (coordination with future power system).

(b) Study of conductor size from economic point of view

On the basis of the items in (a) above and taking into account the increase of power flow from 1995 through 2005 (Table 4.4-1), the present value of cumulative annual expenditures for ten years was obtained as shown in Fig. 4.4-1.

Moreover, the annual expenditures in single year for transmitting power are as shown in Fig. 4.4-2.

(c) Consideration

(i) Size of conductor viewed from cumulative expenditures for ten years

An economically optimum size of conductor is 410 mm^2 between Kotapanjang and Pekanbaru where the power flow is largest. And, there is not much difference between 410 mm^2 and 330 mm^2 between Payakumbuh and Kotapanjang. The size of conductor between Pekanbaru and Dumai should be 240 mm^2 rather than 330 mm^2 in view of cost since the transmitting power of this line is small.

(ii) Size of conductor viewed from expenditures in single year

When viewed from the section in the year 2005, 330 mm^2 or 410 mm^2 will be advantageous judging from transmitting power of 135 MW between Pekanbaru and Minas, and 114 MW or 110 MW between Minas, Duri and Dumai.

(iii) Regarding the transmission line to Pekanbaru through Payakumbuh, the power flow will reach a limit in 2005. Therefore, it is considered necessary to take countermeasures for power source development thereafter.

In the direction from Pekanbaru to Dumai, transmitting power from Pekanbaru as a power source base is expected to increase further in the future.

(iv) In consideration of various situations mentioned above, the conductor sizes have been determined as follows:

Line between Kotapanjang and Pekanbaru: 410 mm^2

Between Ombilin - Payakumbuh - Kotapanjang and main line between Pekanbaru and Dumai : 330 mm^2

Loop line between Padang Luar - Payakumbuh : 240 mm^2

Other branch lines : 240 mm^2

(d) Various dimensions used for calculation

(i) Construction cost

Conductor size (mm^2) (ACSR)	240	330	410	610
Construction cost ¥10^3/km 2 cct.	16,100	17,700	19,300	23,000
Rp x 10^3 (Rp.5.5/yen)	88,550	97,350	106,150	126,500

(ii) Annual expenditures

Service life : 25 years
Interest and depreciation: 10.92%
Maintenance cost : 1.5%
Total 12.42%

(iii) Unit cost of transmission loss

Rp. 47.9/kWh (Average unit cost calculated during preliminary study)

Rp. 31,840/kW/year (Unit generating cost of coal fired steam power plant)

Study was also made in case the unit cost of power loss is changed.

(iv) Discount Rate

12%

(v) Others

Transmission line	:	Parallel running two circuits with conductor temperature of 40°C
Loss factor	:	0.432 (Load factor: 0.6)
Power factor	:	0.95

Table 4.4-1 Sectionwise Load in Transmission Line

	Peak load at each site (MW)				Sectionwise load in transmitting power (MW)				Selected conductor size
	Site	1995	2000	2005	Section	1995	2000	2005	(mm^2)
1	PERTAMINA	30.4	51.1	78.4	2-1	30.4	51.1	78.4	240
2	Dumai	8.1	16.4	22.1	4-2	38.5	67.5	100.5	330
3	Bagan Siapi-api		5.3	8.2	4-3		5.3	8.2	240
4	Duri	2.2	3.8	5.6	5-4	40.7	76.6	114.2	330
5	Minas		14.2	20.7	6-5	40.7	91.0	134.9	330
6	Pekanbaru	46.6	59.2	74.0	7-6	87.3	150.2	208.9	410
7	Bangkinang	4.9	8.6	14.0	8-7	92.2	158.8	222.9	410
8	Kotapanjang	0	- 80	- 80	9-8	92.2	78.8	142.9	330
9	Payakumbuh	17.8	26.4	36.8					

Sectionwise Growth Rate of Power Demand

Unit : %

Section \ Year		1995-2000	2000-2005	1995-2005
2-1	Dumai - PERTAMINA	10.9	8.9	9.9
4-2	Duri - Dumai	12.2	8.2	10.0
5-4	Minas - Duri	13.5	8.3	10.9
6-5	Pekanbaru - Minas	17.5	8.2	12.7
7-6	Bangkinang - Pekanbaru	11.5	6.8	9.1
8-7	Kotapanjang - Bangkinang	11.5	7.0	9.2
9-8	Payakumbuh - Kotapanjang	-3.2	12.6	4.5

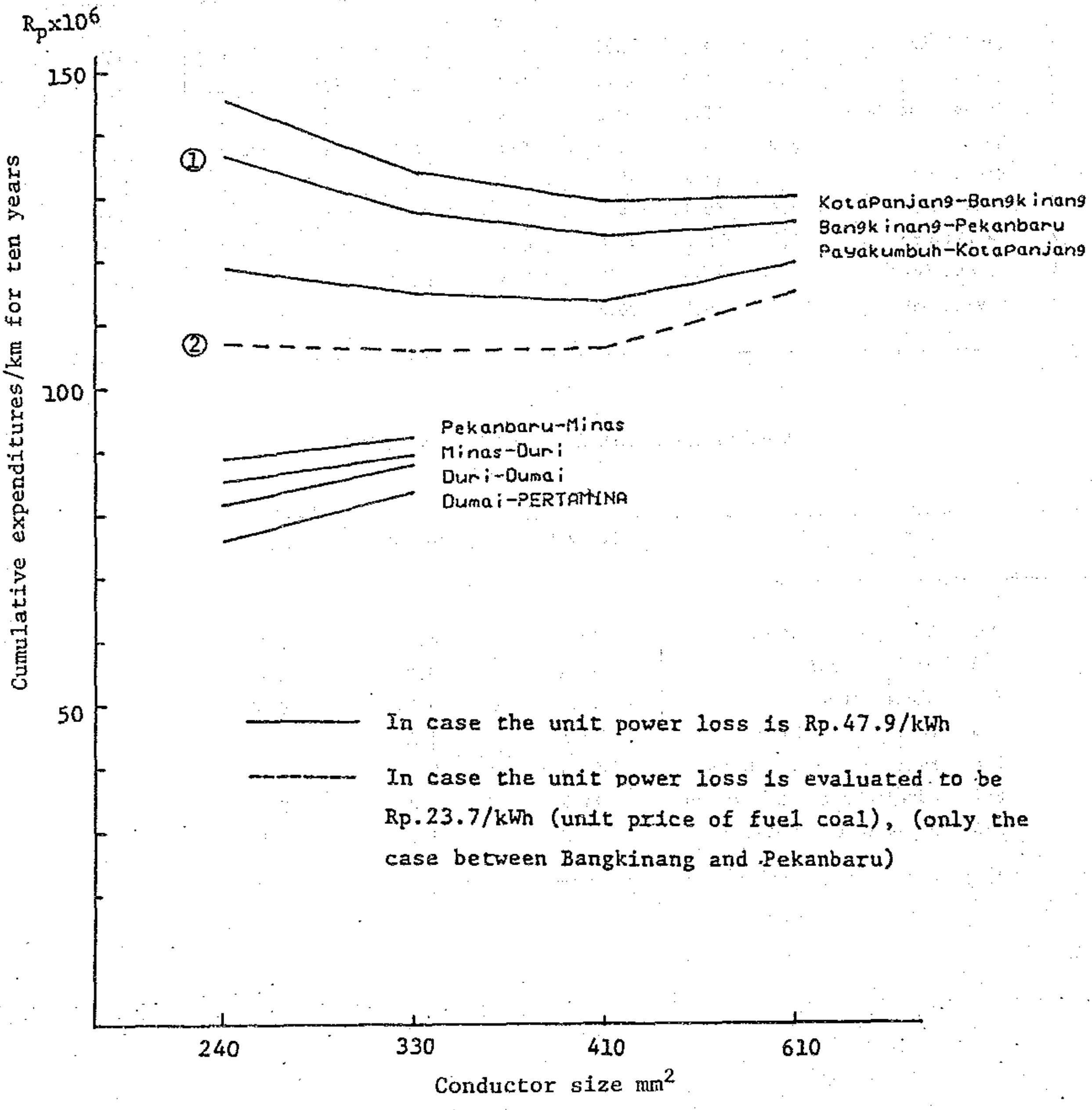


Fig. 4.4-1 Change of Annual Expenditures due to the Size of Conductor
Present value of Cumulative Expenditures for Ten Years

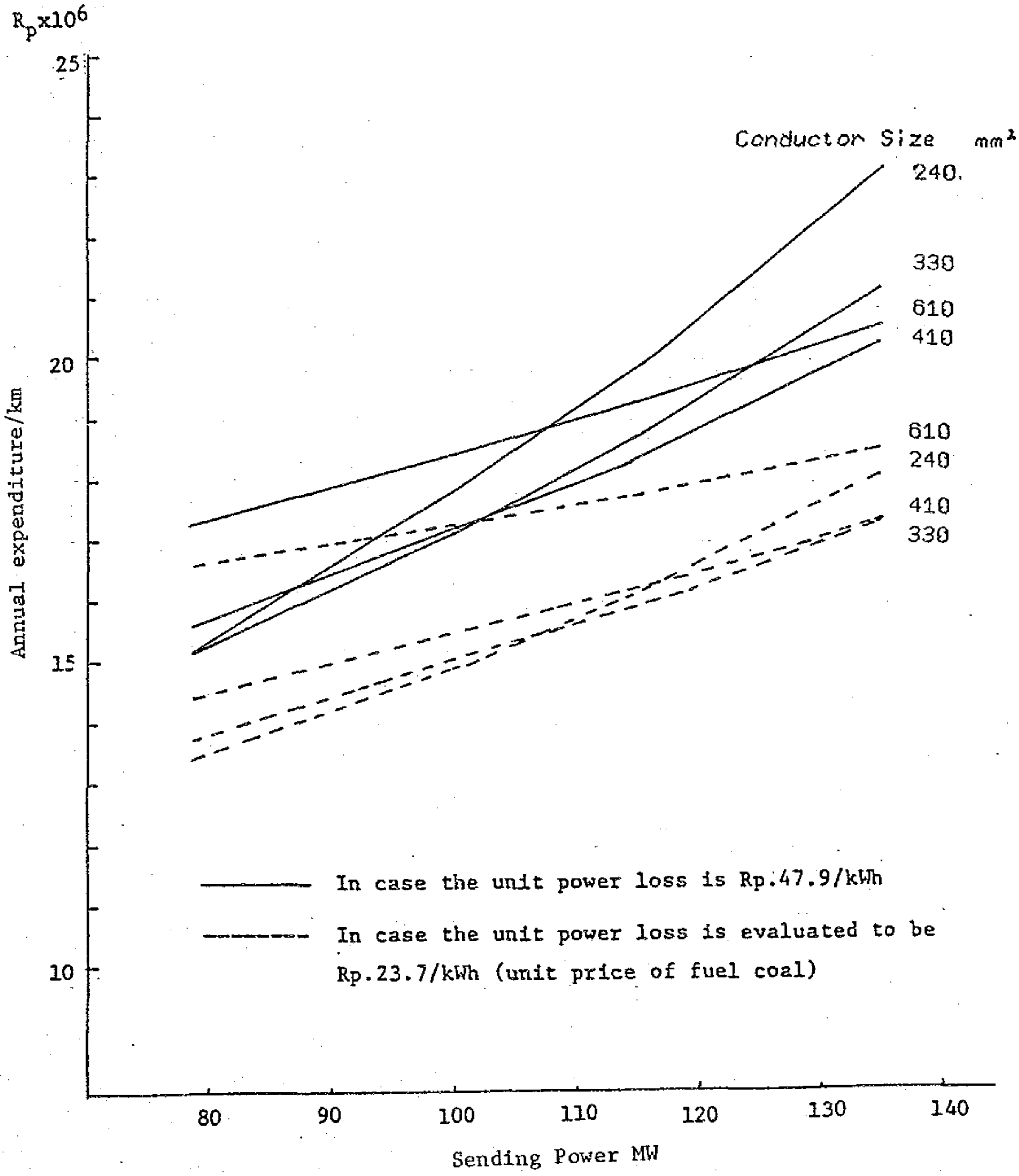


Fig. 4.4-2 Change of Annual Expenditures according to Sending Power Parallel Running by Two Circuits, 150 kV (Pf = 0.95)

SECTION 5

TRANSMISSION FACILITIES

SECTION 5 TRANSMISSION FACILITIES

5.1 Routes of Transmission Lines

5.1.1 Topography in the Areas along the Routes of Transmission Lines

The area under this project extends over the Province of West Sumatra and Riau Province on the central part of Sumatra Island. Topographically speaking, the Province of West Sumatra, which faces the Indian Ocean, consists of a portion of plain mainly in Padang, plateaus mainly in Bukittinggi and Payakumbuh surrounded by Mt. Marapi (2,891 m above sea level) and Mt. Singgalang (2,878 m above sea level), and mountainous areas belonging to Mt. Barisan Ranges up to the border with Riau Province near Pulau Panjang across the equator from Andalas north of Payakumbuh.

In this province, on the other hand, there is a mountainous area with an elevation of roughly 300 m over about 15 km from the border with the Province of West Sumatra through to around Rantanbarangin. However, the northern part of the province from the mountain zone consists of plain, and the elevation of Pekanbaru locating even 140 km inland from the Strait of Malacca is specially as low as only 31 m, with the majority of the area consisting of flat land where there are some undulations on the ground surface. Most of this plain area is occupied by the oil exploration and production area of P.T. CALTEX PACIFIC INDONESIA (hereinafter called CALTEX), which is surrounded by jungle.

5.1.2 Routes of 150 kV Transmission Lines

The respective routes of 150 kV transmission lines were selected after study on 1/50,000 map as well as after field reconnaissance and aerial survey by helicopter. The routes of the 150 kV transmission lines are as outlined in Annexes 5-1, 5-2 and 5-3.

(1) Ombilin Power Plant - Batusangkar Substation
Distance: 29 km

The route of this transmission line between Ombilin and Batusangkar was selected along a main road passing through Bukitgomabak, Kotaalam, Talawi and other villages. By making the straight line portion across hill and paddy field zones along the main road as long as possible, the route of this transmission line was so selected as to connect the power plant and substation with a minimum distance.

(2) Batusangkar Substation - Payakumbuh Substation
Distance: 29 km

The route between these substations is connected through a main route running across Seitarab, Tabatpatan, Barulak and other villages which are inserted between Mt. Marapi (2,891 m) and Mt. Malintang (2,262 m).

Although the distance must be made somewhat longer, this route was selected along this main road where the land is comparatively flat to ensure easy construction and maintenance of the transmission line. The ground surface throughout this area consists of red clay and is considered to have sufficient bearing capacity. Judging from andesite and breccia observed in outcrop, the ground is evaluated to be stable. Although the surrounding mountains are steeply sloped, this area will be free from landslide.

(3) Padang Luar Substation - Payakumbuh Substation

Distance: 31 km

Starting from the Padang Luar Substation in the outskirt of Bukittinggi, this route passes nearly straight along the road running across Bactabal, Lasi, Kataingoi and other villages scattering in a paddy field zone on the foot of Mt. Marapi. Then, this route intersects with a national road near a regulating pond of Batang Agam Power Plant. While minimizing the number of angular towers to as small as possible along the route on the north side of the national road, this route was so selected as to maximize a straight portion as much as possible up to the Payakumbuh Substation.

The volcanic sediments erupted from Mt. Marapi cover the foot of the mountain and form a moderate slope. The ground surface is comprised of clayey soil and in favourable conditions. Therefore, the inverse T-type foundation will be optimum in view of cost and execution of work. Since this route crosses over valley rivers from Mt. Marapi at several positions and there is a possibility of mud flow, the foundations in this area should be separated by about 20 m from the valley rivers.

Moreover, the route around Payakumbuh is surrounded by paddy field and farmland. According to a geologic map, the ground around this area consists of alluvium stratum and is covered by the deposits formed by clay, sandy soil, volcanic gravel and quartzite.

(4) Payakumbuh Substation - Kotapanjang Power Plant

Distance: 83 km

In principle, this route was also selected along the national road as explained below.

(a) Near Payakumbuh

In the portion of plain mainly in Payakumbuh, the transmission line route was selected along the west side of the national road with favourable ground conditions to make a straight line portion as long as possible and ensure easy construction and low cost and convenient maintenance.

(b) Route across the ridges near Andalas

The section from Mt. Sikat to Mt. Gobah (about 9 km) section is a tough transmission line route where rocky mountains approach from both sides between the national road and river valley. Fortunately, however, the rocky mountains are in stable conditions. Therefore, the conventional standard type two circuit towers will be adopted for this section, and the foundations be of special design using rock anchor, etc. By erecting towers on the mid-slope of the mountains and opposite banks of valleys, the transmission line between this section will be constructed along valleys while crossing several times over the national road and valley rivers in a zigzag form.

(c) Ridges near Andalas - Kotapanjang Power Plant

Subsequent to passing through the ridges around Andalas, moderate mountain slopes continue. This section was selected along a basic route straightly connecting the ridges and power plant on this moderate mid-mountain slope or summit of this slope along the national road.

Meanwhile, since the existing national road near Muaramahat will be submerged due to construction of Kotapanjang Hydro-Power Plant, construction of a detouring road is under planning stage. Therefore, the section of the transmission line around this area was selected along this detouring road.

(5) Kotapanjang Hydro-Power Plant - Pekanbaru Substation
Distance: 60 km

The portion of plain extends gradually from around the proposed site for Kotapanjang Hydro-Power Plant, and the national road runs toward Pekanbaru while meandering along the Kampar Kanan River. The transmission line route between this section was selected along the opposite side of Kampar Kanan River (on the south side of the national road) toward Pekanbaru along the national road in order to make the straight line portion as long as possible while avoiding soft ground of former river basin. For transmission towers, it will be necessary to adopt pile foundations depending upon ground conditions.

(6) Pekanbaru Substation - Duri Substation

Distance: 113 km

Starting from the Pekanbaru Substation scheduled to be constructed in the southwestern part of Pekanbaru, this route goes north in the outskirt on the west side of Pekanbaru, and immediately after crossing over Siak River, this route runs parallel to the national road. Although the national road zigzags sharply around Minas, the route of this section was selected basically along the west side of the national road so that the route be not so distant from the national road as well as in order to minimize crossing over the national road as far as practicable. Around the Siak Bridge, river banks are submerged roughly twice a year. Therefore, the columnar portion of foundation of towers on the west side of river bank should be of a circular form with a construction resistant against flowing water pressure, and the height of levee crown be made by more than 30 cm larger than the heighest flood level.

From Pekanbaru through to Minas, moderate undulations continue with the ground surface consisting of brown sand or silt. Because of a few trees and grass, the exposed ground surface is eroded heavily due to rain. Therefore, it is required to take countermeasures for reforestation around tower construction sites to prevent flow of surface materials.

Meanwhile, there is a wide area managed of CALTEX between this section.

Although basic consent has been obtained from CALTEX regarding routing of this transmission line in this area, it is required to make adjustment with CALTEX in detailed design stage regarding:

o Route of new transmission line,
o Separation distance between mutual equipment, etc.

(7) Duri Substation - Dumai Substation

Distance: 60 km

The area between Duri and Dumai is flat land where there swamps scatter here and there. The national road connecting between Duri and Dumai somewhat detours. Therefore, this route was selected along the area with favorable ground conditions.

Namely, this transmission line route was basically selected along this national road, although this route separates from the national road near Bukitnenas in front of Dumai, and goes north straight to the Dumai Substation.

(8) Pauh Limo Substation - Simpangharu Substation

Distance: 7 km

In case the existing Simpangharu Substation is modified to combinedly construct a 150 kV substation, several 150 kV transmission line routes for connecting this substation to its power source, the Pauh Limo Substation were considered. However, a route running parallel with the 20 kV distribution line along a local road toward Kototingga, Kataping and other villages was selected as an optimum route in view of cost and maintenance since it would be possible to connect both of the substations straightly with the shortest distance.

(9) Dumai Substation - PERTAMINA (Dumai Refinery)

Distance: 10 km

The 150 kV transmission line for supply of electric power to the Dumai Refinery of PERTAMINA at the eastern part of Dumai from the Dumai Substation proposed to be constructed at the southwestern part of Dumai was selected along the following route. Namely, by avoiding the off-limit zone of the adjacent Dumai Airport, this route passes through the northern edge of the PERTAMINA camp site adjacent to Dumai Substation and enters the refinery site from the southern side of the Dumai Refinery of PERTAMINA, and reaches the substation in the refinery.

(10) Duri Substation - Bagan Siapiapi Substation

Distance: 122 km

As for the transmission line route to Bagan Siapiapi, the two routes, namely, a route extended from the Dumai Substation and a route branched from the Duri Substation were considered. However, a road network for oil exploration is expanded from Duri to Bangko at present by CALTEX. Since it will be possible to utilize the road network for construction and maintenance of this transmission line, the route branching from the Duri Substation was selected.

In other words, starting from the Duri Substation, this route goes north along the national road, turns to the left near Sebanga, and runs along the road being constructed by CALTEX. Subsequent to crossing over the Rokan River at Merbaupintar, the route goes further north and crosses over the Rokan River again and reaches the Bagan Siapiapi Substation along the right bank of the Rokan River.

The ground conditions cannot be said to be so favorable along medium and small rivers in swamp area. Since the load acting to towers will become large in case sharp angle tower is required, pile foundation will be suitable for such towers. Moreover, it will also be necessary to study adoption of floating foundation and other types of foundation matching the ground conditions.

(11) Padang Luar Substation - Lubuk Sikaping Substation
Distance: 60 km

As for the transmission line route from the Padang Luar Substation to the Lubuk Sikaping Substation, the two routes, namely, a route passing on the west side and that passing on the east side of Bukittinggi were studied. However, the east side route was selected judging from the topography, stability of ground and other conditions.

Namely, starting from the Padang Luar Substation, this route passes through Matur, Baringin, Palembajan, Sipisang, Pandan and other villages along a local road passing on the eastern slope of the surrounding Maninjau Lake on the west side of Bukittinggi. Then, this route reaches the Lubuk Sikaping Substation.

(12) Pauh Limo Substation - Painan Substation

Distance: 62 km

(a) Pauh Limo Substation - Teluk Bayur

This area is an outskirt of Padang where houses are standing in a row along each road and paddy field extend behind these houses. Although the following two routes, namely (i) a route passing through the paddy field and (ii) a route passing over the railway connecting PT. Semen Padang and Padang Port (Teluk Bayur) by constructing gantry towers were studied. In view of the width of the railway and difficulty to cross near a grade separation with the railway, however, the route passing through the paddy field in (i) was selected.

Namely, starting from the Pauh Limo Substation, this route runs along the local road passing through Cupak, Piaitengah, etc., crosses the national road near Tanjungsabar, and reaches Teluk Bayur along the Padang bypass road which has already been completed.

(b) Teluk Bayur - Painan Substation

In the area along Teluk Bayur and Teluk Kabung, a mountain approaches the sea and the national road runs on the mid-slope of the mountain. Therefore, a steep mountain slope faces the left side of the national road, and soil and sand containing boulder extending to 3 or 4 m in width and about 10 m in height cover the slope at many positions. Since the cliff on the right side of the national road faces the sea, this portion is not suitable for the transmission line route along the national road. Hence, the route was selected on a mountain with an elevation of 500 m distant from the national road.

Then, the national road enters an inland part near Teluk Kabung, and after passing through a ridge near Ranaho, it reaches Painan through Baranean, Salido and other villages along the Taroesan River. Consequently, the transmission line route was also selected along this national road toward Painan so as to minimize use of angled tower and make the route as straight as possible.

5.2 Insulation Level

For executing insulation design of transmission line, it is highly important to determine a withstandable abnormal voltage at an optimum level. In other words, overestimation of insulation strength results in the increase of cost, while its underestimation results in the increase in the number of circuits in failure and reduction of reliability. However, any data pertaining to the extent and frequency of abnormal voltage has not been collected under this study, the insulation design of transmission line was carried out according to the concept and procedures which have so far been adopted based on the operation records of transmission line, etc. in the past.

Such abnormal voltage which can be assumed is largely classified into the following two types: namely, external abnormal voltage due to lightning and internal abnormal voltage due to switching surge, etc. as further details are presented below.

5.2.1 External Abnormal Voltage

According to an Isokeraunic Level (IKL) map obtained during this survey, the frequency of lightning in this project area, Central Sumatra, is as high as 30 or 50 in the Province of West Sumatra and 40 or 70 in Riau Province, indicating a feature inherent to tropical zone (Refer to Annex 5-4).

Since the abnormal voltage arising due to lightning (external abnormal voltage) is much higher than the dielectric strength of transmission line, it is impossible to totally eliminate flashover faults due to lightning. Therefore, the transmission line will be protected by stringing overhead groundwire and reducing grounding resistance of tower legs. Moreover, the conductors and insulators will be protected.by installing high speed circuit breakers, arcing horn, armour rods, etc. to restrict damages due to such abnormal voltage within a minimum extent.

5.2.2 Internal Abnormal Voltage

The following items, namely:

- o Number of insulators per string,
- o Insulation gap, etc.

are determined as follows on the assumption that any flashover will not arise due to abnormal voltage (internal abnormal voltage) resulting from switching surge in a power system.

(1) Number of insulators per string

The number of insulator strings should be so determined as to be sufficient against the normal phase-to-ground voltage, switching surge arising in a power system and continuous abnormal voltage at the time of one phase ground fault, etc.

Moreover, the number of insulator strings should also be determined from the gap efficiency for maintaining the gap of arcing horns which are installed to protect insulators against lightning, etc. so that any insulator will not be damaged due to the heat generated on the insulator surface by arc resulting from flashover at the time of lightning.

The number of insulator strings is concluded to be as listed in Table 5.2-1, although the number should be determined further concretely as described in Item (a), (b) and (c) below.

Table 5.2-1 Number of Insulators per String and Arcing Horn Gap

Applicable areas	Insulator device	No. of 250 mm suspension type insulators per string	Impulse flashover voltage (kV)	Gap of arcing horns (mm)	Efficiency of arcing horn gap (%)
Inland area *2 (Equivalent density of salt content: 0.01 mg/cm²)	Suspension	10	750	1,200	82
	Tension	11	750	1,200	75
Sea side area and dust-contaminated area (Equivalent density of salt content: 0.03 mg/cm²)	Suspension	12	750	1,200	68
	Tension	12	750	1,200	68

Notes *1. The gap efficiency refers to a ratio of the arcing horn gap (Z) to the length of insulator string (Zo) (Z/Zo x 100). As is clear from Fig. 5.2-1, the higher this ratio, for example, the lower the critical flashover voltage (the maximum voltage at which the insulator surface is not subjected to flashover). Thereby, the insulator become the more susceptible to damage due to heat generated on the insulator surface by flashover at the time of lightning.

The gap of arcing horns (Z) should, therefore, be so determined that the critical flashover voltage in 150 kV transmission line would become not less than 1.5 times of 50% flashover voltage.

*2. The equivalent density of salt deposit refers to a scale indicating an extent of contamination on the assumption that all contaminants consist of salt content. This density is expressed in terms of the amount of salt content per unit area or mg/cm^2 when the electric conductivity of actual contaminants has reached to a level equivalent to the conductivity of salt content.

(a) Voltage build-up of the line due to one-phase grounded fault

This number refers to that required to withstand against the rise of potential in sound phase at the time of one-phase fault.

Maximum allowable voltage		170 kV		TENGANGAN-TEGANGAN STANDAR, SPLN1: 1978
Target withstand voltage		127.6 kV		Rise of potential in sound phase at the time of one phase ground fault
Design density of salt content		0.03 mg/cm^2	0.01 mg/cm^2	
Insulator type		250 mm dia. suspension type insulator	250 mm dia. suspension type insulator	
Contamination withstand voltage of 250 mm dia. suspension type insulator		11.0 kV/insulator	14.8 kV/insulator	
No. of insulators per string	Suspension	12	10*	*Number determined from the efficiency of arcing horn gap.
	Tension	12	11*	

(b) Number of insulators required against switching surge

Maximum allowable voltage		170 kV	TEGANGAN-TEGANGAN STANDAR, SPLN1: 1978
Crest valve of withstand voltage		138.8 kV	
Multiplication factor of switching surge		2.8	
Required insulation strength of insulator string		466.4 kV	Correction coefficient atmospheric pressure: 1.2
No. of insulators per string	Suspension	10*	*Number determined from the efficiency of arcing horn gap
	Tension	11*	