2.2. Regional Load Forecast

By the method explained in Appendix A. "The Method of Forecasting Load by Region Based on The Historical Data of Sales", the demand forecast value by use and by Cabang obtained in the preceding paragraph is converted into the peak time demand so as to be outputted as a time series by substations for distribution. (Refer to Table 2.2-1 (1) ∿ (14)) The summary of this method is shown in Fig. 2.2-1. It is characterized that the obtained result has the sufficient objectiveness and reproducibility, because most of the enormous calculations proceeded to be computerized, except the following two (2) items. Since the estimation is based on the monthly billing statistics, the big volume of calculation like the time series trend analysis can be routinely and quickly executed in connection with zones determined by the location of each customer. As a result, the variations of regional load growth tendency can be taken without delay and reflected into the load forecast. In case that the data accumulation period is not long enough, however, the reliability of forecast value is not certain enough. (In this time, the period used for data accumulation is nothing but fifteen (15) months.) Accordingly, it is advisable to adjust the total value by the target value obtained separately. The demand forecast value obtained in the preceding section was utilized for target data in this time. Above two (2) items for which the detailed studies are required in prior to the computarized calculation are as follows:

(i) Standardized Weekday Load Curves by Use

Weekday load curves of twenty four (24) hours for several use categories are established. The value thereof shows a ratio of load by hours (MW) to the contracted capacity (MVA) or average demand on a weekday (MW). The establishment of such curve enables the estimate of demand conversion factors for every time points in a weekday including the peak time with a high accuracy.

(ii) Supply area by every distribution substation

The following is used for the forecasting of supply area:

1) The maps defining the locations of substations, existing/planned distribution lines and every zone in outline.

2) The latest data on load condition of every distribution substation.

2.2.1. Principal Input Data

(1) Weekday Factors

The proportions of weekday average demand to the weekly or monthly average demand are supposedly set by use in the following way, taking into consideration the whole demand record of the system.

Use	Weekday Factor
For Residential	1.000
For Commercial/Public	1.035
For Industrial	1.050
TOTAL :	1.030

(2) Demand Conversion Factors

The proportions of weekday every-hour demand(kW) to the contractual kVA in September 1983 and weekday average demand (kW) are fixed on a trial and error basis by employing the billing statistics together with the load curves of whole system demand, which equals the standard load curves by use.
The factors corresponding to 14 and 19 hours were extracted from these load curves and employed as in the following table.

	for Contract kVA		for Weekday Average Demand	
	14 hours	19 hours	14 hours	19 hours
Residential	(0.1819) 0.1200	(0.4010) 0.3800	(0.7153) 0.4720	(1.5768) 1.4940
Commercial/Public	(0.2806) 0.2000	(0.2639) 0.2800	(1.3915) 1.0410	(1.3096) 1.4580
Light Industry (I1 + I2)	0.2100	0.1300	1.5650	0.9690
Heavy Industry (I3)	0.3250	0.2850	1.3340	1.1700
Heavy Industry (I4)	0.6000	0.6000	1.0000	1.0000

The figures in parenthesis shown on the above table were obtained by considering the variations of future load curves, and are regarded as a value at the time of December 2004. The values between September 1983 and December 2004 are obtained by linear interpolation.

(3) Trend curves by Cabang of distribution loss rate

The distribution loss rates by Cabang are to be converged into a constant value (set at 10% for each Cabang), along with revised exponential curves, and the following formulas were obtained out of annual statistical results carried out by PLN data and the estimated values, and were applied to each Cabang.

(Loss rate) = K + S* (expA)*(expB)**t [%]
Where, K=10.0, S= -1 ..... Cabang Banyuwangi
S= +1 ..... Others of each Cabang

t: elapsed years after Dec. 1900.

Cabang	A	B	Cabang	A	B
Surabaya Utara	27.04162	-0.3040436	Mojokerto	27.57348	-0.3064051
Surabaya Selatan	31.00065	-0.3443655	Madiun	29.14473	-0.3285625
Bojonegoro	49.48337	-0.5582369	Jember	27.47745	-0.3091248
Malang	32.17167	-0.3579769	Banyuwangi	61.03855	-0.7307686
Pasuruan	34.25163	-0.3815969	Situbondo	24.25191	-0.2680974
Kediri	28.06051	-0.3116261	Pamekasan	59.77571	-0.7241021

(4) Supply areas by substation

The supply areas by substation are specified as input data, at an unit of one tenth (1/10) of each zone, at the time of first year and when supply area is modified.
This is to make the modification by a trial and error method from the results of outputs by substation, as shown in Fig. 2.2-1(2).

2.2.2. Load Forecasting

(1) Distribution substations

Based upon the supply areas mentioned above, the forecast loads by substation are to come out by electronic computation. (Table 2.2-1 (1) ∿ (14))

(2) Big customers of HV supply

As stated in Appendix A.4(3), the peak loads of big customers for HV supply of 70kV and 150kV were forecast by each substation. (Table A-15)
Table 2.2-3 shows the compiled results of forecast loads at 19 hours every weekday by distribution substation.

(3) Bali Island

The following shows the actual peak loads and estimated load in recent years of Denpasar system.

Time	1983/3	1984/3	1985/3	1986/3	1987/3
Load at peak	26.2	39.1	44.9	51.4	63.6MW

On the basis of the above results, the estimated values were obtained after a regressive analysis of growth curves as seen in the following Table. Considering that it is equal to 90% of the whole island's load, the load of the whole island was obtained. The increasing portion after March 1987 over the obtained load for the whole island in March 1986 is deemed to be the load to be supplied from the main island.

During the third and/or fourth stage, the geothermal power plant may be developed, in which case it is considered that this plant will substitute the gas turbine and/or diesel power plants.

Time	Peak load	Whole Bali Is.	Increasing portian over March 1986
1983/3	27.8 MW	30.9 MW	----
84/3	36.2	40.2	----
85/3	45.0	50.0	----
86/3	53.9	59.9	----
87/3	62.4	69.3	9.4 MW
88/3	70.5	78.3	18.4
89/3	77.9	86.6	26.7
90/3	84.6	94.0	34.1
91/3	90.5	100.6	40.7
92/3	95.7	106.3	46.4
93/3	100.2	111.3	51.4
94/3	104.1	115.7	55.8
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99/3	116.1	129.0	69.1
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2004/3	120.9	134.0	74.1

Table 2.2-1(1)

SUMMARY OF SUBSTATION LOAD FORECAST MW

1 SURABAYA UTARA

	UJUNG		KREMBANGAN:NEW PERAK		SAWAHAN		TANDES		SEGOROMADU	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	3.53	6.66	7.11	13.61	14.83	22.45	10.14	14.32	5.18	7.19
1984/ 4	3.54	6.71	7.21	13.86	14.89	22.51	10.05	13.90	5.20	7.27
1984/ 5	3.56	6.74	7.25	13.95	14.89	22.50	10.04	13.92	5.17	7.23
1984/ 6	3.59	6.81	7.28	14.02	15.22	22.92	10.17	14.07	5.30	7.64
1985/ 3 **	3.92	7.31	8.01	15.18	16.81	24.86	11.25	15.30	6.07	8.89
1986/ 3	4.42	7.98	9.13	16.90	19.16	27.59	12.89	17.07	7.33	10.95
1987/ 3	4.96	8.70	10.40	18.81	21.73	30.43	14.73	18.96	8.89	13.57
1988/ 3	5.59	9.50	11.83	20.90	24.51	33.28	16.78	20.90	10.84	16.87
1989/ 3	6.29	10.39	13.43	23.17	27.53	36.25	19.03	22.86	13.20	20.84
1990/ 3	7.08	11.37	15.24	25.72	30.84	39.41	21.59	25.07	15.85	25.09
1991/ 3	7.96	12.45	17.28	28.58	34.45	42.79	24.50	27.54	18.81	29.61
1992/ 3	8.95	13.63	19.59	31.77	38.38	46.38	27.78	30.32	22.09	34.36
1993/ 3	10.04	14.93	22.19	35.35	42.62	50.17	31.49	33.43	15.43	23.59 *
1994/ 3	11.25	16.35	25.10	39.34	47.20	54.17	35.66	36.90	17.81	26.69
1995/ 3	12.59	17.89	28.37	43.78	52.13	58.38	40.34	40.78	20.42	29.87
1996/ 3	14.07	19.58	32.01	48.72	57.40	62.79	45.58	45.10	23.25	33.13
1997/ 3	15.69	21.40	18.36	26.26 *	63.02	67.42	51.40	49.89	26.31	36.43
1998/ 3	17.46	23.39	20.56	28.99	69.00	72.25	57.86	55.18	29.61	39.74
1999/ 3	19.38	25.53	22.97	32.01	75.34	77.29	64.98	61.01	33.12	43.04
2004/ 3	31.36	38.83	38.03	50.26	111.78	105.10	110.29	97.99	54.07	59.93

	SIMOKERTO		BENOWO		SURABAYA UTARA	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	0.0	0.0	0.0	0.0	40.78	64.24
1984/ 4	0.0	0.0	0.0	0.0	40.89	64.26
1984/ 5	0.0	0.0	0.0	0.0	40.91	64.35
1984/ 6	0.0	0.0	0.0	0.0	41.55	65.46
1985/ 3 **	0.0	0.0	0.0	0.0	46.07	71.54
1986/ 3	0.0	0.0	0.0	0.0	52.92	80.50
1987/ 3	0.0	0.0	0.0	0.0	60.73	90.46
1988/ 3	0.0	0.0	0.0	0.0	69.55	101.45
1989/ 3	0.0	0.0	0.0	0.0	79.48	113.51
1990/ 3	0.0	0.0	0.0	0.0	90.60	126.66
1991/ 3	0.0	0.0	0.0	0.0	103.00	140.97
1992/ 3	0.0	0.0	0.0	0.0	116.79	156.46
1993/ 3	0.0	0.0	10.28	15.73 *	132.05	173.20 *
1994/ 3	0.0	0.0	11.87	17.79	148.91	191.23
1995/ 3	0.0	0.0	13.61	19.91	167.46	210.61
1996/ 3	0.0	0.0	15.50	22.08	187.81	231.40
1997/ 3	17.71	27.96 *	17.54	24.29	210.05	253.64 *
1998/ 3	20.02	31.31	19.74	26.50	234.25	277.36
1999/ 3	22.59	35.02	22.08	28.69	260.46	302.59
2004/ 3	38.81	57.54	36.04	39.96	420.38	449.62

Table 2.2-1(2)

SUMMARY OF SUBSTATION LOAD FORECAST MW

2 SURABAYA SELATAN

	WARU		SUKOLILO		NGAGEL		DRIYORE JO		BUDURAN(SIDOARJO)	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	26.06	36.00	51.37	62.16	7.66	13.20	6.98	7.31	11.92	13.05
1984/ 4	26.14	36.13	51.35	62.25	7.52	12.99	6.97	7.32	12.14	13.28
1984/ 5	25.96	36.02	52.32	63.20	7.73	13.24	6.78	7.16	12.26	13.42
1984/ 6	26.02	36.24	52.28	63.21	7.73	13.25	6.69	7.13	12.29	13.51
1985/ 3 **	28.12	39.05	22.64	27.89 *	4.18	7.04 *	7.43	8.32	13.44	14.93
1986/ 3	31.64	43.53	26.00	31.57	4.65	7.60	7.60	7.44 *	8.40	9.94 *
1987/ 3	16.43	23.67 *	27.82	32.80 *	5.20	8.25	8.75	8.74	9.64	11.64
1988/ 3	18.56	26.15	32.29	37.59	5.83	8.99	6.01	6.01 *	11.14	13.75
1989/ 3	20.96	28.84	37.55	43.17	6.54	9.81	6.86	6.81	12.96	16.36
1990/ 3	23.69	31.86	43.66	49.63	7.34	10.71	7.84	7.74	14.92	18.87
1991/ 3	26.78	35.25	50.70	57.04	8.23	11.71	8.98	8.81	17.02	21.26
1992/ 3	30.27	38.98	58.76	65.49	9.24	12.80	10.27	10.00	19.41	23.77
1993/ 3	34.23	43.11	67.89	75.04	10.36	13.99	11.76	11.34	22,10	26.40
1994/ 3	38.74	47.69	78.15	85.76	11.62	15.29	13.49	12.86	25.18	29.16
1995/ 3	43.91	52.82	89.58	97.71	13.02	16.72	15.51	14.60	28.69	32.09
1996/ 3	50.01	58.94	101.78	109.89	14.58	18.27	17.98	16.82	33.16	36.28
1997/ 3	57.08	65.91	115.00	123.01	16.32	19.98	20.90	19.43	38.37	41,04
1998/ 3	65.50	74.01	46.15	57.82 *	18.22	21.82	24.51	22.60	44.39	46.42
1999/ 3	75.29	83.34	52.84	64.72	20.30	23.82	28.81	26.35	51.42	52.74
2004/ 3	128.29	133.63	88.47	99.85	32.02	34.89	51.83	46.26	88.96	85.36

	KENJERAN		RUNGKUT		SIMPANG		DARMO GRAND		BABATAN	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984/ 4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984/ 5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984/ 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985/ 3 **	9.86	15.73 *	29.35	32.38 *	0.0	0.0	0.0	0.0	0.0	0.0
1986/ 3	10.98	17.16	34.14	37.13	0.0	0.0	0.0	0.0	0.0	0.0
1987/ 3	8.79	13.45 *	39.92	42.87	8.30	13.54 *	16.88	20.29 *	0.0	0.0
1988/ 3	9.89	14.83	46.79	49.65	9.32	14.89	19.13	22.91	4.00	4.00 *
1989/ 3	11.15	16.40	54.85	57.59	10.51	16.43	21.66	25.61	4.57	4.54
1990/ 3	12.60	18.16	64.21	66.77	11.86	18.17	14.07	17.52 *	5.23	5.16
1991/ 3	14.27	20.16	41.59	44.50 *	13.41	20.13	15.99	19.56	5.98	5.87
1992/ 3	16.18	22.41	48.19	51.00	15.19	22.33	18.20	21.82	6.85	6.67
1993/ 3	18.40	24.97	55.57	58.26	17.23	24.82	20.76	24.32	7.84	7.56
1994/ 3	20.96	27.87	63.73	66.29	19.57	27.64	23.73	27.10	8.99	8.57
1995/ 3	23.93	31.17	72.63	75.05	22.28	30.82	27.18	30.21	10.34	9.73
1996/ 3	27.39	34.94	81.79	83.48	25.41	34.44	31.38	34.15	11.99	11.21
1997/ 3	31.39	39.23	91.38	92.18	29.01	38.55	36.30	38.69	13.94	12.96
1998/ 3	35.99	44.11	101.16	100.97	33.13	43.20	41.99	43.87	55.30	52.76 *
1999/ 3	41.25	49.63	80.88	81.26 *	37.63	47.96	48.59	49.88	60.57	57.44
2004/ 3	70.78	81.17	103.41	94.52 *	61.99	73.23	84.45	82.04	103.41	94.52

Table 2.2-1(3)

SUMMARY OF SUBSTATION LOAD FORECAST MW

2 SURABAYA SELATAN

	KRIAN DAYTIME	KRIAN EVENING	NGIWO DAYTIME	NGIWO EVENING	SEMANBUNG DAYTIME	SEMANBUNG EVENING	KALANG PILANG DAYTIME	KALANG PILANG EVENING	KETINTANG DAYTIME	KETINTANG EVENING
1984/ 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984/ 4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984/ 5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984/ 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985/ 3 **	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986/ 3	8.10	10.18 *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987/ 3	9.40	11.66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988/ 3	11.07	13.75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989/ 3	12.98	16.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990/ 3	15.16	18.56	0.0	0.0	0.0	0.0	10.53	11.20 *	0.0	0.0
1991/ 3	17.64	21.30	0.0	0.0	33.36	32.79 *	12.05	12.71	0.0	0.0
1992/ 3	20.42	24.25	0.0	0.0	38.95	38.20	13.82	14.38	0.0	0.0
1993/ 3	23.50	27.39	0.0	0.0	45.21	44.28	15.88	16.24	0.0	0.0
1994/ 3	26.90	30.71	0.0	0.0	52.12	51.00	18.31	18.34	0.0	0.0
1995/ 3	30.60	34.16	0.0	0.0	59.61	58.34	21.16	20.71	0.0	0.0
1996/ 3	34.77	38.18	0.0	0.0	67.21	65.20	24.70	23.85	0.0	0.0
1997/ 3	39.29	42.41	0.0	0.0	75.06	72.20	28.89	27.52	0.0	0.0
1998/ 3	16.45	20.43 *	55.30	52.76 *	82.94	79.15	33.77	31.76	0.0	0.0
1999/ 3	19.03	22.92	60.57	57.44	60.57	57.44 *	39.50	36.74	60.57	57.44 *
2004/ 3	35.06	37.35	103.41	94.52	103.41	94.52	70.48	63.20	103.41	94.52

	TROSOBO DAYTIME	TROSOBO EVENING	SIDOSERMO DAYTIME	SIDOSERMO EVENING	SURABAYA SELATAN DAYTIME	SURABAYA SELATAN EVENING
1984/ 3	0.0	0.0	0.0	0.0	104.00	131.72
1984/ 4	0.0	0.0	0.0	0.0	104.11	131.97
1984/ 5	0.0	0.0	0.0	0.0	105.04	133.05
1984/ 6	0.0	0.0	0.0	0.0	105.00	133.34
1985/ 3 **	0.0	0.0	0.0	0.0	115.01	145.35 *
1986/ 3	0.0	0.0	0.0	0.0	131.53	164.55 *
1987/ 3	0.0	0.0	0.0	0.0	151.13	186.90 *
1988/ 3	0.0	0.0	0.0	0.0	174.04	212.52 *
1989/ 3	0.0	0.0	0.0	0.0	200.59	241.60
1990/ 3	0.0	0.0	0.0	0.0	231.11	274.36 *
1991/ 3	0.0	0.0	0.0	0.0	266.01	311.09 *
1992/ 3	0.0	0.0	0.0	0.0	305.73	352.10
1993/ 3	0.0	0.0	0.0	0.0	350.72	397.71
1994/ 3	0.0	0.0	0.0	0.0	401.48	448.27
1995/ 3	0.0	0.0	0.0	0.0	458.46	504.14
1996/ 3	0.0	0.0	0.0	0.0	522.14	565.65
1997/ 3	0.0	0.0	0.0	0.0	592.92	633.11
1998/ 3	16.34	15.06 *	0.0	0.0	671.15	706.74 *
1999/ 3	19.20	17.57	0.0	0.0	757.03	786.69 *
2004/ 3	34.56	30.84	32.02	34.89 *	1295.95	1275.33 *

Table 2.2-1(4)

SUMMARY OF SUBSTATION LOAD FORECAST MW

3 BOJONEGORO

	BOJONEGORO DAYTIME	EVENING	BABAT DAYTIME	EVENING	LAMONGAN DAYTIME	EVENING	TUBAN DAYTIME	EVENING	BOJONEGORO DAYTIME	EVENING
1984/ 3	1.19	2.79	0.81	2.00	0.48	1.28	0.0	0.0	2.47	6.07
1984/ 4	1.19	2.79	0.80	1.99	0.48	1.28	0.0	0.0	2.47	6.06
1984/ 5	1.18	2.77	0.81	2.01	1.51	2.28	0.0	0.0	3.50	7.06
1984/ 6	1.18	2.76	0.80	2.00	1.52	2.31	0.0	0.0	3.50	7.06
1985/ 3 **	1.23	2.73	0.82	1.96	0.58	1.49	0.0	0.0	2.64	6.19
1986/ 3	1.40	2.84	0.89	1.97	0.70	1.70	0.0	0.0	2.98	6.51
1987/ 3	1.69	3.09	1.01	2.03	0.87	1.98	0.0	0.0	3.57	7.11
1988/ 3	2.14	3.48	1.05	2.01 *	0.52	1.11 *	0.70	1.34 *	4.41	7.94 *
1989/ 3	2.72	4.00	1.29	2.26	0.60	1.21	0.86	1.50	5.47	8.97
1990/ 3	3.35	4.57	1.54	2.53	0.69	1.30	1.02	1.68	6.60	10.08
1991/ 3	3.93	5.17	1.76	2.77	0.77	1.38	1.18	1.85	7.64	11.17
1992/ 3	4.40	5.72	1.96	3.01	0.85	1.46	1.30	2.01	8.51	12.20
1993/ 3	4.76	6.17	2.13	3.23	0.94	1.60	1.42	2.15	9.25	13.15
1994/ 3	5.06	6.61	2.27	3.44	1.05	1.73	1.52	2.30	9.90	14.08
1995/ 3	5.33	7.05	2.41	3.65	1.15	1.87	1.61	2.43	10.50	15.00
1996/ 3	5.59	7.51	2.55	3.85	1.26	2.00	1.70	2.56	11.09	15.93
1997/ 3	5.87	8.00	2.68	4.04	1.37	2.14	1.78	2.69	11.69	16.87
1998/ 3	6.15	8.53	2.80	4.22	1.48	2.27	1.87	2.81	12.30	17.84
1999/ 3	6.47	9.11	2.93	4.39	1.59	2.40	1.95	2.92	12.94	18.82
2004/ 3	8.54	12.90	3.42	4.87	2.11	2.85	2.28	3.25	16.35	23.87

Table 2.2-1(5)

SUMMARY OF SUBSTATION LOAD FORECAST MW

4 MALANG

	KEBONAGUNG		POLEHAN		BLIMBING		SENGKALING		LAWANG	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	5.41	11.86	4.29	6.16	3.20	5.87	1.49	2.40	2.52	4.38
1984/ 4	5.42	11.87	4.29	6.18	3.23	5.93	1.51	2.45	2.56	4.45
1984/ 5	5.47	11.96	4.30	6.21	3.25	6.00	1.53	2.50	2.58	4.52
1984/ 6	5.52	12.05	4.31	6.25	3.29	6.13	1.54	2.53	2.61	4.58
1985/ 3 **	6.19	13.26	4.76	6.86	3.65	6.74	1.73	2.84	2.93	5.11
1986/ 3	7.15	14.92	5.45	7.76	3.80	6.82 *	2.46	4.24 *	3.43	5.96
1987/ 3	8.17	16.55	6.25	8.73	4.44	7.87	2.90	4.99	4.05	7.00
1988/ 3	9.21	18.03	7.16	9.77	5.19	9.12	3.44	5.90	4.79	8.26
1989/ 3	10.17	19.08	8.22	10.98	6.08	10.60	4.08	7.00	5.68	9.76
1990/ 3	11.25	20.46	9.45	12.38	7.13	12.33	4.74	7.97	6.66	11.30
1991/ 3	12.52	22.07	10.83	13.86	8.35	14.35	5.50	9.10	7.71	12.86
1992/ 3	13.88	23.78	12.36	15.44	9.79	16.72	6.35	10.32	8.84	14.44
1993/ 3	15.33	25.58	14.09	17.19	11.36	19.15	7.27	11.57	10.09	16.16
1994/ 3	16.88	27.46	16.05	19.15	12.93	21.37	8.31	12.97	11.51	18.06
1995/ 3	18.51	29.43	18.24	21.30	14.63	23.69	9.45	14.44	13.06	20.08
1996/ 3	20.24	31.46	20.68	23.64	16.47	26.10	10.70	15.99	14.75	22.19
1997/ 3	22.04	33.57	23.38	26.20	18.46	28.61	12.06	17.63	16.59	24.40
1998/ 3	23.92	35.75	26.36	28.97	20.59	31.20	13.55	19.34	18.57	26.71
1999/ 3	25.88	37.99	29.62	31.97	22.86	33.87	15.15	21.14	20.72	29.12
2004/ 3	36.74	50.26	50.24	50.40	36.21	48.08	24.97	31.20	33.66	42.45

	SUKOREJO		TUREN		SENGGURUH		KARANGKATES		PLTA SELOREJO	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	0.47	1.08	1.60	2.88	0.28	0.52	0.28	0.52	0.24	0.54
1984/ 4	0.49	1.09	1.62	2.93	0.28	0.52	0.28	0.52	0.25	0.55
1984/ 5	0.50	1.11	1.64	2.99	0.29	0.53	0.29	0.53	0.25	0.56
1984/ 6	0.50	1.13	1.66	3.03	0.29	0.54	0.29	0.54	0.25	0.57
1985/ 3 **	0.57	1.26	1.86	3.39	0.33	0.60	0.33	0.60	0.28	0.63
1986/ 3	0.67	1.48	2.19	3.97	0.38	0.69	0.38	0.69	0.33	0.74
1987/ 3	0.79	1.74	2.59	4.69	0.45	0.81	0.45	0.81	0.40	0.87
1988/ 3	0.94	2.06	3.07	5.57	0.53	0.95	0.53	0.95	0.47	1.03
1989/ 3	1.13	2.44	3.66	6.63	0.63	1.11	0.63	1.11	0.56	1.22
1990/ 3	1.34	2.86	4.28	7.61	0.74	1.31	0.74	1.31	0.67	1.43
1991/ 3	1.53	3.22	3.03	5.20 *	0.86	1.49	0.86	1.49	0.77	1.61
1992/ 3	1.74	3.58	3.48	5.84	0.99	1.67	0.99	1.67	0.87	1.79
1993/ 3	1.96	3.97	3.97	6.54	1.12	1.86	1.12	1.86	0.98	1.99
1994/ 3	2.21	4.40	4.54	7.32	1.27	2.08	1.27	2.08	1.10	2.20
1995/ 3	2.47	4.84	5.16	8.14	1.43	2.30	1.43	2.30	1.23	2.42
1996/ 3	2.74	5.28	5.83	9.01	1.61	2.53	1.61	2.53	1.37	2.64
1997/ 3	3.03	5.72	6.57	9.91	1.80	2.77	1.80	2.77	1.51	2.86
1998/ 3	3.32	6.17	7.37	10.86	2.00	3.01	2.00	3.01	1.66	3.08
1999/ 3	3.62	6.61	8.23	11.84	2.22	3.26	2.22	3.26	1.81	3.30
2004/ 3	5.19	8.64	13.44	17.29	3.48	4.60	3.48	4.60	2.59	4.32

Table 2.2-1(6)

SUMMARY OF SUBSTATION LOAD FORECAST MW

4 MALANG

	KEPANJEN		MALANG	
	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	0.0	0.0	19.79	36.19
1984/ 4	0.0	0.0	19.95	36.50
1984/ 5	0.0	0.0	20.10	36.89
1984/ 6	0.0	0.0	20.28	37.34
1985/ 3 **	0.0	0.0	22.61	41.29
1986/ 3	0.0	0.0	26.25	47.28 *
1987/ 3	0.0	0.0	30.49	54.07
1988/ 3	0.0	0.0	35.34	61.63
1989/ 3	0.0	0.0	40.84	69.93
1990/ 3	0.0	0.0	47.00	78.95
1991/ 3	1.90	3.41 *	53.86	88.67 *
1992/ 3	2.17	3.82	61.44	99.07
1993/ 3	2.48	4.26	69.77	110.13
1994/ 3	2.82	4.76	78.89	121.85
1995/ 3	3.20	5.28	88.82	134.21
1996/ 3	3.60	5.82	99.61	147.20
1997/ 3	4.04	6.39	111.28	160.82
1998/ 3	4.51	6.97	123.85	175.08
1999/ 3	5.02	7.57	137.35	189.94
2004/ 3	8.01	10.80	218.02	272.64

Table 2.2-1(7)

SUMMARY OF SUBSTATION LOAD FORECAST MW

5 PASURUAN

	PROBOLINGO DAYTIME	PROBOLINGO EVENING	PLERED DAYTIME	PLERED EVENING	BANGIL DAYTIME	BANGIL EVENING	PANDAAN DAYTIME	PANDAAN EVENING	PORONG DAYTIME	PORONG EVENING
1984/ 3	4.96	6.64	1.44	2.03	0.77	1.35	2.85	3.65	0.85	1.36
1984/ 4	4.96	6.68	1.44	2.05	0.78	1.37	2.85	3.67	0.86	1.37
1984/ 5	4.96	6.70	1.44	2.06	0.79	1.38	2.84	3.67	0.86	1.38
1984/ 6	4.99	6.81	1.46	2.12	0.78	1.38	2.84	3.68	0.90	1.41
1985/ 3 **	5.53	7.53	1.63	2.36	0.87	1.51	3.13	4.05	1.01	1.58
1986/ 3	6.41	8.68	1.90	2.74	1.00	1.71	3.63	4.65	1.19	1.84
1987/ 3	7.49	10.05	2.23	3.19	1.16	1.95	4.22	5.38	1.41	2.15
1988/ 3	6.39	9.06 *	2.62	3.70	1.36	2.24	4.94	6.24	1.67	2.51
1989/ 3	7.47	10.48	3.07	4.28	1.59	2.58	5.77	7.24	1.97	2.91
1990/ 3	8.72	12.05	3.59	4.93	1.86	2.97	6.74	8.38	2.30	3.35
1991/ 3	10.13	13.79	4.17	5.64	2.17	3.42	7.86	9.68	2.68	3.83
1992/ 3	11.73	15.71	4.83	6.42	2.53	3.93	9.12	11.08	3.10	4.35
1993/ 3	13.51	17.80	5.56	7.27	2.94	4.52	10.53	12.62	3.57	4.92
1994/ 3	15.48	20.06	6.36	8.19	3.40	5.16	12.12	14.32	4.08	5.52
1995/ 3	17.67	22.52	7.26	9.19	3.88	5.78	13.90	16.19	4.64	6.17
1996/ 3	20.08	25.15	8.23	10.25	4.40	6.45	15.87	18.22	5.25	6.85
1997/ 3	22.70	27.95	9.30	11.37	4.98	7.15	18.05	20.42	5.90	7.57
1998/ 3	25.54	30.92	10.45	12.55	5.59	7.88	20.43	22.79	6.59	8.31
1999/ 3	28.61	34.04	11.68	13.80	6.26	8.65	23.02	25.32	7.34	9.08
2004/ 3	46.91	51.46	19.01	20.69	10.18	12.87	38.93	40.13	11.61	13.18

	LECES DAYTIME	LECES EVENING	KRAKSAAN DAYTIME	KRAKSAAN EVENING	PAITON DAYTIME	PAITON EVENING	PASURUAN DAYTIME	PASURUAN EVENING
1984/ 3	2.08	3.01	0.0	0.0	0.0	0.0	12.95	18.03
1984/ 4	2.08	3.04	0.0	0.0	0.0	0.0	12.97	18.18
1984/ 5	2.09	3.05	0.0	0.0	0.0	0.0	12.98	18.25
1984/ 6	2.09	3.07	0.0	0.0	0.0	0.0	13.06	18.48
1985/ 3 **	2.32	3.40	0.0	0.0	0.0	0.0	14.48	20.43
1986/ 3	2.69	3.93	0.0	0.0	0.0	0.0	16.83	23.55
1987/ 3	3.14	4.55	0.0	0.0	0.0	0.0	19.67	27.27
1988/ 3	3.68	5.26	1.66	1.80 *	0.71	0.77 *	23.02	31.59 *
1989/ 3	4.30	6.08	1.93	2.07	0.83	0.89	26.94	36.52
1990/ 3	5.01	6.99	2.25	2.39	0.97	1.02	31.44	42.08
1991/ 3	5.82	7.99	2.62	2.75	1.12	1.18	36.58	48.28
1992/ 3	6.73	9.11	3.05	3.17	1.31	1.36	42.39	55.14
1993/ 3	7.76	10.34	3.53	3.64	1.51	1.56	48.91	62.67
1994/ 3	8.91	11.66	4.08	4.17	1.75	1.79	56.18	70.88
1995/ 3	10.18	13.12	4.71	4.76	2.02	2.04	64.25	79.77
1996/ 3	11.59	14.68	5.41	5.43	2.32	2.33	73.14	89.35
1997/ 3	13.13	16.35	6.19	6.17	2.65	2.64	82.88	99.62
1998/ 3	14.81	18.13	7.06	6.99	3.02	2.99	93.49	110.56
1999/ 3	16.62	20.01	8.01	7.88	3.43	3.38	104.98	122.16
2004/ 3	27.58	30.64	14.10	13.58	6.04	5.82	174.36	188.37

Table 2.2-1(8)

SUMMARY OF SUBSTATION LOAD FORECAST MW

6 KEDIRI

	KEDIRI		TULUNGAGUNG		BLITAR		PLTA WLINGI		KERTOSONO	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	3.66	6.65	1.68	2.98	0.65	1.24	0.43	0.82	0.99	2.22
1984/ 4	3.69	6.71	1.67	2.97	0.65	1.25	0.44	0.83	1.00	2.24
1984/ 5	3.71	6.80	1.71	3.05	0.67	1.29	0.45	0.86	1.02	2.29
1984/ 6	3.76	6.84	1.73	3.07	0.68	1.30	0.45	0.87	1.03	2.31
1985/ 3 **	4.25	7.63	2.04	3.68	0.79	1.51	0.52	1.01	1.16	2.53
1986/ 3	4.99	8.76	2.56	4.72	0.96	1.84	0.64	1.22	1.10	2.36 *
1987/ 3	5.85	10.02	3.23	6.08	1.18	2.24	0.78	1.50	1.26	2.61
1988/ 3	6.86	11.47	4.01	7.61	1.44	2.74	0.96	1.83	1.44	2.87
1989/ 3	8.04	13.17	4.87	9.21	1.76	3.34	1.17	2.23	1.64	3.16
1990/ 3	9.38	15.03	5.83	10.93	2.14	4.08	1.43	2.72	1.86	3.47
1991/ 3	10.91	17.13	6.85	12.65	2.61	4.97	1.74	3.32	2.11	3.82
1992/ 3	12.64	19.49	7.92	14.32	3.16	6.04	2.11	4.03	2.39	4.20
1993/ 3	14.64	22.23	9.22	16.44	3.66	6.90	2.44	4.60	2.69	4.63
1994/ 3	16.91	25.35	10.63	18.62	4.19	7.78	2.79	5.18	3.03	5.09
1995/ 3	19.46	28.84	12.12	20.81	4.72	8.63	3.15	5.75	3.45	5.65
1996/ 3	22.05	32.08	13.83	23.40	5.33	9.62	3.56	6.42	3.92	6.28
1997/ 3	24.80	35.41	15.72	26.14	5.97	10.64	3.98	7.09	4.46	6.99
1998/ 3	27.74	38.88	17.77	29.02	6.62	11.64	4.41	7.76	5.06	7.78
1999/ 3	30.83	42.43	19.99	32.00	7.27	12.63	4.85	8.42	5.73	8.67
2004/ 3	47.61	60.32	33.33	47.65	10.14	16.66	6.76	11.10	10.78	15.15

	TRENGGALEK		NGANJUK		KEDIRI	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	0.66	1.72	0.0	0.0	8.07	15.64
1984/ 4	0.66	1.73	0.0	0.0	8.11	15.73
1984/ 5	0.66	1.74	0.0	0.0	8.23	16.03
1984/ 6	0.67	1.74	0.0	0.0	8.31	16.13
1985/ 3 **	0.74	1.88	0.0	0.0	9.49	18.23
1986/ 3	0.84	2.05	0.24	0.47 *	11.33	21.42 *
1987/ 3	0.91	2.14	0.28	0.54	13.50	25.12
1988/ 3	0.99	2.20	0.33	0.62	16.03	29.33
1989/ 3	1.07	2.28	0.39	0.71	18.94	34.09
1990/ 3	1.16	2.37	0.45	0.81	22.26	39.40
1991/ 3	1.27	2.46	0.52	0.92	26.00	45.27
1992/ 3	1.38	2.57	0.61	1.05	30.20	51.70
1993/ 3	1.51	2.68	0.70	1.20	34.86	58.68
1994/ 3	1.63	2.80	0.80	1.36	39.99	66.18
1995/ 3	1.77	2.91	0.94	1.57	45.61	74.17
1996/ 3	1.91	3.03	1.10	1.80	51.70	82.63
1997/ 3	2.05	3.14	1.28	2.07	58.27	91.49
1998/ 3	2.18	3.25	1.49	2.37	65.28	100.70
1999/ 3	2.31	3.34	1.74	2.72	72.73	110.21
2004/ 3	2.71	3.51	3.63	5.28	114.96	159.68

Table 2.2-1(9)

SUMMARY OF SUBSTATION LOAD FORECAST MW

7 MOJOKERTO

	MOJOKERTO		PLTA MENDALAN		PLOSO		JOMBANG		MOJOKERTO	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	4.92	7.03	1.25	2.57	0.09	0.23	0.0	0.0	6.26	9.83
1984/ 4	4.96	7.16	1.25	2.57	0.09	0.23	0.0	0.0	6.30	9.96
1984/ 5	4.98	7.22	1.28	2.64	0.09	0.24	0.0	0.0	6.35	10.10
1984/ 6	4.99	7.27	1.30	2.67	0.10	0.24	0.0	0.0	6.39	10.18
1985/ 3 **	5.72	8.48	1.42	2.79	0.10	0.25	0.0	0.0	7.24	11.52
1986/ 3	6.86	10.35	1.58	2.95	0.11	0.26	0.0	0.0	8.56	13.55
1987/ 3	8.21	12.52	1.77	3.12	0.12	0.27	0.0	0.0	10.10	15.91
1988/ 3	9.77	15.01	1.98	3.31	0.13	0.28	0.0	0.0	11.89	18.60
1989/ 3	11.55	17.81	2.21	3.51	0.14	0.29	0.0	0.0	13.91	21.60
1990/ 3	13.55	20.90	0.39	0.75 *	0.15	0.29	2.05	2.95 *	16.14	24.90 *
1991/ 3	15.75	24.28	0.46	0.82	0.16	0.30	2.18	3.03	18.55	28.43
1992/ 3	18.22	28.05	0.55	0.91	0.16	0.30	2.28	3.08	21.21	32.33
1993/ 3	21.03	32.23	0.66	1.03	0.16	0.30	2.40	3.13	24.25	36.69
1994/ 3	24.21	36.85	0.80	1.17	0.17	0.29	2.53	3.20	27.70	41.52
1995/ 3	27.76	41.91	0.99	1.36	0.17	0.30	2.67	3.28	31.59	46.85
1996/ 3	31.73	47.41	1.22	1.59	0.17	0.30	2.84	3.37	35.96	52.67
1997/ 3	36.11	53.32	1.52	1.89	0.17	0.30	3.03	3.47	40.83	58.98
1998/ 3	40.92	59.65	1.90	2.25	0.18	0.30	3.27	3.64	46.26	65.84
1999/ 3	46.21	66.43	2.37	2.70	0.18	0.31	3.63	3.91	52.39	73.34
2004/ 3	78.39	104.25	4.71	4.62 *	0.24	0.35	7.56	7.20 *	90.90	116.42 *

Table 2.2-1(10)

SUMMARY OF SUBSTATION LOAD FORECAST MW

8 MADIUN

	MANISREJO:NEW MADIUN DAYTIME	MANISREJO:NEW MADIUN EVENING	CARUBAN DAYTIME	CARUBAN EVENING	PONOROGO DAYTIME	PONOROGO EVENING	PACITAN DAYTIME	PACITAN EVENING	DOLOPO DAYTIME	DOLOPO EVENING
1984/ 3	5.81	9.86	0.17	0.42	0.48	1.06	0.20	0.51	1.09	2.47
1984/ 4	5.86	9.97	0.17	0.43	0.49	1.10	0.20	0.53	1.12	2.55
1984/ 5	5.91	10.11	0.18	0.44	0.50	1.12	0.20	0.54	1.14	2.60
1984/ 6	5.96	10.25	0.19	0.46	0.51	1.13	0.21	0.55	1.15	2.64
1985/ 3 **	6.64	11.20	0.21	0.51	0.57	1.26	0.24	0.61	1.31	2.94
1986/ 3	7.66	12.57	0.25	0.59	0.67	1.46	0.28	0.71	1.56	3.42
1987/ 3	8.80	14.04	0.30	0.69	0.78	1.69	0.34	0.82	1.86	4.00
1988/ 3	9.34	14.06 *	0.35	0.80	0.91	1.95	0.40	0.96	2.22	4.65
1989/ 3	9.72	13.68 *	0.41	0.92	1.04	2.23	0.46	1.10	2.61	5.35
1990/ 3	11.17	15.42	0.47	1.04	1.19	2.53	0.53	1.25	3.05	6.11
1991/ 3	12.80	17.32	0.54	1.17	1.35	2.84	0.61	1.41	3.52	6.91
1992/ 3	14.61	19.37	0.61	1.31	1.51	3.15	0.69	1.57	4.02	7.73
1993/ 3	16.61	21.58	0.69	1.44	1.68	3.47	0.78	1.73	4.55	8.56
1994/ 3	18.77	23.92	0.76	1.57	1.88	3.82	0.86	1.89	5.13	9.43
1995/ 3	21.13	26.42	0.83	1.69	2.10	4.17	0.94	2.04	5.75	10.31
1996/ 3	23.71	29.08	0.90	1.81	2.33	4.52	1.02	2.18	6.40	11.18
1997/ 3	26.51	31.93	0.96	1.91	2.57	4.87	1.10	2.32	7.08	12.03
1998/ 3	29.53	34.95	1.02	2.01	2.87	5.24	1.17	2.43	7.72	12.83
1999/ 3	32.78	38.18	1.07	2.09	3.19	5.59	1.23	2.53	8.36	13.56
2004/ 3	52.74	56.70	1.33	2.47	4.66	6.89	1.51	2.98	11.36	16.65

	MAGETAN DAYTIME	MAGETAN EVENING	NGAWI DAYTIME	NGAWI EVENING	MADIUN DAYTIME	MADIUN EVENING
1984/ 3	0.0	0.0	0.0	0.0	7.75	14.32
1984/ 4	0.0	0.0	0.0	0.0	7.84	14.57
1984/ 5	0.0	0.0	0.0	0.0	7.93	14.81
1984/ 6	0.0	0.0	0.0	0.0	8.01	15.03
1985/ 3 **	0.0	0.0	0.0	0.0	8.96	16.51
1986/ 3	0.0	0.0	0.0	0.0	10.42	18.75
1987/ 3	0.0	0.0	0.0	0.0	12.08	21.25
1988/ 3	0.0	0.0	0.74	1.57 *	13.95	23.98 *
1989/ 3	0.98	2.05 *	0.79	1.62	16.03	26.95 *
1990/ 3	1.04	2.11	0.86	1.67	18.32	30.14
1991/ 3	1.10	2.16	0.92	1.73	20.84	33.54
1992/ 3	1.15	2.21	0.98	1.78	23.58	37.12
1993/ 3	1.20	2.25	1.05	1.84	26.55	40.88
1994/ 3	1.25	2.29	1.11	1.89	29.77	44.80
1995/ 3	1.30	2.32	1.17	1.93	33.22	48.88
1996/ 3	1.34	2.35	1.22	1.96	36.92	53.08
1997/ 3	1.38	2.37	1.26	1.98	40.88	57.41
1998/ 3	1.47	2.42	1.30	2.00	45.08	61.87
1999/ 3	1.59	2.48	1.32	2.00	49.54	66.43
2004/ 3	2.37	2.93	1.44	2.04	75.41	90.67

Table 2.2-1(11)

SUMMARY OF SUBSTATION LOAD FORECAST MW

9 JEMBER

	JEMBER		LUMAJANG		BONDOWOSO		TANGGUL		JEMBER	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	3.25	7.08	1.06	2.21	0.0	0.0	0.0	0.0	4.32	9.29
1984/ 4	3.30	7.19	1.07	2.24	0.0	0.0	0.0	0.0	4.38	9.44
1984/ 5	3.36	7.32	1.10	2.32	0.0	0.0	0.0	0.0	4.46	9.64
1984/ 6	3.47	7.48	1.12	2.36	0.0	0.0	0.0	0.0	4.59	9.84
1985/ 3 **	3.86	8.10	1.22	2.54	0.0	0.0	0.0	0.0	5.08	10.65
1986/ 3	3.61	7.35 *	1.43	2.87	0.80	1.67 *	0.0	0.0	5.85	11.90 *
1987/ 3	4.13	8.19	1.66	3.22	0.95	1.91	0.0	0.0	6.73	13.32
1988/ 3	4.71	9.12	1.91	3.61	1.13	2.19	0.0	0.0	7.76	14.93
1989/ 3	5.37	10.15	2.21	4.04	1.35	2.52	0.0	0.0	8.93	16.72
1990/ 3	3.40	6.32 *	2.54	4.53	1.62	2.90	2.71	4.96 *	10.26	18.71 *
1991/ 3	3.84	7.00	2.93	5.08	1.94	3.35	3.07	5.49	11.78	20.93
1992/ 3	4.33	7.73	3.39	5.70	2.33	3.87	3.46	6.07	13.50	23.38
1993/ 3	4.85	8.50	3.91	6.40	2.81	4.48	3.88	6.68	15.45	26.06
1994/ 3	5.39	9.31	4.52	7.18	3.38	5.19	4.33	7.33	17.63	29.01
1995/ 3	5.97	10.14	5.22	8.06	4.07	6.03	4.81	8.00	20.08	32.23
1996/ 3	6.57	11.03	6.03	9.04	4.90	6.95	5.31	8.72	22.82	35.74
1997/ 3	7.25	12.00	6.97	10.14	5.78	7.91	5.88	9.50	25.89	39.55
1998/ 3	8.02	13.05	8.05	11.36	6.71	8.90	6.53	10.36	29.31	43.67
1999/ 3	8.88	14.20	9.29	12.73	7.68	9.90	7.26	11.30	33.11	48.13
2004/ 3	15.06	21.51	18.88	22.42	12.92	14.97	12.61	17.40	59.47	76.30

Table 2.2-1(12)

SUMMARY OF SUBSTATION LOAD FORECAST MW

10 BANYUWANGI

	BANYUWANGI		GENTENG		BANYUWANGI	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	1.68	3.86	0.0	0.0	1.68	3.86
1984/ 4	1.71	3.94	0.0	0.0	1.71	3.94
1984/ 5	1.75	4.04	0.0	0.0	1.75	4.04
1984/ 6	1.83	4.18	0.0	0.0	1.83	4.18
1985/ 3 **	2.11	4.66	0.0	0.0	2.11	4.66
1986/ 3	2.56	5.38	0.0	0.0	2.56	5.38
1987/ 3	3.12	6.24	0.0	0.0	3.12	6.24
1988/ 3	3.85	7.25	0.0	0.0	3.85	7.25
1989/ 3	4.80	8.48	0.0	0.0	4.80	8.48
1990/ 3	4.29	7.25 *	1.76	2.73 *	6.05	9.99 *
1991/ 3	5.30	8.37	2.40	3.47	7.70	11.84
1992/ 3	6.61	9.72	3.25	4.42	9.86	14.14
1993/ 3	8.28	11.35	4.39	5.62	12.67	16.98
1994/ 3	10.38	13.31	5.87	7.13	16.25	20.44
1995/ 3	13.00	15.65	7.74	8.99	20.73	24.64
1996/ 3	16.17	18.41	10.06	11.23	26.23	29.63
1997/ 3	19.95	21.63	12.83	13.83	32.78	35.46
1998/ 3	24.34	25.33	16.02	16.78	40.36	42.11
1999/ 3	29.25	29.43	19.60	20.05	48.86	49.48
2004/ 3	56.45	52.62	41.11	39.52	97.56	92.14

Table 2.2-1(13)

SUMMARY OF SUBSTATION LOAD FORECAST MW

11 SITUBONDO

	SITUBONDO			ASEMBAGUS			SITUBONDO		
	DAYTIME	EVENING		DAYTIME	EVENING		DAYTIME	EVENING	
1984/ 3	0.86	2.06		0.0	0.0		0.86	2.06	
1984/ 4	0.87	2.09		0.0	0.0		0.87	2.09	
1984/ 5	0.90	2.16		0.0	0.0		0.90	2.16	
1984/ 6	0.92	2.22		0.0	0.0		0.92	2.22	
1985/ 3 **	0.98	2.32		0.0	0.0		0.98	2.32	
1986/ 3	1.08	2.50		0.0	0.0		1.08	2.50	
1987/ 3	1.20	2.69		0.0	0.0		1.20	2.69	
1988/ 3	1.32	2.90		0.0	0.0		1.32	2.90	
1989/ 3	1.46	3.14		0.0	0.0		1.46	3.14	
1990/ 3	1.62	3.39		0.0	0.0		1.62	3.39	
1991/ 3	1.79	3.67		0.0	0.0		1.79	3.67	
1992/ 3	1.99	3.97		0.0	0.0		1.99	3.97	
1993/ 3	2.20	4.29		0.0	0.0		2.20	4.29	
1994/ 3	2.43	4.64		0.0	0.0		2.43	4.64	
1995/ 3	2.68	5.01		0.0	0.0		2.68	5.01	
1996/ 3	2.95	5.40		0.0	0.0		2.95	5.40	
1997/ 3	3.24	5.81		0.0	0.0		3.24	5.81	
1998/ 3	3.54	6.25		0.0	0.0		3.54	6.25	
1999/ 3	3.87	6.71		0.0	0.0		3.87	6.71	
2004/ 3	5.48	8.87	*	0.26	0.40	*	5.74	9.27	*

Table 2.2-1(14)

SUMMARY OF SUBSTATION LOAD FORECAST MW

12 PAMEKASAN

	CANDIH(GILI TIMUR)		BANGKALAN		SAMPANG		PAMEKASAN		SUMENEP	
	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING	DAYTIME	EVENING
1984/ 3	0.02	0.07	0.35	0.76	0.28	0.69	0.61	1.23	0.46	1.03
1984/ 4	0.03	0.07	0.35	0.76	0.29	0.71	0.63	1.28	0.48	1.08
1984/ 5	0.03	0.08	0.36	0.77	0.30	0.73	0.63	1.30	0.49	1.09
1984/ 6	0.03	0.08	0.36	0.79	0.30	0.75	0.64	1.31	0.49	1.10
1985/ 3 **	0.03	0.09	0.41	0.88	0.35	0.85	0.72	1.47	0.56	1.23
1986/ 3	0.04	0.11	0.48	1.02	0.43	1.01	0.85	1.70	0.66	1.43
1987/ 3	0.05	0.13	0.57	1.18	0.53	1.19	1.00	1.96	0.78	1.64
1988/ 3	0.06	0.16	0.67	1.36	0.64	1.41	1.17	2.24	0.91	1.89
1989/ 3	0.07	0.19	0.78	1.55	0.77	1.67	1.36	2.55	1.06	2.15
1990/ 3	0.09	0.22	0.90	1.76	0.94	1.98	1.57	2.88	1.23	2.44
1991/ 3	0.10	0.26	1.04	1.99	1.13	2.33	1.79	3.24	1.43	2.77
1992/ 3	0.13	0.32	1.18	2.22	1.36	2.73	2.04	3.60	1.65	3.15
1993/ 3	0.15	0.38	1.34	2.47	1.62	3.16	2.31	3.99	1.90	3.57
1994/ 3	0.19	0.45	1.52	2.76	1.89	3.58	2.61	4.41	2.19	4.04
1995/ 3	0.22	0.53	1.72	3.07	2.17	3.97	2.94	4.87	2.52	4.58
1996/ 3	0.27	0.63	1.95	3.44	2.42	4.30	3.30	5.37	2.88	5.19
1997/ 3	0.32	0.73	2.19	3.80	2.71	4.71	3.68	5.88	3.29	5.82
1998/ 3	0.36	0.82	2.44	4.16	3.04	5.19	4.08	6.38	3.71	6.49
1999/ 3	0.41	0.91	2.71	4.54	3.37	5.67	4.50	6.90	4.17	7.21
2004/ 3	0.65	1.34	4.25	6.54	5.11	7.96	6.87	9.53	7.08	11.62

	PAMEKASAN	
	DAYTIME	EVENING
1984/ 3	1.73	3.78
1984/ 4	1.77	3.91
1984/ 5	1.80	3.97
1984/ 6	1.82	4.02
1985/ 3 **	2.08	4.53
1986/ 3	2.47	5.27
1987/ 3	2.92	6.11
1988/ 3	3.44	7.05
1989/ 3	4.04	8.11
1990/ 3	4.72	9.29
1991/ 3	5.50	10.60
1992/ 3	6.36	12.02
1993/ 3	7.32	13.57
1994/ 3	8.40	15.24
1995/ 3	9.57	17.02
1996/ 3	10.83	18.93
1997/ 3	12.19	20.94
1998/ 3	13.64	23.04
1999/ 3	15.17	25.22
2004/ 3	23.96	36.99

Fig. 2.2-1(1) Schematic Illustration of the Regional Load Forecast

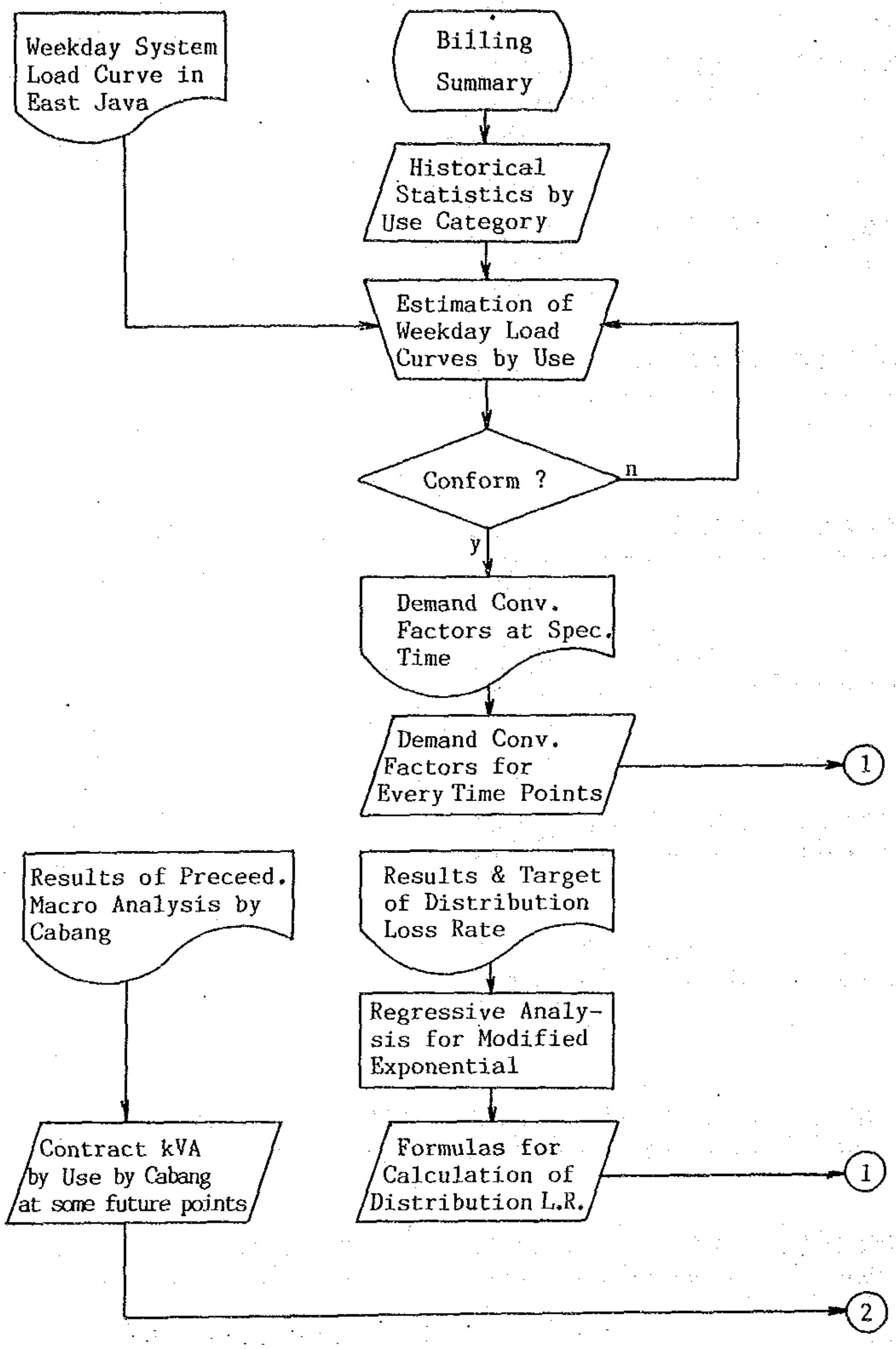


Fig. 2.2-1(2) Schematic Illustration of the Regional Load Forecast

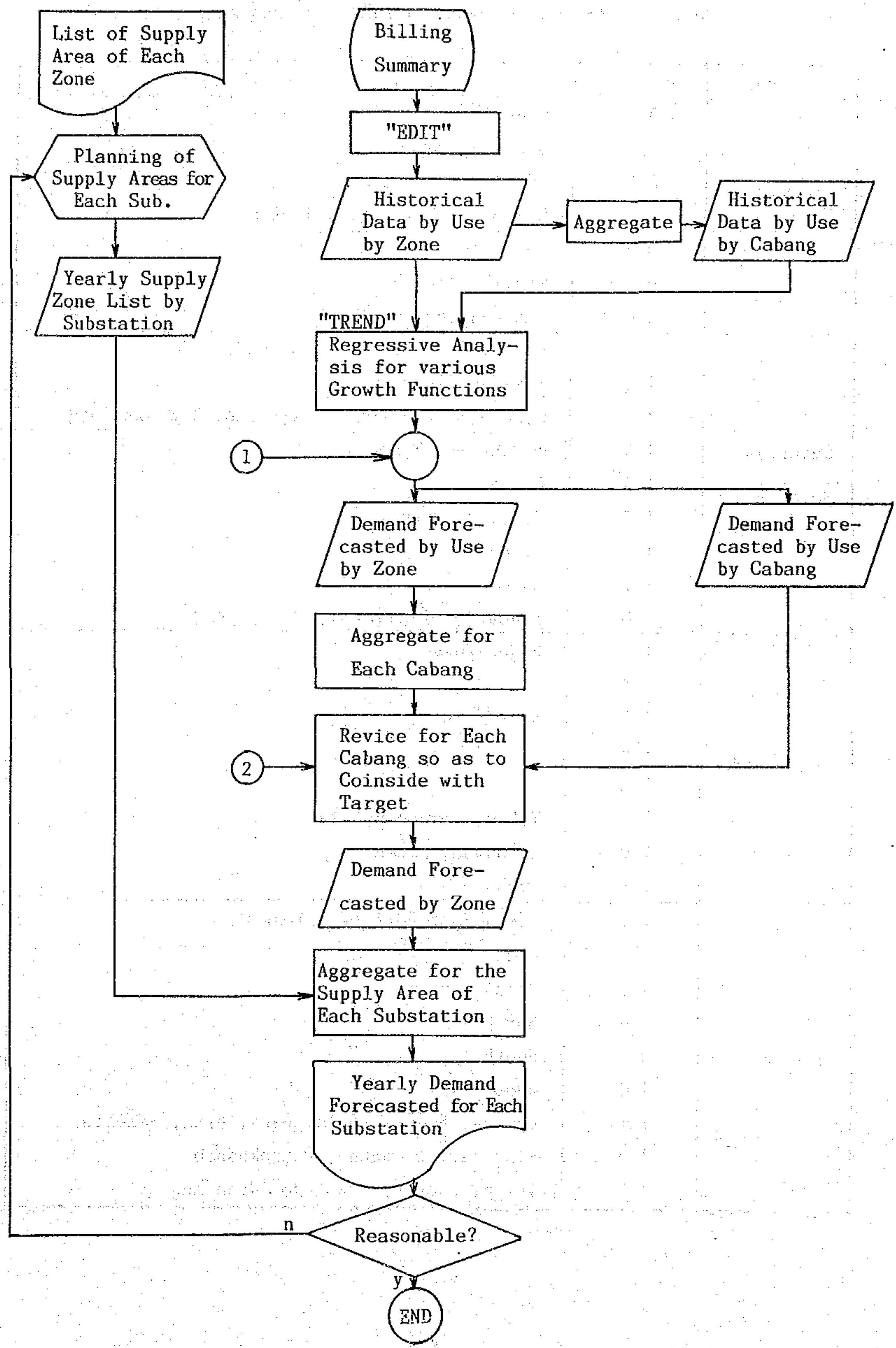


Table. 2.2-2 Major Towns Included in Each Zone

(1/3)

Cabang	zone code	Major Towns/Villages
Surabaya	0 1	Genteng
	0 2	Bubutan, Tandes
	0 3	Pabean, Cantian
	0 4	Semampir, Simokerto, Tambaksari
	0 5	Sukolilo
	0 6	Gresik, Bungoh
	0 8	Krembangan
Surabaya Selatan	1 0	Krian, Wonoayu, Wringinanom
	1 1	Sawahan, Tegalsari
	1 2	Menganti, Kademean, Driyorejo, Karangpilang
	1 3	Wonokromo, Wonocolo
	1 4	Gubeng
	1 5	Rungkut, Waru
	1 6	Taman
	1 7	Lakor
	1 8	Sidoarjo, Tanggulangin, Krembung
Bojonegoro	1 1	Bojonegoro
	1 2	"
	1 3	"
	1 4	"
	1 5	"
	1 6	Tuban, Semanding, Tasikmadu
	1 7	Lamongan, Babad
	1 8	Tuban
Malang	1 1	North-East Part of Malang City
	1 2	East "
	1 3	North "
	1 4	North-West "
	1 5	South "
	1 6	West "
	1 7	Lawang, Bedali, Bululawang, Batu, Selekta
	1 8	Singosari, Tumpang, Poncokusumo
	1 9	Turen, Dampit, Sukorejo, Ngantang

Cabang	zone code	Major Towns/Villages
Pasuruan	1 0	Pasuruan, Plered
	1 1	Probolingo, Leces
	1 2	Kraksaan, Pajarakan
	1 3	Bangil, Beji
	1 4	Pandaan
	1 5	Tretes
	1 6	Porong, Gempol,
Kediri	1 0	Trenggalek, Pogalan
	1 1	South Part of Kediri City
	1 2	East "
	1 3	West "
	1 4	North "
	1 5	Blitar, Sanankulon,
	1 6	Tulungagung, Karangrejo, Gandekan
	1 7	Nganjuk, Berbek, Loceret, Sidokare, Sukomero
	1 8	Kertosono
	1 9	Pare, Kandangan
Mojokerto	1 1	South Part of Mojokerto City
	1 2	North "
	1 3	Bangsal, Dellangn, Pacet
	1 4	Jombang, Peterongan, Diwek
	1 5	Ngoro, Kandangan
	1 6	Ploso, Sentul, Tembelang
	1 7	Mojosari, Wonokusumo, Sidorejo
	1 8	Mojosari
Madiun	1 0	Caruban, Bancong
	1 1	North Part of Madiun City
	1 2	East "
	1 3	South "
	1 4	West "
	1 5	Dolopo, Ponorogo, Sarangan
	1 6	Magetan, Sarangan, Plaosan
	1 7	Ngawi, Geneng, Paron
	1 8	Maospati, Tebon
	1 9	Pacitan, Kebonagnng

(3/3)

Cabang	zone code	Major Towns/Villages
Jember	1 1	Jember City
	1 2	Lumajang, Sukodono
	1 3	Bondowoso, Wonosari
	1 4	Kalisat
	1 5	Kalisat
	1 7	Jember City
Banyuwangi	1 1	Banyuwangi City
	1 2	"
	1 6	Rogojampi, Kabat, Singojuruh
	1 7	Genteng
	1 8	Muncar
Situbondo	1 1	Situbondo City
	1 2	Panarukan
	1 3	Besuki
	1 4	Asembagus
Pamekasan	1 0	Kamal, Ambunten, Sepulu, Waru, Batu Marmer, Tanjung Bumi, Banyu Atas, Sapudi, Omben,Kwanyar
	1 1	Pamekasan City
	1 2	Gading, Guluk-Guluk, Sumenep
	1 3	Sampang
	1 4	Bangkalan
	1 5	Ketapang
	1 6	Pasongsongan
	1 7	Modung, Blega
	1 8	Pakong
	1 9	Prenduan

FIG. 2.2-2

ELECTR
IN EAST

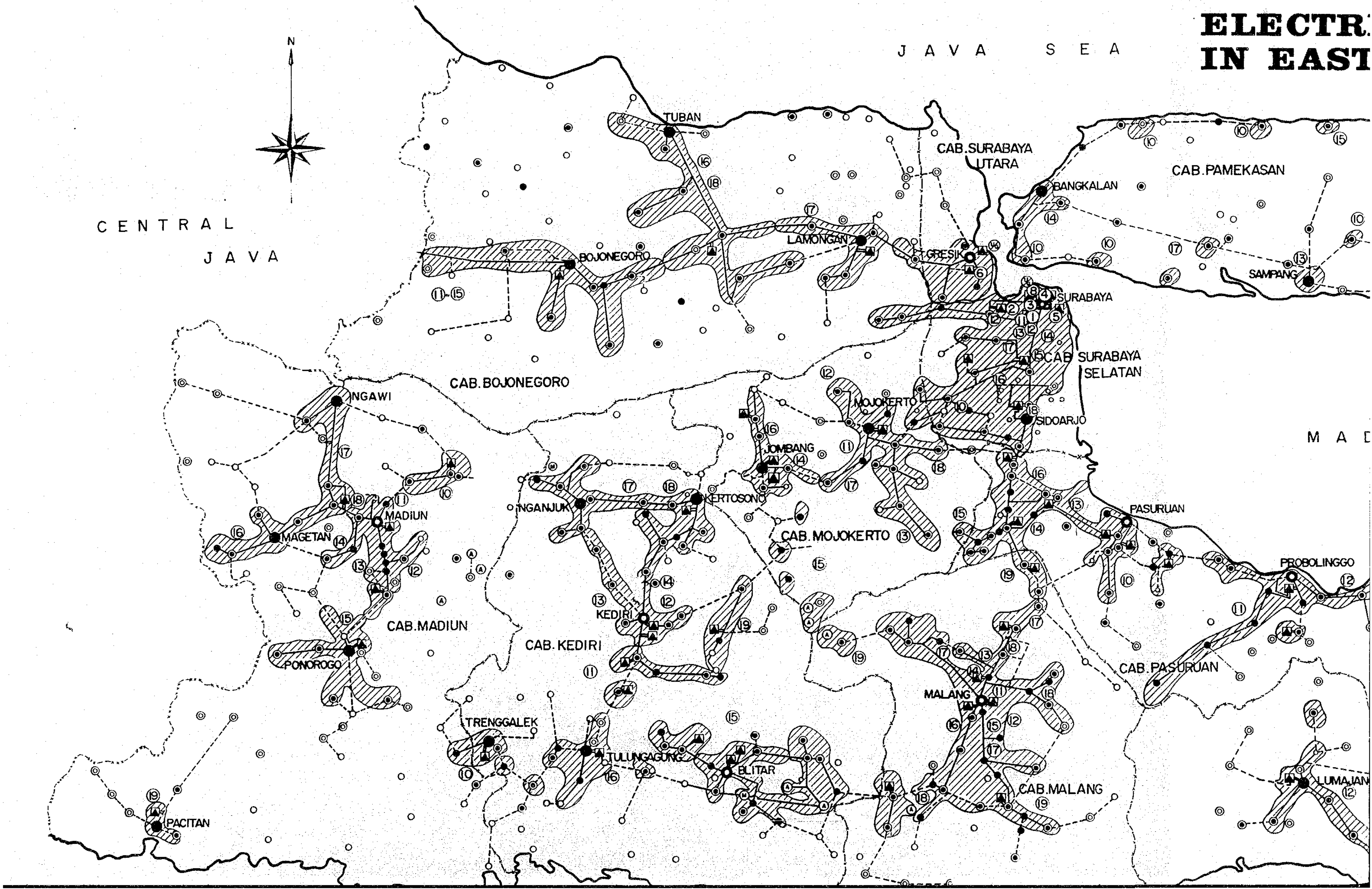
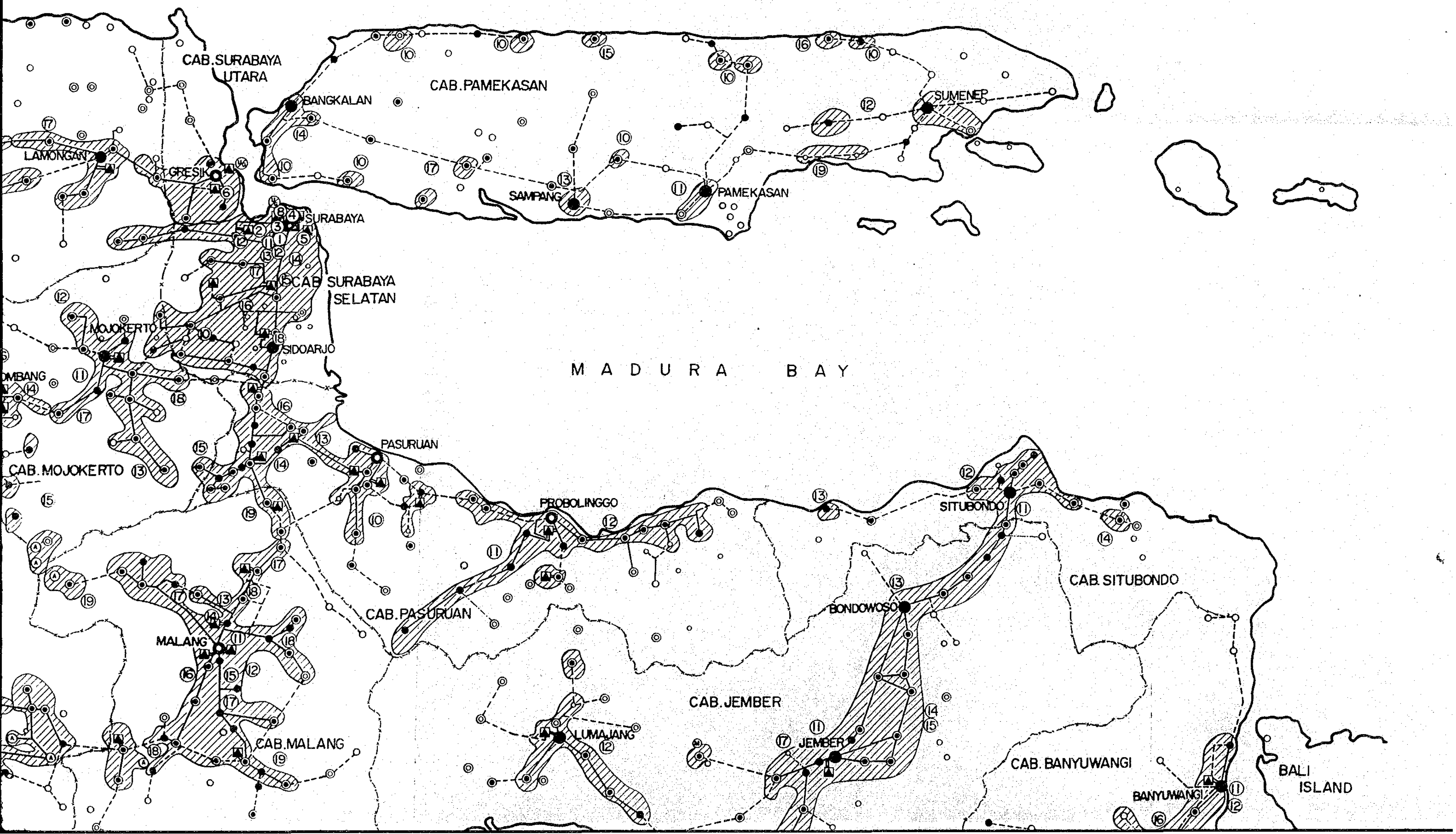
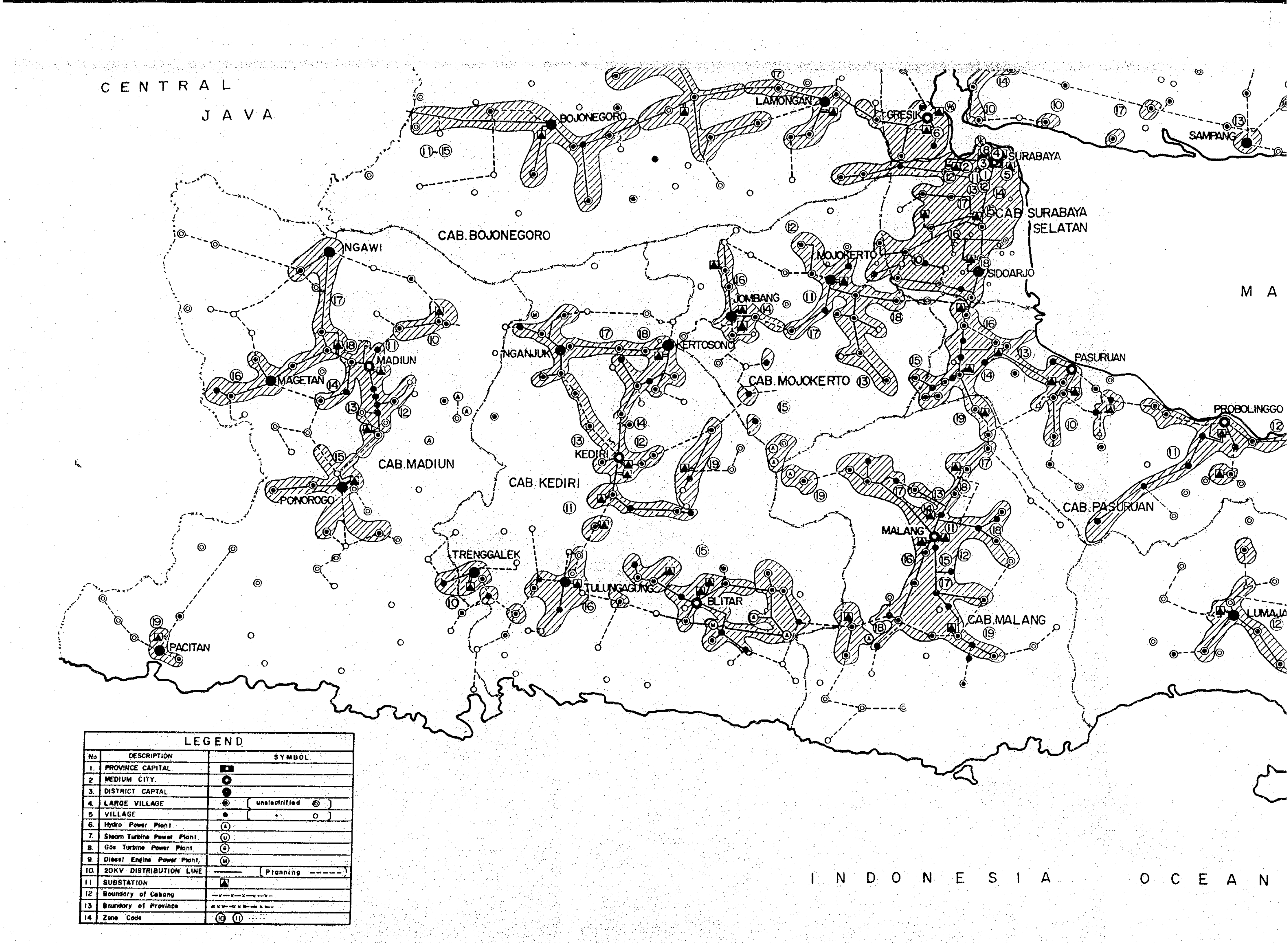


FIG. 2.2-2

ELECTRIC POWER DISTRIBUTION MAP IN EAST JAVA




CENTRAL
JAVA
BOJONEGORO
LAMONGAN
GRESIK
SURABAYA
SAMPANG
CAB. BOJONEGORO
CAB SURABAYA SELATAN
NGAWI
MOJOKERTO
SIDOARJO
JOMBANG
MADIUN
MAGETAN
NGANJUK
KERTOSONO
CAB. MOJOKERTO
PASURUAN
PROBOLINGGO
KEDIRI
CAB. MADIUN
CAB. KEDIRI
PONOROGO
CAB. PASURUAN
MALANG
TRENGGALEK
TULUNGAGUNG
BLITAR
CAB. MALANG
LUMAJANG
PACITAN
INDONESIA OCEAN
LEGEND
No
DESCRIPTION
SYMBOL
1. PROVINCE CAPITAL
2. MEDIUM CITY.
3. DISTRICT CAPTAL
4. LARGE VILLAGE
unelectrified
5. VILLAGE
6. Hydro Power Plant
7. Steam Turbine Power Plant.
8. Gas Turbine Power Plant
9. Diesel Engine Power Plant.
10. 20KV DISTRIBUTION LINE
Planning
11 SUBSTATION
12 Boundary of Cabang
13 Boundary of Province
14 Zone Code

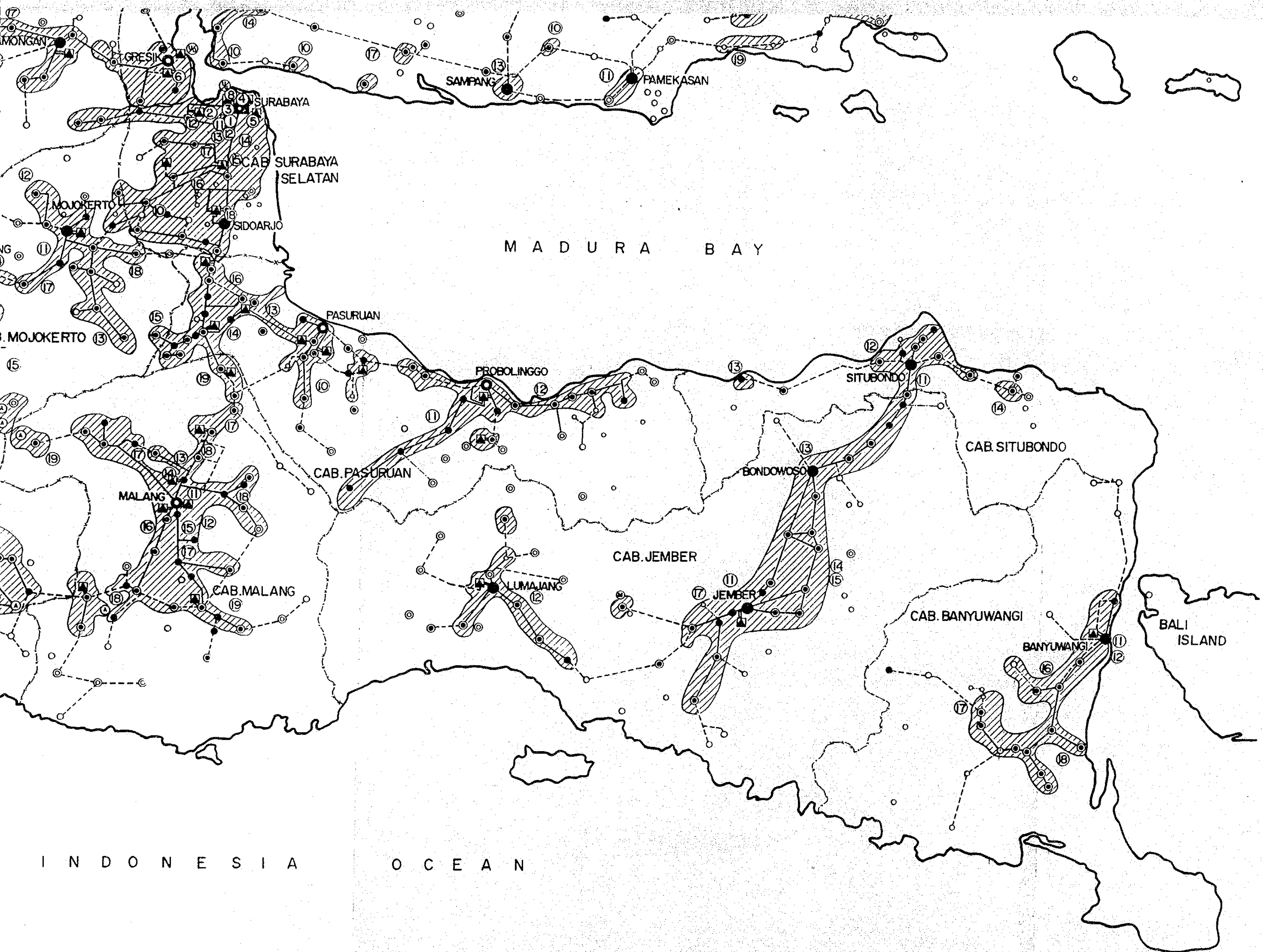

GRESIK
SURABAYA
SAMPANG
PAMEKASAN
CAB. SURABAYA
SELATAN
MOJOKERTO
SIDOARJO
MADURA BAY
PASURUAN
. MOJOKERTO
PROBOLINGGO
SITUBONDO
CAB. SITUBONDO
CAB. PASURUAN
BONDOWOSO
MALANG
CAB. JEMBER
LUMAJANG
JEMBER
CAB. MALANG
CAB. BANYUWANGI
BALI
ISLAND
BANYUWANGI
INDONESIA
OCEAN

Table 2.2-3(1) Long Term Demand Forecast of Distribution Substations

Cabaugs	Sudstations	Ordinary Peak Demand on Weekdays (MW)			
		1989/3	1994/3	1999/3	2004/3
Surabaya Utara & Selatan	Ujung	(8.4) 10.4	(8.4) 16.4	(8.4) 25.5	(8.4) 38.8
	Krembangan	23.2	39.3	32.0	50.3
	Sawahan	36.3	54.2	(10.5) 77.8	(10.5) 105.1
	Tandes	22.9	36.9	(18.0) 61.0	(18.0) 98.0
	Segoromadu	((21.0)) (21.0) 20.8	((27.3)) (28.5) 26.7	((27.3)) (31.5) 43.0	((27.3)) (31.5) 59.9
	Simokerto			35.0	57.5
	Benowo		17.8	28.7	40.0
	PLTU Gresik			((22.8))	((97.6))
	Simpang	16.4	27.6	48.0	73.2
	Waru	(34.5) 28.8	(51.3) 47.7	(51.3) 83.3	(51.3) 133.6
	Sukolilo	43.2	85.8	64.7	99.9
	Ngagel	9.8	15.3	23.8	34.9
	Driyore jo	6.8	12.9	26.4	46.3
	Buduran	16.4	29.2	52.7	85.4
	Kenjeran	16.4	27.9	49.6	81.2
	Rungkut	57.6	66.3	81.3	94.5
	Darmo Grand	25.6	27.1	49.9	82.0

Table 2.2-3(2) Long Term Demand Forecast of Distribution Substations

Cabangs	Substations	Ordinary Peak Demand on Weekdays (MW)			
		1989/3	1994/3	1999/3	2004/3
	Babatan	4.5	8.6	66.2	110.0
	Krian	((3.5)) 16.0	((47.2)) 30.7	((151.1)) 22.9	((382.5)) 37.4
	Ngiwo			57.4	94.5
	Semanbung		51.0	57.4	94.5
	Kalang Pilang		18.3	36.7	63.2
	Ketintang			57.4	94.5
	Trosobo			17.6	30.8
	Sidosermo				34.9
Bojonegoro	Bojonegoro	4.0	6.6	9.1	12.9
	Babat	((18.0)) 2.3	((18.0)) 3.4	((18.0)) 4.4	((18.0)) 4.9
	Lamongan	((13.9)) 1.2	((23.4)) 1.7	((23.4)) 2.4	((23.4)) 2.9
	Tuban	1.5	2.3	2.9	3.3
Malang	Kebonagung	19.1	27.5	38.0	50.3
	Polehan	11.0	19.2	32.0	50.4
	Blimbing	10.6	21.4	33.9	48.1
	Sengkaling	7.0	13.0	21.1	31.2
	Lawang	9.8	18.1	29.1	42.5

Table 2.2-3(3) Long Term Demand Forecast of Distribution Substations

Cabangs	Substations	Ordinary Peak Demand on Weekdays (MW)			
		1989/3	1994/3	1999/3	2004/3
	Sukorejo	2.4	4.4	6.6	8.6
	Turen	6.6	7.3	11.8	17.3
	Sengguruh	1.1	2.1	3.3	4.6
	Karangkates	1.1	2.1	3.3	4.6
	PLTA Selorejo	1.2	2.2	3.2	4.3
	Kepanjen		4.8	7.6	10.8
Pasuruan	Probolingo	10.5	20.1	34.0	51.5
	Plered	4.3	8.2	13.8	20.7
	Bangil	2.6	5.2	8.7	12.9
	Pandaan	7.2	14.3	25.3	40.1
	Porong	2.9	5.5	9.1	13.2
	Leces	6.1	11.7	20.0	30.6
	Kralsaan	2.1	4.2	7.9	13.6
	Paiton	(1.8) 0.9	1.8	3.4	5.8
Kediri	Kediri	(9.1) 13.2	(20.7) 25.4	((15.4)) (21.6) 42.4	((44.1)) (21.6) 60.3
	Tulungagung	9.2	18.6	32.0	47.7
	Blitar	3.3	7.8	12.6	16.7

Table 2.2-3(4) Long Term Demand Forecast of Distribution Substations

Cabangs	Substations	Ordinary Peak Demand on Weekdays (MW)			
		1989/3	1994/3	1999/3	2004/3
	PLTA Wlingi	2.2	5.2	8.4	11.1
	Kertosono	3.2	5.1	8.7	15.2
	Trenggalek	2.3	2.8	3.3	3.5
	Nganjük	0.7	1.4	2.7	5.3
Mojokerto	Mojokerto	(7.5) 17.8	((10.5)) (12.0) 36.9	((41.9)) (12.0) 66.4	((105.8)) (12.0) 104.3
	PLTA Mendalan	3.5	1.2	2.7	4.6
	Ploso	0.3	0.3	0.3	0.4
	Jombang	0	3.2	3.9	7.2
Madiun	Manisrejo	13.7	23.9	38.2	56.7
	Caruban	0.9	1.6	2.1	2.5
	Ponorogo	2.2	3.8	5.6	6.9
	Pacitan	1.1	1.9	2.5	3.0
	Dolopo	5.4	9.4	13.6	16.7
	Magetan	2.1	2.3	2.5	2.9
	Ngawi	1.6	1.9	2.0	2.0

Table 2.2-3(5) Long Term Demand Forecast of Distribution Substations

Cabangs	Substations	Ordirary Peak Demand on Weekdays (MW)			
		1989/3	1994/3	1999/3	2004/3
Jember	Jember	((13.7)) 10.2	((25.3)) 9.3	((38.2)) 14.2	((69.3)) 21.5
	Lumajang	4.0	7.2	12.7	22.4
	Bondowoso	2.5	5.2	9.9	15.0
	Tanggul		7.3	11.3	17.4
Banyu-wangi	Banyuwangi	8.5	13.3	29.4	52.6
	Genteng		7.1	20.1	39.5
Situbondo	Situbondo	3.1	4.6	6.7	9.3
	Asembagus				0.4
Pamekasan	Candih	((36.0)) 0.2	((36.0)) 0.5	((36.0)) 0.9	((36.0)) 1.3
	Bangkalan	1.6	2.8	4.5	6.5
	Sampang	1.7	3.6	5.7	8.0
	Pamekasan	2.6	4.4	6.9	9.5
	Sumenep	2.2	4.0	7.2	11.6

Note: o Each figure means forecasted average demand at 19:00 hours on weekdays.

o Double parenthesized figures mean big customers demand fed by 150kV.

o Single parenthesized ones mean those of 70kV or special use for construction (Paiton).

o The rest mean those of distribution transformers.

2.3. System Planning

Based on the Long Term Demand Forecast of Distribution Substations (Table 2.2-3) which is obtained in the preceeding paragraph, we have made an expansion plan of the facilities for transmission line, substation, distribution line and others for a long term until March, 2004.

It is desirable that hereafter this expansion Plan will be utilized to confirm the rationality of various construction plans from a long-term point of view.

However, the accuracy of demand which is forecasted for the remote future using only available data at the present time is naturally limited. So, it is needless to say that such a plan should be considered as a rolling plan and should be reviewed every two (2) or three (3) years.

From convenience´sake, they are called in this Report "the 1st stage" up to March, 1989, "the 2nd stage" from 1st up to March, 1994, "the 3rd stage" from 2nd up to March,1999 and "the 4th stage" from 3rd up to March,2004. Master plan includes these twenty (20) years.

The mid term (the 2nd Stage) plan and the long term (the 3rd and 4th Stages) plan are mainly described in this chapter, while the short term plan will be mentioned later in 3.2.1.

2.3.1. General

The following items were regarded in this system planning.

(1) Reduction of number of facilities and works

In order to reduce the construction cost which is effected by the number of facilities or works, the introduction of comparatively large scaled facilities was considered. As for various expansion patterns, economic examinations will be mentioned in Chapter 5.

(2) Simple Voltage Levels to Reduce Facility Number

Twenty-five (25) or thirty (30) kV systems are considered to be disused in the future. As for the 70 kV systems, the least additional installation of 70 kV system is expected. It has also intended to minimize expansion of 150 kV/70 kV connection transformer and to make simple feeders of 70 kV lines by means of upgrading 70 kV to 150 kV system, except for special area.

(3) Avoidance of Losses by Power Flow-Detours and Reliability Improvement.

Power flows along detours (ex. Gresik - Waru - Sawahan) yield not only increase in power losses but also complexity in system configurations, and result in the lower system reliability because of the difficulty in operation of separated systems which include power sources. Besides, detours are also related to increase of capital cost which originate in the decrease of system efficiency. Accordingly, we kept power flow in mind in this planning, and considered most effective supply methods and transmission line construction. For instance, consideration was made in this planning that the separated operation system by Gresik P/S could easily be run by means of cutoff of Gresik-Krian Line. Further, the separated operation system at eastern region by one unit of Paiton P/S, and the separated operation system at Kebonagung S/S by Sutami P/S and Wlingi P/S could also be considered in this planning.

(4) Establishment of Operation Target which is Regarded from the Measures against Accidents.

When the power factor is considered to be about 85%, and the load varience or forecast error is estimated at 15%, power allowance at 2 c.c.t. transmission line will be about 75% of maximum capacity (kVA) as a target.
This value corresponds to the overloading of 50% when one (1) circuit is tripped.

In case of one (1) circuit, it is advisable to install an additional circuit in early time for the sake of loss reduction.

As for a substation, 73.9% of total transformer capacity (kVA) is considered as the target load (kW) in the same way; further, in consideration of the measures against accidents, it was repressed up to 70% and 60% when the station has only two (2) banks and one (1) bank, respectively.

The unit capacity of substation transformers, was planned as described in another Section, considering the unit price per kVA, number of circuits possible to feed, and desirable total number of transformers in a station.

2.3.2. Power Resources Forecast

The planning of the power supply sources until 2004, has not been established yet, and the assumptive plan of new power sources was supposed as follows:

Hydroelectric:	Sengguruh		14.5 x 2 = 29.0 MW	1987/88
	Tulungagung		22.0 KW	1989/90
	Wonorejo		8.0 + 6.2 = 14.2 MW	1989/90
	Kesamben		16.4 x 2 = 32.8 MW	1989/90
	Metro		5.0 x 2 = 10.0 MW	1991/92
	Lesti & Kepanjen		12.6 + 13.7 = 26.3 MW	1995/96
	Tegalombo & Grindulu		20.0 + 32.0 = 52.0	1997/98
Thermal:	Gresik	#3U	200 MW	1986/87
	"	#4U	200 MW	1987/88
	Paiton	#1U	400 MW	1989/90
	"	#2U	400 MW	1990/91
	"	#3U	600 MW	1992/93
	"	#4U	600 MW	1993/94
	"	#5U	600 MW	third stage
	"	#6U	600 MW	third stage

2.3.3. Individual Planning (refer to Fig. 2.3-1)

(1) New installation of distribution substations

(Second Stage)
Benowo (92/93), Semanbung (90/91), Karang Pilang (89/90), Kepanjen (90/91), Tanggul (89/90), Genteng (89/90), Jombang (89/90)

(Third Stage)
Simokerto (96/97), Ngiwo (97/98), Trosobo (97/98), Ketintang (89/99)

(Fourth Stage)
Sidosermo, Asembagus

(2) New installation of distribution transformers

The annual planning of new installation of distribution transformers were formed, according to load forecasting for each point, aforesaid load targets and standards of installation. The contents are shown on Table 4.1-6.

As the results,

Total net utilization factor [1)]	:	41.2% at March, 1989
- ditto -	:	58.6% at March, 1994
- ditto -	:	58.2% at March, 1999
- ditto -	:	66.2% at March, 2004

It shows the increasing tendency period by period, which explicitly supports the efficiency of the master plan.

Note 1)
Total net utilization is obtained by dividing the total loads at peak for each point by the total load targets for each point.

(3) Voltage Raise of Substation

(Second Stage)

(a) Voltage raise to 150 kV for Sawahan Substation

In order to increase the supply power of Sawahan Substation which is regarded as an important substation located in the heart of Surabaya City, a voltage raise to 150 kV is required. For this purpose, the Tandes-Sawahan Line of 70 kV should be rebuilt and raised to that of 150 kV, and a connection transformer of 150/70 kV should be transferred from Tandes and placed at Sawahan Substation.

(b) Voltage raise to 150 kV for Driyorojo Substation

The connection transformer of Mojokerto Substation calls for an additional installation at the Third Stage, and then Driyorojo Substation should be raised to 150 kV during 1993/1994 periods when an additional installation of distribution transformer is required to Driyorojo Substation, and should also receive 1π (pi) from Krian-Babatan 150 kV line.

(c) Voltage raise to 150 kV for Lawang Substation

In order to lower the loads of the connection transformer at Bangil Substation and of 70 kV Bangil-Blimbing Line, a branch line of 1π (pi) is to be drawn from 150 kV Bangil-Kebonagung Line and then Lawang Substation is to be raised to that of 150 kV at 1992/1993 period when an additional installation of transformers is needed.

(d) Voltage raise to 150 kV for Polehan Substation

In order to avoid a prospective increase in establishments of the connection transformer of Kebonagung Substation and Polehan Lines, the existing 70 kV Kebonagung-Polehan Line shall be rebuilt to be of 150 kV, and Polehan Substation is to be that of 150 kV at 1990/1991 period when an additional installation of distribution transformers is needed for Polehan Substation.

(e) Voltage raise to 150 kV for Buduran (Sidoarjo) Substation

The 70 kV Waru-Buduran Line will be over-loaded at the end of Second Stage. A branch line of 2π (pi) shall be drawn from the 150 kV Waru-Bangil Line at 1993 period and Buduran Substation is to be raised to 150 kV, as an additional installation of distribution transformers will be required at 1993 period, which is expected to make it possible that a prospective increase at the Fourth Stage in connection transformers at Waru Substation be not required.

(Third Stage)

(a) Voltage raise to 150 kV for Sengkaling

In order to avoid an increase in connection transformers at Kebonagung Substation, at 1997/1998 period when an additional installation of distribution transformers is required for Sengkaling Substation, the existing 70 kV Kebonagung-Sengkaling Line (designed for 150 kV) shall be raised to 150 kV, and 150/70 kV connection transformer 50MVA x 1 and distribution transformer 50MVA shall be collocated for Sengkaling Substation.

(b) Tulungagung Substation

The connection transformer at Kediri Substation will be expanded with that of 50 MVA during 1987/1988 period, and will require another installation of 100 MVA transformer at the Third Stage.

The Kediri-Tulungagung Line of 70 kV will be over-loaded at the Fourth Stage, and (still more) Tulungagung Substation will require an additional installation of distribution transformer of 50 MVA during 1994/1995 period.

Therefore, two more circuits to the Kediri-Tulungagung Line of 150 kV shall be newly installed at the Third Stage (1996/1997 period), and the bus bars of 150 kV and a distribution transformer 50MVA x 2 of 150/20 kV will be collocated at Tulungagung Substation.

(c) Voltage raise to 150 kV for Blimbing Substation

After a raise to 150 kV for Sengkaling Substation, Blimbing Substation will be incorporated into the 70 kV system of the former, which will be over-loaded during the Fourth Stage. Therefore, a branch line of 1π (pi) shall be drawn from the 150 kV Bangil-Kebonagung Line at 1994/1995 period when an additional installation of distribution transformer is required for Blimbing Substation, and the substation is to be raised to 150 kV, which can avoid an increase in connection transformers during the Fourth Stage for Sengkaling Substation.

(Fourth Stage)

None

(4) Reinforcement counter-measures for transmission system

(Second Stage)

(a) Reinforcement of supply capability to Tandes and reliability improvement

On the assumption that the generating capacity of Gresik Thermal Power Station is at around 320 MW, the study about its possible separate supply area reveals the affirmative supply capacity up to the Second Stage for Tandes and Sawahan inclusive, but demands a compulsory exclusion of Tandes later on after the end of Second Stage.

Therefore, the transmission line of 1π (one pi) deverged from the Gresik-Waru Line of 150 kV will be necessary as a new source line to Tandes in the beginning, and the Line shall be extended to Krian Substation at the beginning of the Third Stage. Tandes is to receive two circuits directly from Krian Substation.

(b) New EHV supply point on the east side followed by the completion of Paiton Power Station

Paiton Power Station will be completed 400 MW in October, 1989, and is to be expanded later year by year and will be transmitted with EHV.

In order to supply some of this generating power to the eastern part of East Java, a step-down transformer 300 MVA of 500 kV should be annexed to Paiton Power Station (at 1989/1990 period) and one of 500 MVA should be added (at 1990/1991 period) to be able to supply generally to the east of Probolinggo.

(c) Reinforcement of the secondary system (to the area of Jember) of EHV Paiton Substation.

Followed by the completion of EHV Paiton Substation, and in order to reinforce the supply capability to the areas of Situbondo, Jember and Banyuwangi, another circuit should be supplemented to the 150 kV transmission line among Paiton, Situbondo and Jember.

(Third Stage)

(a) Introduction of EHV T/L to Eastern Surabaya

It will be demanded to introduce a new extra high voltage transmission line into Sukolilo Substation or its vicinities, which consists of single π (pi) branch of EHV Krian-Paiton Line.

Because, at the beginning of Third Stage, the load of Krian-Waru-Rungkut Line which is the only line to feed to Eastern Surabaya will exceed its transmission capacity.

The adequate capacities of the transformers to be set are considered as 500 MVA (94/95), +500 MVA (95/96).
Further, the exclusion of its 70 kV buses should be considered in connection with this work.

(b) Completion of Surabaya 150 kV Ring Line

In order to exhibit the more supply capabilities of Sukolilo S/S, and to expect the more supply reliabilities, a 150 kV T/L which utilizes the route of 70 kV transmission line between Ujung S/S and Sukolilo S/S should be newly established, and the Surabaya 150 kV Ring Line will be completed (at the beginning of the Third Stage).

For this purpose, the 70 kV transmission line between Perak P/S and Ujung S/S shall be reconstructed, as the preparatory works, into a 150 kV/70 kV co-stringed transmission line within the Second Stage.

(c) Reinforcement of Supply Capabilities to Malang/Bangil by the Construction of Krian-Kebonagung (150 kV) Line

Although after transferred the eastward district of Probolinggo S/S into Paiton System, the Krian S/S - Waru S/S - Bangil S/S Line will approach full load at the end of the Third Stage.

Hence, installation of a new transmission line of 150 kV, 2 c.c.t. shall be established between Krian S/S and Kebonagung S/S at the end of Third Stage.

(d) Extention of Tandes Branch and installation of Krian-Tandes Line

As previously stated, Krian-Tandes Line should be completed at the beginning of the Third Stage, when necessary to exclude Tandes from Gresik separated system.

Furthermore, it is to be considered that the construction period should be advanced as the situation may require, in order to ensure the most suitable route.

(e) Reinforcement of Supply Capability to Banyuwangi, Bali Island

It is deemed that the total load of Situbondo, Bondowoso, Jember, Banyuwangi and Bali Island will exceed the total capacities of transmission lines including the existing and planned one at the end of the Third Stage. (voltage drop is notable.)

Further, it is also deemed that additional supplying points will be necessary at the east of Situbondo or at the north of Banyuwangi, in future.

Therefore, a new 150 kV transmission line which passes through the North-East Coast of the Island and transmits power from Situbondo S/S to Banyuwangi S/S should be constructed within the Third Stage.

(Fourth Stage)

(a) Reinforcement of Supply Capability to Mojokerto, Kediri

Although new foundation of new hydro power stations whose capacities are comparatively small are expected, it is considered that Krian-Mojokerto Line will approach to full load at the beginning of the Fourth Stage.

So, a 150 kV transmission line should be planned between Krian and Kediri. The partial line between Krian and Mojokerto should be completed in advance at the beginning of the Fourth Stage and should be used together with the existing lines to result in reinforcement of supply capability to Mojokerto.

(5) Capacity Increase of Primary Substations

Under the condition that any larger power plant other than many smaller hydro plants in Southern area will not be constructed in the 150 kV system, the necessitated additional capacity of Krian S/S (500 MVA is existing at the end of the First Stage) is considered to reach the following quantity in spite of the aforesaid construction of Sukolilo S/S (1,000 MVA) and Paiton S/S (800 MVA)

500 MVA	:	existing at the beginning of Second Stage
500 MVA	:	Second Stage
1,000 MVA	:	Third Stage
1,000 MVA	:	Fourth Stage
3,000 MVA	:	total

Consequently, the EHV T/L which connects with Central Java will also be necessitated to add the second circuit.

Fig. 2.3－1(1) East Java Power System Map (After Completion of 1st Stage)

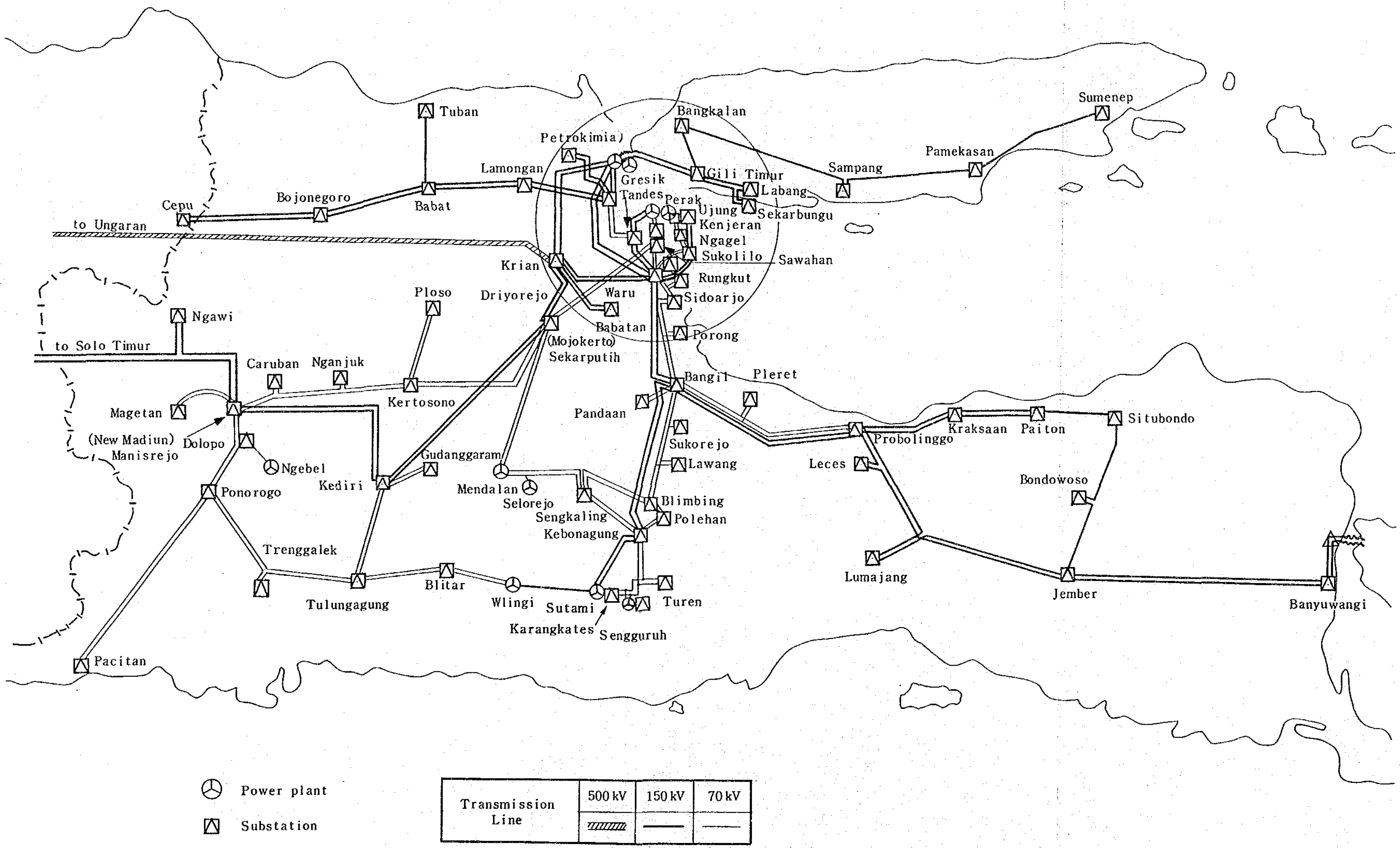


Fig. 2.3-1(2) East Java Power System Map (After Completion of 2nd Stage)

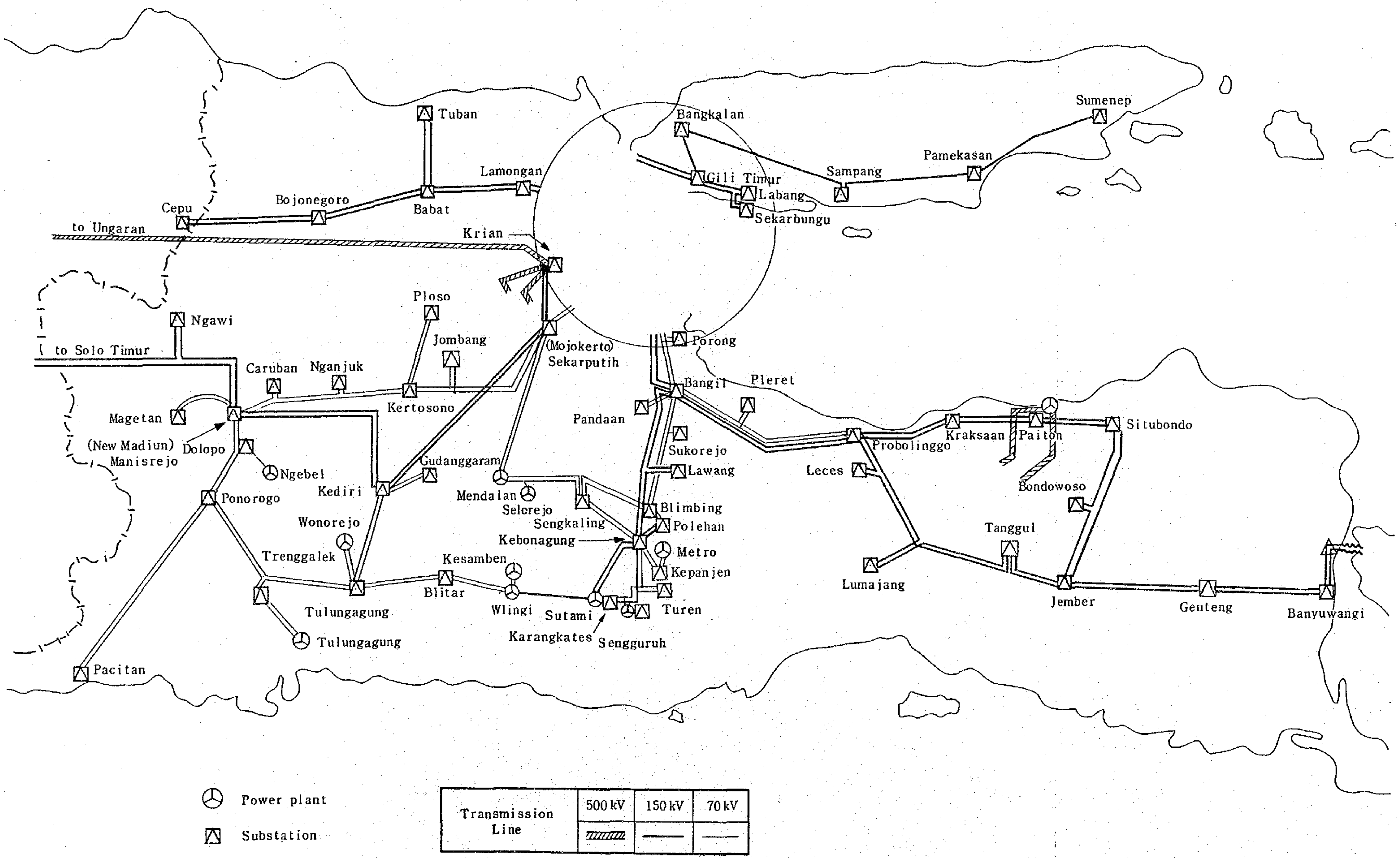


Fig. 2.3-1(3) East Java Power System Map (After Completion of 3rd Stage)

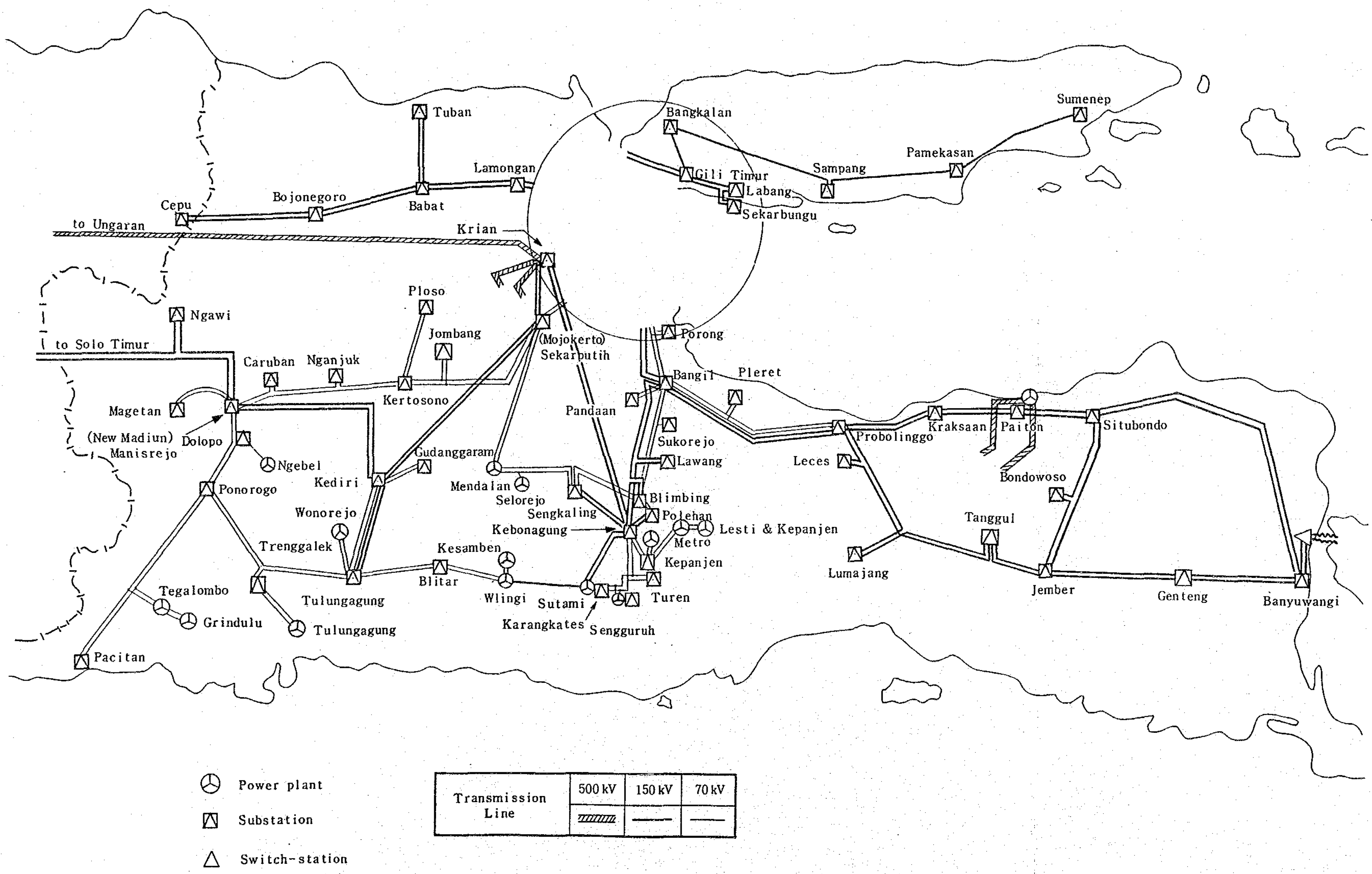
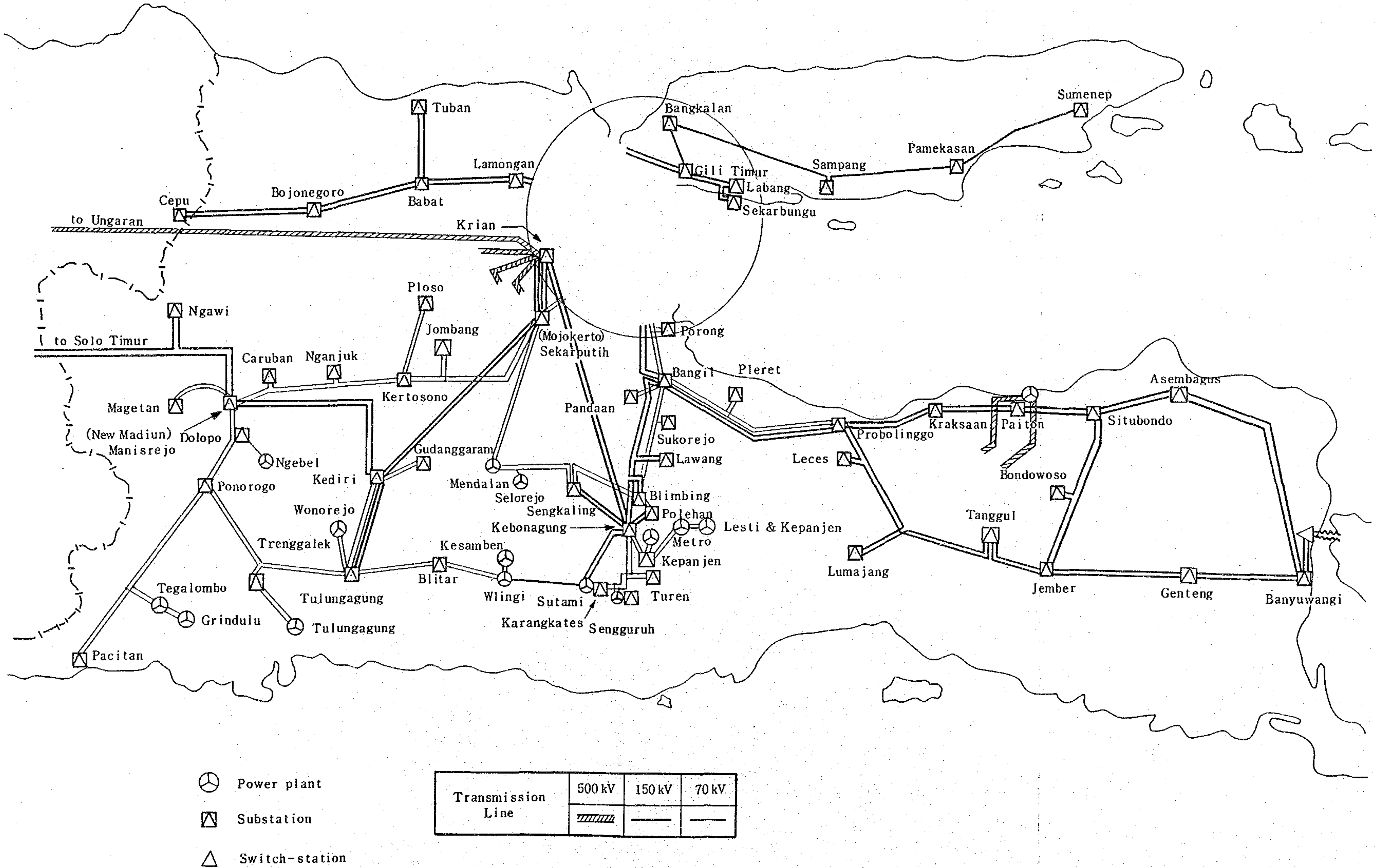


Fig. 2.3-1(4) East Java Power System Map (After Completion of 4th Stage)



Transmission Line	500 kV	150 kV	70 kV

Fig. 2.3-1(1)' East Java Power System Map (Surabaya City)
(After Completion of 1st Stage)

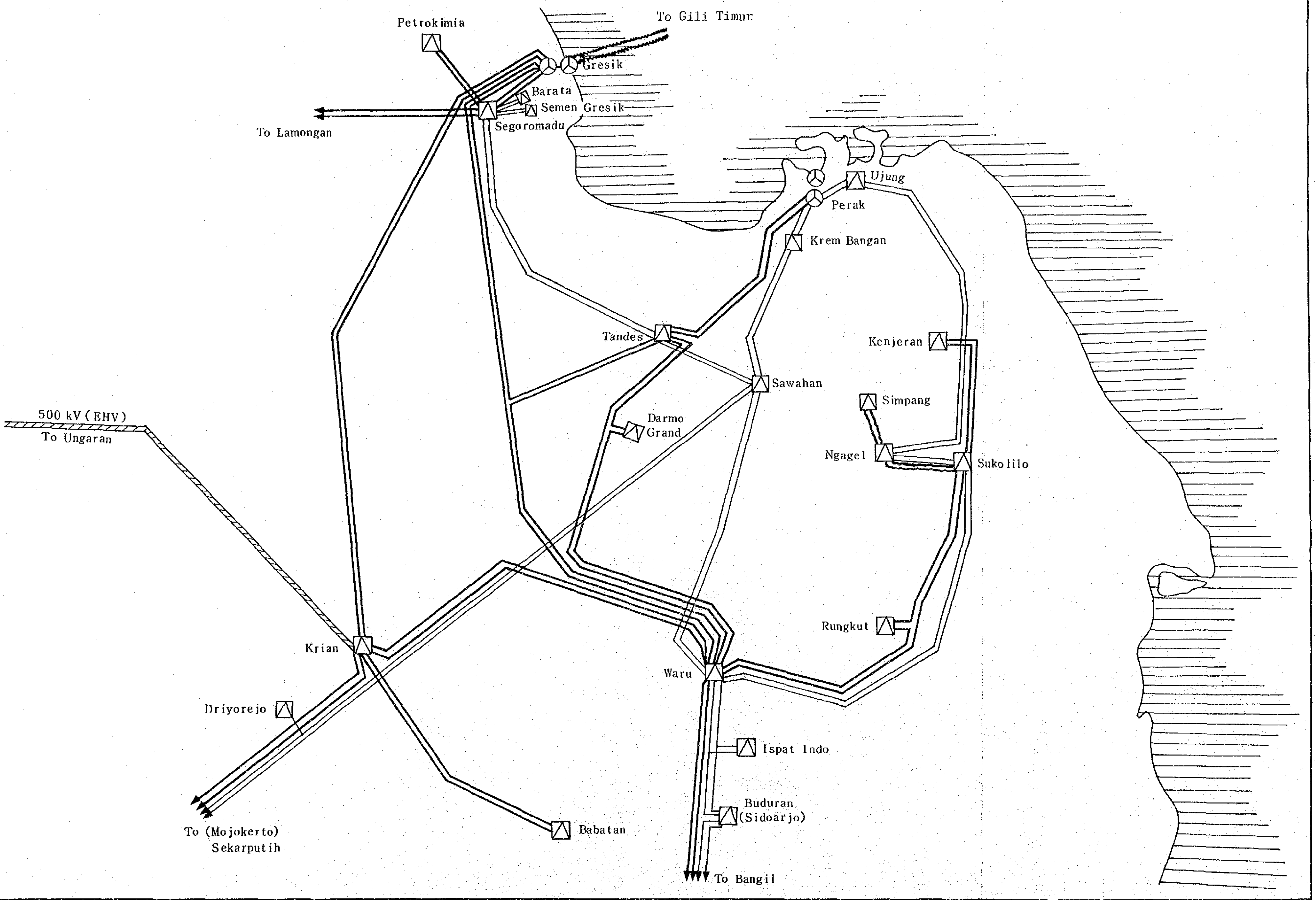


Fig. 2.3－1(2)′ East Java Power System Map (Surabaya City)
(After Completion of 2nd Stage)

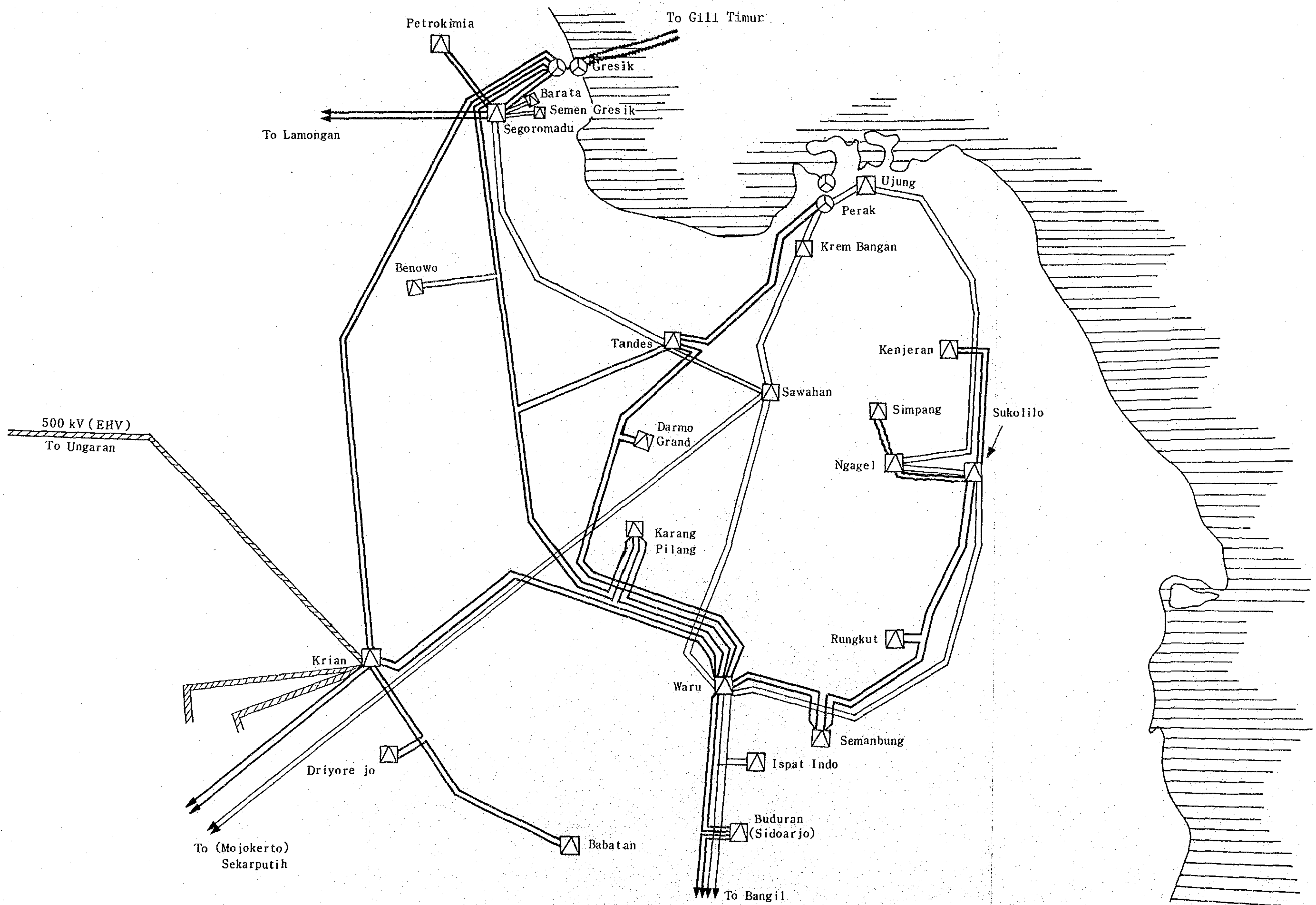


Fig. 2.3－1(3)′ East Java Power System Map (Surabaya City)
(After Completion of 3rd Stage)

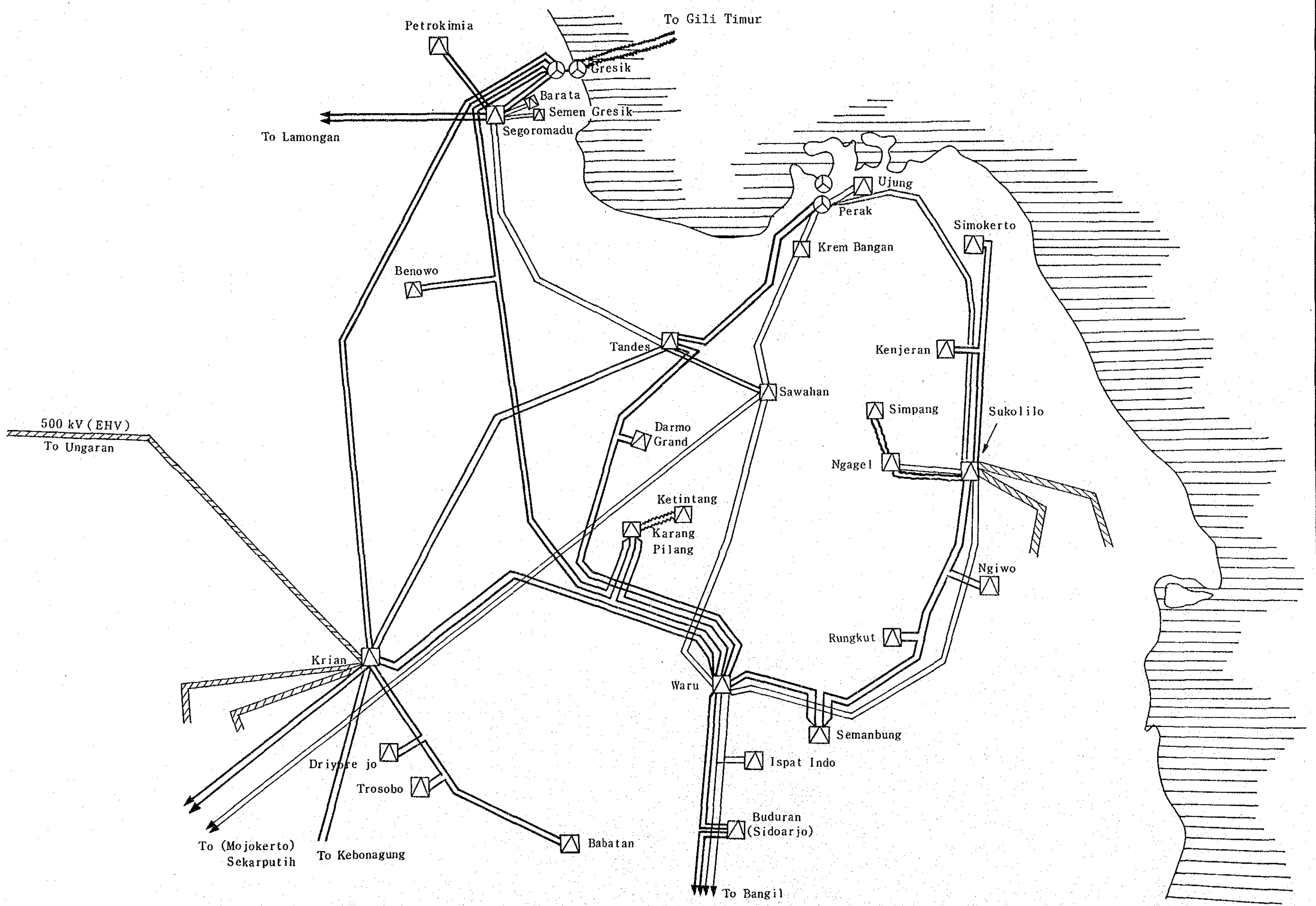
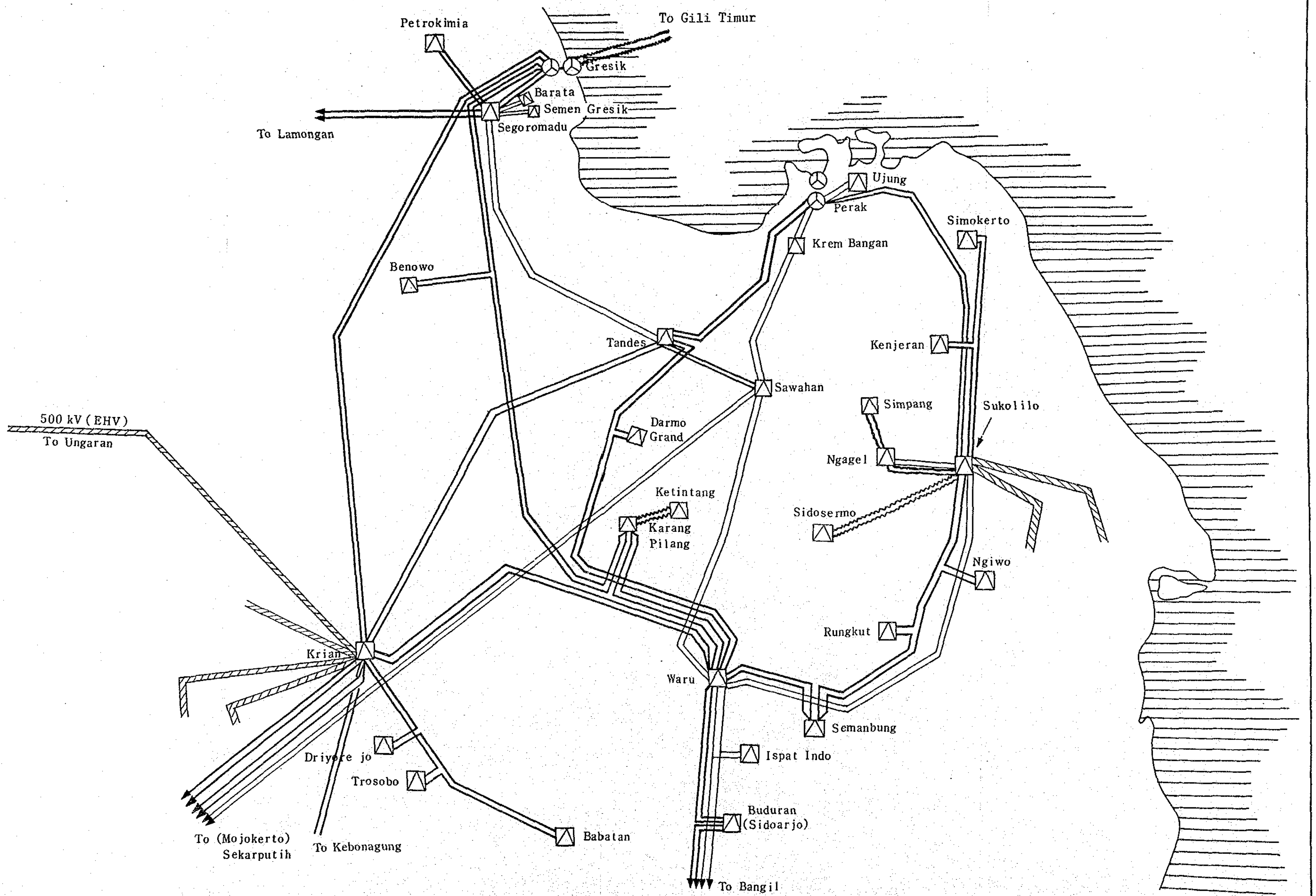


Fig. 2.3－1(4)′ East Java Power System Map (Surabaya City)
(After Completion of 4th Stage)



2.4. System Analysis

2.4.1 Power Flow

In order to confirm whether the projected system can be operated rationally and whether the facilities has an adequate supply surplus or not, the power flow analysis at a peak hour was carried out for the end of each stage.

(1) Presuppositions for the Calculation

(a) The constants of generators, transformers and transmission lines are determined on the basis of the data obtained out of the existing facilities, and the other values which may be changed in future projects are supposedly employed for the calculation. The summarized are as shown on Tables 2.4-1, 2.4-2, 2.4-3. The system configuration and the constants of the facilities are shown on Fig. 2.4-1 (1) ∿ (4).

(b) The target values for rational system operation of the power plants are determined as follows:

i)	Power factor of thermal power plants	: 85 - 95%
ii)	Power factor of hydro power plants	: 90 - 100%
iii)	Operative voltage of substations	: 95 - 105%

(c) The values shown on Table 2.2-3 are employed as the loads of East Java except those of Bali Island, which are as indicated in 2.2.2(3).

(d) The gas turbine generators at Perak and Gresik Power Stations are supposed to recess as cold reserve, and No.1 and No.2 Units (Oil-fired thermal power station, 25 MV x 2 units) at Perak Power Station are also supposed to recess after the completion in October 1989 of Paiton Power Station, so far as the connection transformer's loading can afford. The output at peak hour of the thermal power station is settled at 80% of the maximum output and one unit (Paiton, 600 MW) of the maximum capability is supposed to recess at the time of scheduled maintenance.

(e) The output of the hydro power station is settled as a firm one, and yet it is supposed at 70% of the maximum output, if it is not clear by construction schedule in future. (Refer to Table 2.4-4).

(f) The power factor of the load is determined at 0.85 within the city of Surabaya and at 0.90 for the others.

(2) Results and views on the calculation of the power flow

In order to study the line loading, power loss, voltage drop in the system planning mentioned in the foregoing section and a necessary quantity of the related capacitor, the calculations of the power flow on the system of all East Java was carried out, whose figured results, are as shown on Fig. 2.4-2(1) ∿ (4). The required capacitors are as indicated on Table 2.4-5.

This results corresponds to the case that neither any large power plants which follow Paiton P/S nor any installations of EHV S/S to the middle and southern parts of East Java will be founded by the year of 2004, Mar. Therefore, if such new plants and stations would additionally be founded on and after IV stage, it is possible to be expected that the balance of demand supply would be improved and that the amount of required shunt capacitors would be decreased.

2.4.2 Short Circuit Capacity

The calculation of short circuit capacity was made with the system configuration in 2004. The constants of generators, transformers and transmission lines are same as determined for Analysis of Power Flow, shown on Tables 2.4-1, 2.4-2 and 2.4-3. It is supposed for the calculation that the secondary side (low voltage side) of the connection transformer is to operate in loop, but the one of the distribution transformer is not to operate in loop. The short circuit capacity of the principal substations, as a result, are as in Fig. 2.4-3. The substations whose rupturing capacity required for the circuit breaker will be the maximum one and their capacity are as follows:

150 kV system	Krian Substation	6600 MVA	(25.4 kA)
70 kV system	Waru Substation	1100 MVA	(9.1 kA)
20 kV system	Waru Substation	580 MVA	(16.7 kA)

Taking into account the rated capacity of circuit breaker and the current capacity of the ground wire at the time of faults, if the circuit breakers have the limited capacity for the systems of 150 kV - 25 kA, 70 kV - 20 kA, 20 kV - 20 kA, the countermeasures shall be required only against the 150 kV bus bar of Krian Substation, at the time of fault. Namely, when the Fourth Stage comes in and the transformers (500/150 kV) of 500 MVA x 2 units and 1,000 MVA x 2 units are required on such 150 kV bus-bar, the secondary side of the transformer has to be divided into two or more systems and the short circuit current shall be limited to less than 25 kA, as countermeasures.

2.4.3 Transient Stability

To ascertain that the system has enough transient stability when one(1) line three(3) phase short circuit would occur on the transmission line whose load condition is severest, the phase angles of generators were calculated for the following three lines which connect with power plants.

- Sukolilo Line & Krian Line of Paiton P/S
- Ponorogo Line of Grindulu P/S

It was ascertained that in no case any step out would occur as figured on Fig. 2.4-4(1-1) ∿ (3-2), for 0.1 sec and 0.15 sec of short circuit respectively.

TABLE 2. 4-1-(1) Generator Data

STATION	TYPE	NO.	MW	PF	(MVA)	TERM. VOLT.	SPEED	ON RATING			P.U.ON 100 MVA			NOTE
								Xd'(%)	Xd" (%)	H(%)	Xd'	Xd"	H	
PERAK	STEAM	2	25.0	0.8	32.0	13.8		20.8	11.7	3.5	0.65	0.37	1.12	Exsisting
//	GAS	1	25.0	0.8	32.0	13.8		28.0	15.0	7.0	0.88	0.47	2.24	//
//	STEAM	2	50.0	0.8	62.5	11.0		24.5	16.4	4.0	0.39	0.26	2.5	//
GRESIK	GAS	2	20.0	0.8	25.0	11.0		28.0	15.0	7.0	1.12	0.60	1.8	//
//	STEAM	2	100.0	0.8	125.0	13.2		26.0	15.0	3.0	0.21	0.12	3.8	//
//	//	2	200.0	0.8	250.0	13.2		26.0	15.0	3.0	0.10	0.06	7.5	//
SUTAMI	HYDRO	3	35.0	0.9	39.0	11.0		19.3	13.0	3.65	0.49	0.33	1.4	//
WLINGI	//	2	27.0	0.9	30.0	11.0		19.3	13.0	3.65	0.64	0.43	1.1	//
SELOREJO	//	1	4.8	0.8	5.6	6.6		36.9	22.6	1.65	6.59	4.04	0.09	//
MENDALAN	//	1	5.6	0.8	7.0	6.0		30.0	20.0	2.5	4.29	2.86	0.18	//
//	//	3	5.8	0.8	7.25	6.0		30.0	20.0	2.5	4.14	2.76	0.18	//
SIMAN	//	3	3.6	0.8	4.5	6.3		30.0	20.0	2.7	6.67	4.44	0.12	//
SENGGURUH	HYDRO	2	14.5	0.9	16.0			19.3	13.0	3.65	1.20	0.80	0.6	
TULUNGAGUNG	//	1	22.0	0.9	24.5			19.3	13.0	3.65	0.79	0.53	0.89	
WONOREJO	//	1	8.0	0.9	9.0			19.3	13.0	3.65	3.37	2.25	0.24	
//	//	1	6.2	0.9	7.0			19.3	13.0	3.65	4.35	2.90	0.19	
METRO	//	2	5.0	0.9	5.5			19.3	13.0	3.65	5.36	3.57	0.15	
KESAMBEN	//	2	16.4	0.9	18.0			19.3	13.0	3.65	1.06	0.71	0.66	
LESTI	//	1	12.6	0.9	14.0			19.3	13.0	3.65	1.38	0.93	0.51	
KEPANJEN	//	1	13.7	0.9	15.2			19.3	13.0	3.65	1.27	0.86	0.56	

TABLE 2. 4－1－(2) Generator Data

STATION	TYPE	NO.	MW	PF	(MVA)	TERM. VOLT.	SPEED	ON RATING Xd'(%)	ON RATING Xd" (%)	ON RATING H(%)	P.U.ON 100 MVA Xd'	P.U.ON 100 MVA Xd"	P.U.ON 100 MVA H	NOTE
TEGAROMBO	HYDRO	1	20.0	0.9	22.2			19.3	13.0	3.65	0.87	0.59	0.81	
GRINDULU	//	1	32.0	0.9	35.6			19.3	13.0	3.65	0.54	0.37	1.30	
PAITON	STEAM	2	400.0	0.8	500.0			26.0	15.0	3.0	0.052	0.03	15.0	
//	//	4	600.0	0.8	750.0			26.0	15.0	3.0	0.035	0.02	22.5	

TABLE 2. 4-2-(1) Transformer Data

NAME OF STATION	TRANS. RATIO (KV)	No. OF UNIT & NOMINAL RATING (MVA)	REACTANCE ON RATING (%)	REACTANCE ON 100 MVA & SYSTEM BASE VOLTAGE PER UNIT	NOTE
KRIAN	500/150	1 × 500	14	0.028	
〃	500/150	1 × 1000	14	0.014	
GRESIK	/150	2 × 27	11	0.407	Existing
〃	/150	2 × 120	11	0.092	〃
〃	/150	2 × 240	11	0.046	
PERAK	/70	3 × 40	7.5	0.188	Existing
〃	/150	2 × 62.5	11	0.176	〃
SUTAMI	/150	3 × 39	11	0.282	〃
WLINGI	/150	2 × 30	11	0.368	〃
MENDALAN	/70	3 × 10	7.5	0.75	〃
SELOREJO	/70	1 × 5.6	7.5	1.33	〃
SENGGURUH	/70	1 × 32	7.5	0.234	
WARU	150/70	3 × 39	9.9	0.254	Existing
〃	〃	2 × 50	9.9	0.198	〃
〃	〃	1 × 100	11	0.11	
PERAK	150/70	1 × 35	11	0.314	Existing
BANGIL	150/70	2 × 35	10.9	0.311	〃
〃	〃	1 × 100	11	0.11	
KEBONAGUNG	150/70	1 × 35	11.0	0.314	Existing
WLINGI	150/70	1 × 30	11	0.367	〃
MOJOKERTO	150/70	1 × 35	9.7	0.277	〃
〃	〃	1 × 50	11	0.22	
SEGOROMADU	150/70	1 × 50	10.8	0.216	Existing
〃	〃	2 × 50	11	0.22	
KEDIRI	150/70	1 × 35	9.7	0.277	Existing
〃	〃	1 × 50	11	0.22	
MANISUREJO	150/70	1 × 35	10.7	0.306	Existing
PAITON	500/150	1 × 500	14	0.028	
〃	500/150	1 × 300	14	0.047	
PAITON P/S	/500	1 × 500	14	0.028	
〃	/500	1 × 750	14	0.019	
SUKOLILO	500/150	2 × 500	14.0	0.028	

TABLE 2. 4-2-(2) Transformer Data

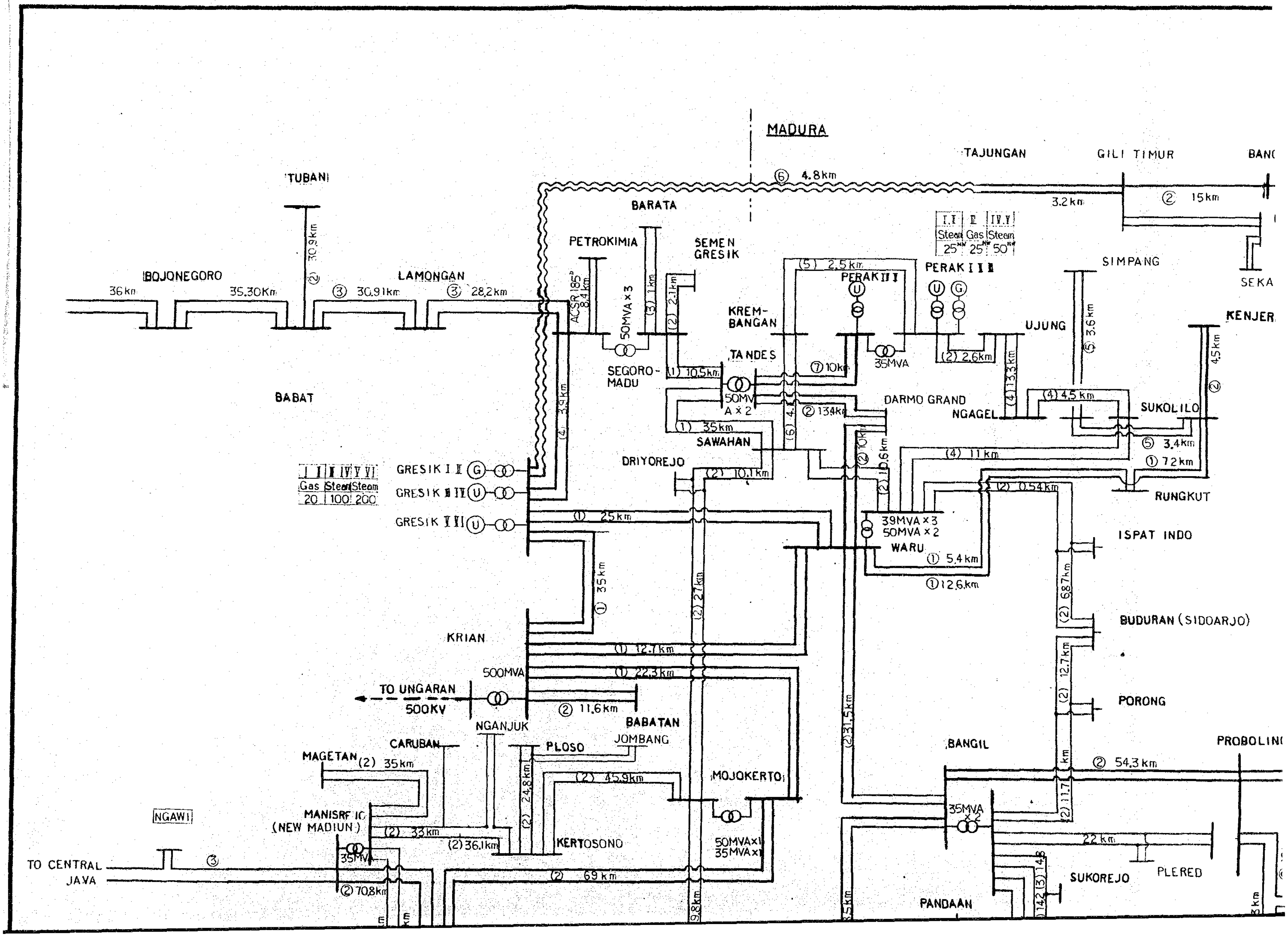
NAME OF STATION	TRANS. RATIO (KV)	Nos of Unit NOMINAL RATING (MVA)	REACTANCE ON RATING (%)	REACTANCE ON 100 MVA SYSTEM BASE VOLTAGE PER UNIT	NOTE
METRO	/70	2 × 5.5	7.5	1.34	
KESAMBEN	/70	2 × 18	7.5	0.41	
KEPANJEN	/70	1 × 15.2	7.5	0.50	
TEGALOMBO	/70	1 × 22.2	7.5	0.34	
WONOREJO	/70	1 × 6.2	7.5	1.21	
〃	/70	1 × 8.0	7.5	0.94	
GRINDULU	/70	1 × 35.6	7.5	0.21	
SENGKALING	150/70	2 × 50	11.0	0.22	
TULUNGAGUNG	/70	1 × 24.4	7.5	0.375	
TANDES	150/70	2 × 50	11.0	0.22	
SAWAHAN	150/70	2 × 50	11.0	0.22	

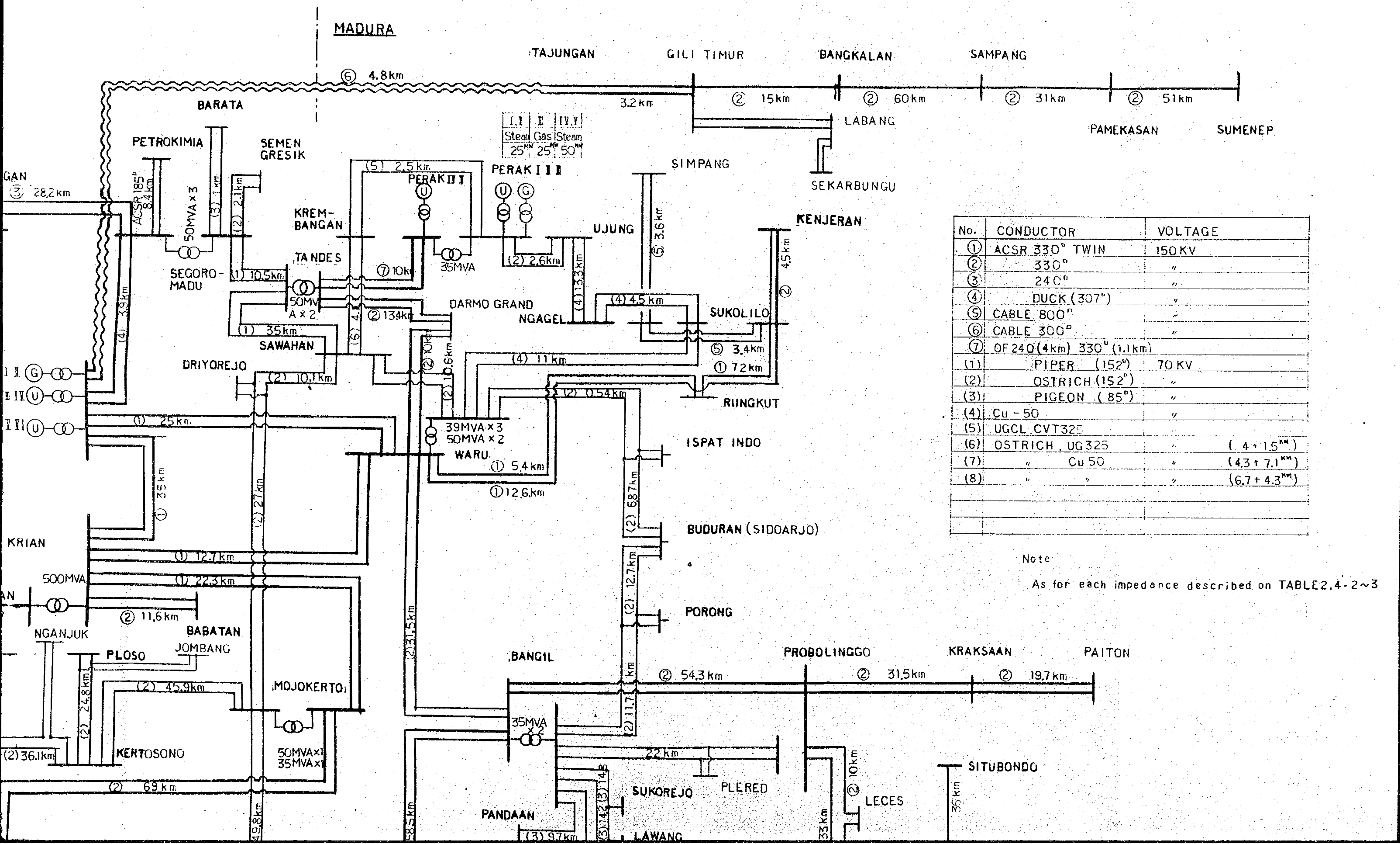
TABLE 2. 4 − 3 Transmission Line Data

NOMINAL VOLTAGE (KV)	CONDUCTOR mm	POSITIVE SEQUENCE IMPEDANCE/KM Rat40°C(ohms)	X (ohms)	Y(mhos)	IN PER UNIT ON 100 MVA & NOMINAL VOLTAGE/KM/CCT R	X	Y	NOTE
500	282 × 4	2.90×10^{-2}	2.88×10^{-1}	3.86×10^{-6}	1.16×10^{-5}	1.15×10^{-4}	9.66×10^{-3}	
150	330 Twin	4.79×10^{-2}	3.05×10^{-1}	3.69×10^{-6}	2.13×10^{-4}	1.35×10^{-3}	8.31×10^{-4}	
150	330	$9.57\times10^{-}$	4.00×10^{-1}	2.86×10^{-6}	4.25×10^{-4}	1.78×10^{-3}	6.43×10^{-4}	
150	307	1.05×10^{-1}	4.02×10^{-1}	2.84×10^{-6}	4.68×10^{-4}	1.79×10^{-3}	6.40×10^{-4}	
150	240	1.49×10^{-1}	4.07×10^{-1}	2.80×10^{-6}	6.61×10^{-4}	1.81×10^{-3}	6.31×10^{-4}	
150	185	2.02×10^{-1}	4.15×10^{-1}	2.75×10^{-6}	8.98×10^{-4}	1.85×10^{-3}	6.18×10^{-4}	
150	160	2.26×10^{-1}	4.20×10^{-1}	2.71×10^{-6}	1.01×10^{-3}	1.87×10^{-3}	6.10×10^{-4}	
150	UGC 300	6.23×10^{-2}	1.11×10^{-1}	9.74×10^{-5}	2.77×10^{-4}	4.92×10^{-4}	2.19×10^{-2}	
150	UGC 800	2.44×10^{-2}	1.38×10^{-1}	1.73×10^{-4}	1.08×10^{-4}	6.14×10^{-4}	3.90×10^{-2}	
70	240	1.49×10^{-1}	3.70×10^{-1}	3.10×10^{-6}	3.04×10^{-3}	7.55×10^{-3}	1.52×10^{-4}	
70	152	2.31×10^{-1}	3.85×10^{-1}	2.97×10^{-6}	4.72×10^{-3}	7.85×10^{-3}	1.46×10^{-4}	
70	85	3.57×10^{-1}	3.96×10^{-1}	2.88×10^{-6}	7.28×10^{-3}	8.09×10^{-3}	1.41×10^{-4}	
70	CU 50	3.97×10^{-1}	4.26×10^{-1}	2.67×10^{-6}	8.11×10^{-3}	8.70×10^{-3}	1.31×10^{-4}	

TABLE 2.4-4 Hydro Power Station Data

NAME OF STATION	CAP. × NOS (MW) Nos.	TOTAL CAPACITY (MW)	FIRM OUTPUT (MW)	COM. YEAR	NOTE
SUTAMI	35 × 3	105	77		Exsisting
WLINGI	27 × 2	54	52		〃
MENDALAN	5.6 × 1	5.6	4.9		〃
〃	5.8 × 3	17.4	15.1		〃
SIMAN	3.6 × 3	10.8	9.8		〃
SELOREJO	4.8 × 1	4.8	2		〃
SENGGURUH	14.5 × 2	29	20	1987	
KESAMBEN	16.4 × 2	32.8	23	1989	
WONOREJO	8 × 1	8	5.6	〃	
〃	6.2 × 1	6.2	4.3	〃	
TULUNGAGUNG	22 × 1	22	15.4	〃	
METRO	5 × 1	10	7	1991	
KEPANJEN	13.7 × 1	13.7	9.6	1995	
LESTI	12.6 × 1	12.6	8.8	1995	
GRINDULU	32 × 1	32	22.4	1997	
TEGAROMBO	20 × 1	20	14	〃	

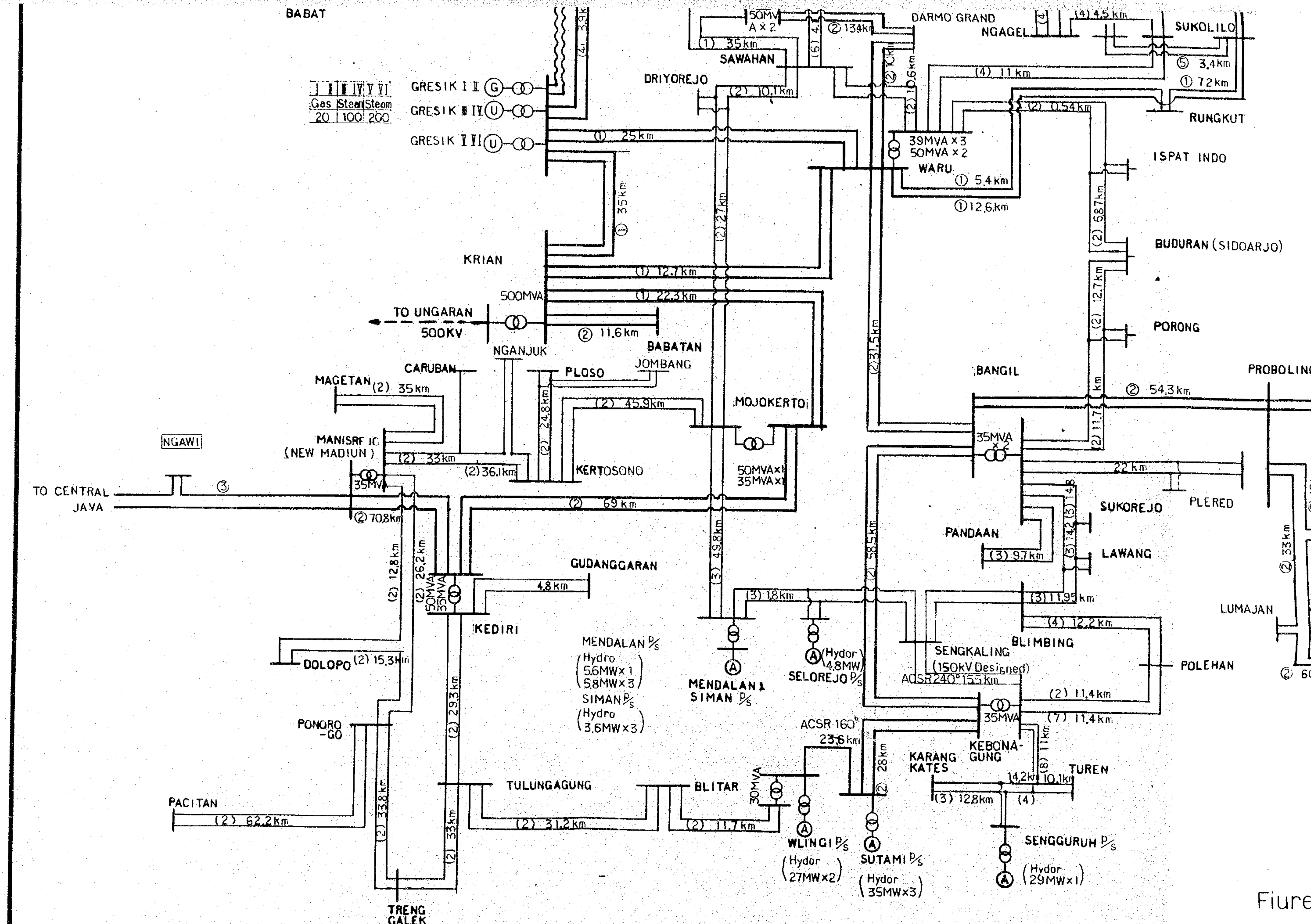

MADURA
TAJUNGAN
GILI TIMUR
⑥ 4.8km
3.2km
② 15km
TUBANI
BARATA
PETROKIMIA
SEMEN GRESIK
SIMPANG
SEKA
KENJER
I.II Steam 25MW
III Gas 25MW
IV.V Steam 50MW
PERAK III
PERAK I II
(5) 2.5km
BOJONEGORO
LAMONGAN
36km
35.30Km
③ 30.91km
③ 28.2km
② 30.9km
ACSR 185
8.4km
50MVA×3
(3) 1km
(2) 2.1km
KREM-BANGAN
UJUNG
TANDES
SEGORO-MADU
(1) 10.5km
⑦ 10km
35MVA
(2) 2.6km
(4) 13.3km
⑤ 3.6km
4.5km
②
BABAT
50MVA×2
(4) 3.9km
② 134km
DARMO GRAND
NGAGEL
(4) 4.5km
SUKOLILO
① 35km
SAWAHAN
(6) 4.1
(2) 10km
(2) 10.6km
⑤ 3.4km
① 72km
(4) 11km
DRIYOREJO
(2) 10.1km
(2) 0.54km
RUNGKUT
I II III IV V VI
Gas 20
Steam 100
Steam 200
GRESIK I II
GRESIK III IV
GRESIK V VI
① 25km
39MVA×3
50MVA×2
WARU
① 5.4km
① 12.6km
ISPAT INDO
① 35km
(2) 27km
(2) 6.87km
BUDURAN (SIDOARJO)
KRIAN
① 12.7km
① 22.3km
500MVA
TO UNGARAN
500KV
② 11.6km
(2) 12.7km
PORONG
BABATAN
NGANJUK
CARUBAN
PLOSO
JOMBANG
MAGETAN
(2) 35km
(2) 24.8km
(2) 45.9km
MOJOKERTO
(2) 31.5km
BANGIL
② 54.3km
PROBOLIN
NGAWI
MANISREJO
(NEW MADIUN)
(2) 33km
(2) 36.1km
KERTOSONO
35MVA
50MVA×1
35MVA×1
35MVA×2
(2) 11.7km
22km
TO CENTRAL JAVA
③
② 70.8km
(2) 69km
9.8km
SUKOREJO
PLERED
PANDAAN
(3) 14.2
(3) 14.8



No.	CONDUCTOR	VOLTAGE	
①	ACSR 330ᴰ TWIN	150KV	
②	330ᴰ	〃	
③	240ᴰ	〃	
④	DUCK (307ᴰ)	〃	
⑤	CABLE 800ᴰ	〃	
⑥	CABLE 300ᴰ	〃	
⑦	OF 240 (4km) 330ᴰ (1.1km)		
(1)	PIPER (152ᴰ)	70 KV	
(2)	OSTRICH (152ᴰ)	〃	
(3)	PIGEON (85ᴰ)	〃	
(4)	Cu - 50	〃	
(5)	UGCL CVT325		
(6)	OSTRICH , UG325	〃	(4 + 1.5KM)
(7)	〃 Cu 50	〃	(4.3 + 7.1KM)
(8)	〃 〃	〃	(6.7 + 4.3KM)

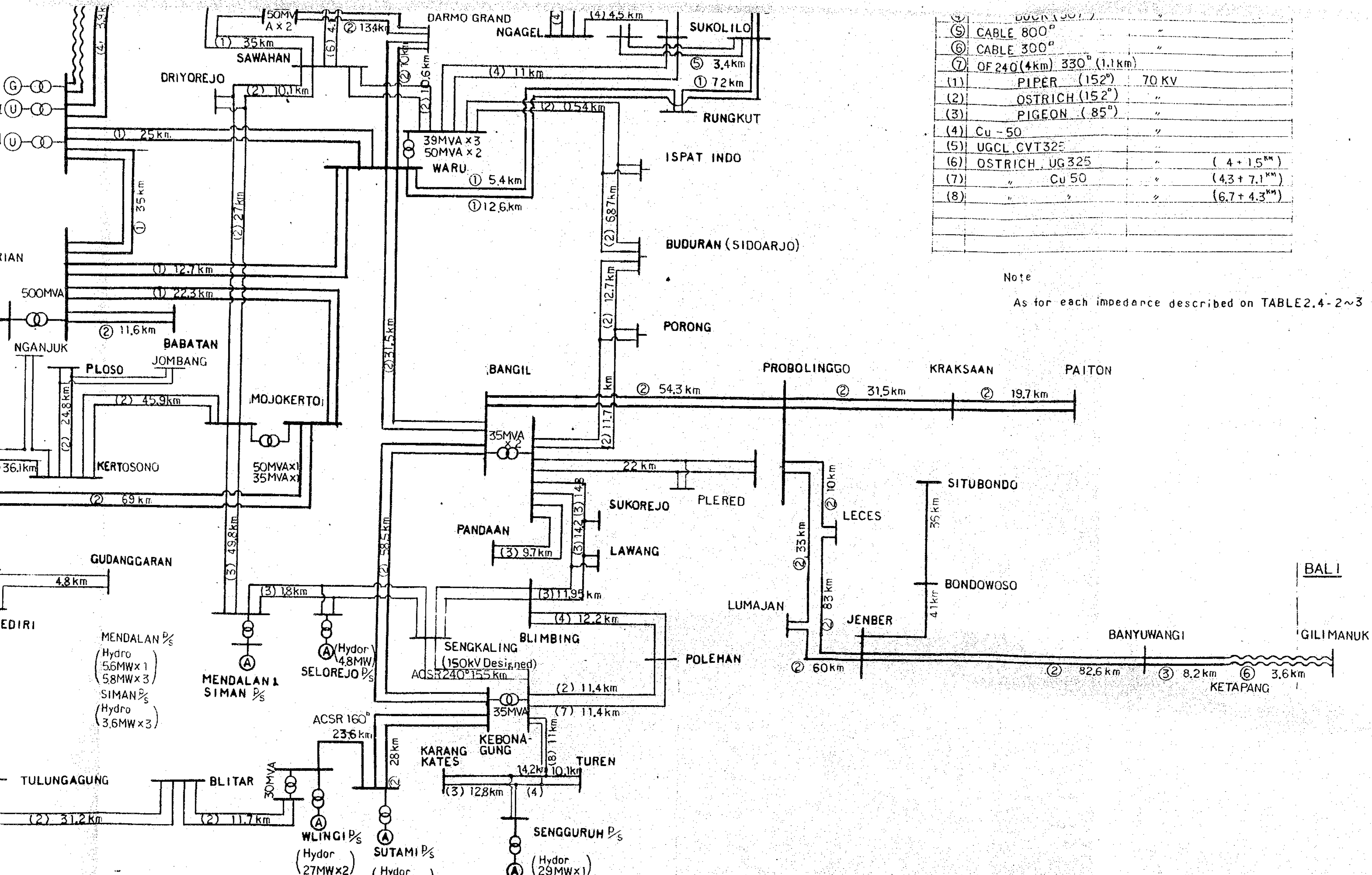
Note

As for each impedance described on TABLE2.4-2~3



BABAT
GRESIK I II
GRESIK III IV
GRESIK V VI
Gas 20
Steam 100
Steam 200
DRIYOREJO
SAWAHAN
DARMO GRAND
NGAGEL
SUKOLILO
RUNGKUT
ISPAT INDO
39MVA x 3
50MVA x 2
WARU
BUDURAN (SIDOARJO)
PORONG
BANGIL
PROBOLIN
KRIAN
500MVA
TO UNGARAN 500KV
NGANJUK
BABATAN
JOMBANG
PLOSO
CARUBAN
MAGETAN
MOJOKERTO
NGAWI
MANISREJO (NEW MADIUN)
TO CENTRAL JAVA
35MVA
KERTOSONO
50MVAx1
35MVAx1
35MVA x 2
PLERED
SUKOREJO
PANDAAN
LAWANG
GUDANGGARAN
KEDIRI
50MVA
35MVA
MENDALAN P/S (Hydro 5.6MW x 1, 5.8MW x 3)
SIMAN P/S (Hydro 3.6MW x 3)
MENDALAN & SIMAN P/S
SELOREJO P/S (Hydor 4.8MW)
SENGKALING (150kV Designed)
BLIMBING
POLEHAN
LUMAJAN
ACSR 240° 155 km
ACSR 160°
DOLOPO
PONORO-GO
PACITAN
TULUNGAGUNG
BLITAR
30MVA
KARANG KATES
KEBONA-GUNG
TUREN
WLINGI P/S (Hydor 27MW x 2)
SUTAMI P/S (Hydor 35MW x 3)
SENGGURUH P/S (Hydor 29MW x 1)
TRENG GALEK

Fiure

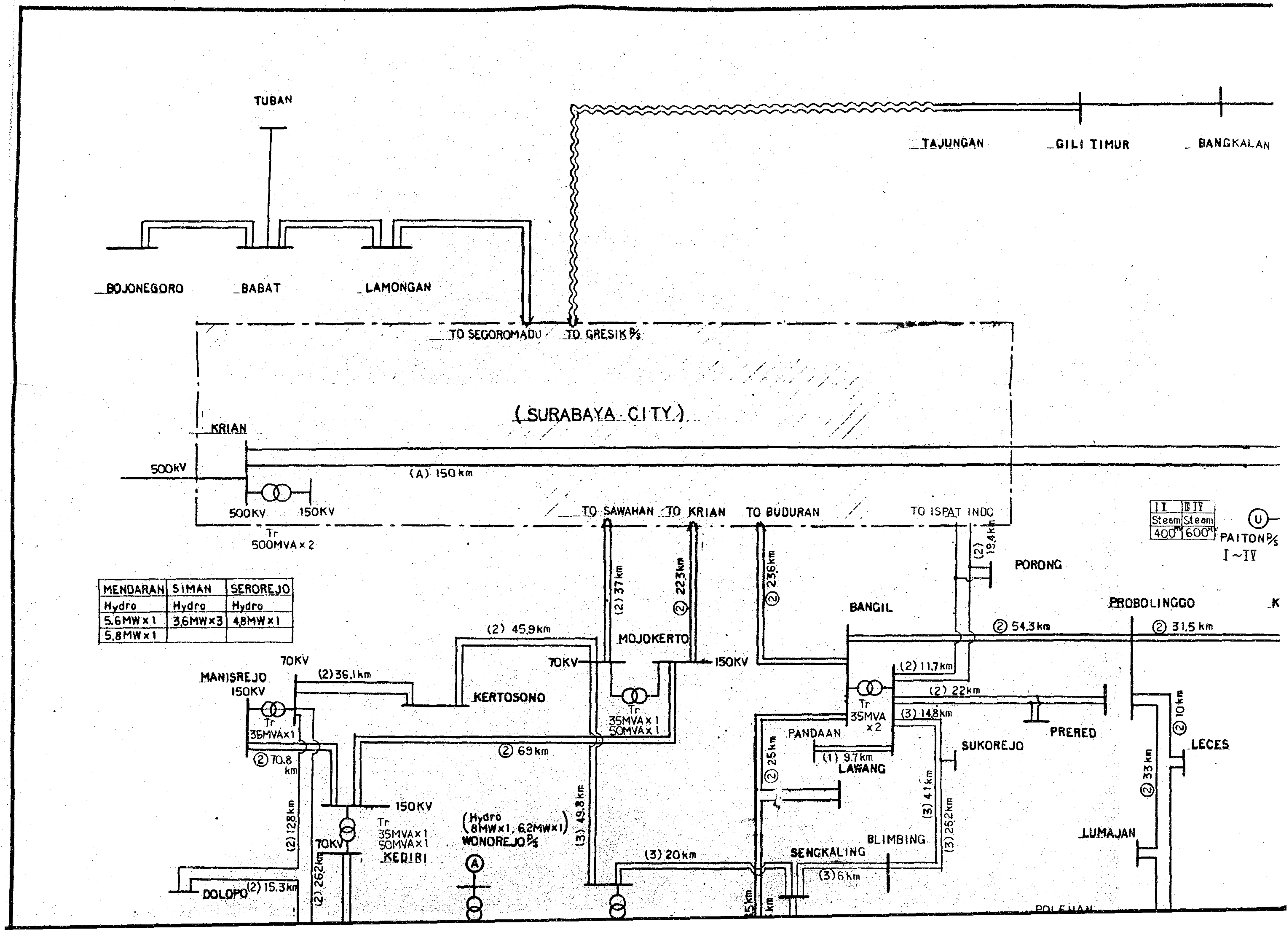


④	DUCK (30[illegible])	″	
⑤	CABLE 800°	″	
⑥	CABLE 300°	″	
⑦	OF 240 (4km) 330° (1.1km)		
(1)	PIPER (152°)	70 KV	
(2)	OSTRICH (152°)	″	
(3)	PIGEON (85°)	″	
(4)	Cu - 50	″	
(5)	UGCL, CVT325	″	
(6)	OSTRICH, UG325	″	(4 + 1.5 km)
(7)	″ Cu 50	″	(4.3 + 7.1 km)
(8)	″ ″	″	(6.7 + 4.3 km)

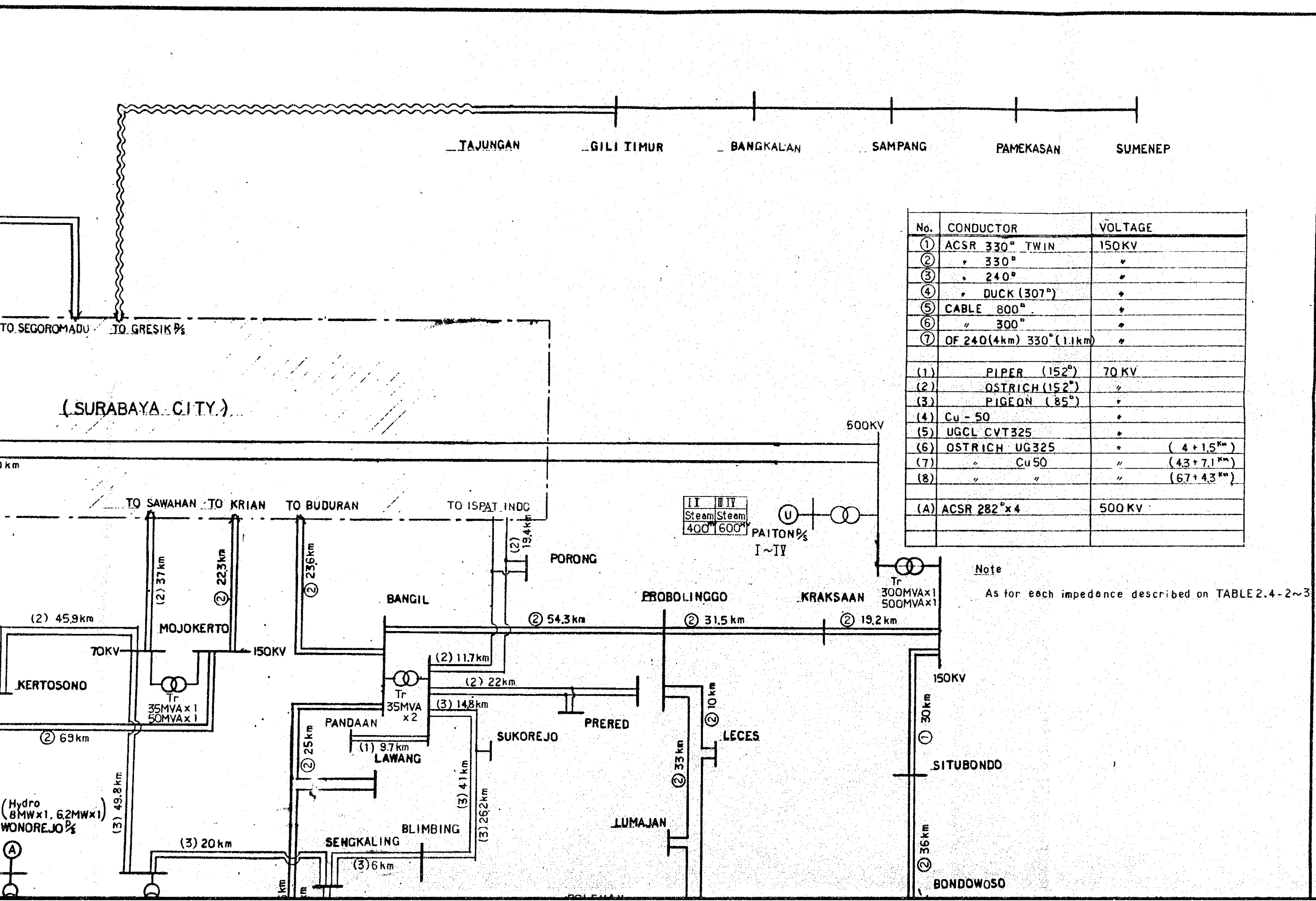
Note

As for each impedance described on TABLE2.4-2~3

Fiure 2.4-1 (1) Single Line Diagram in Mar. 1989



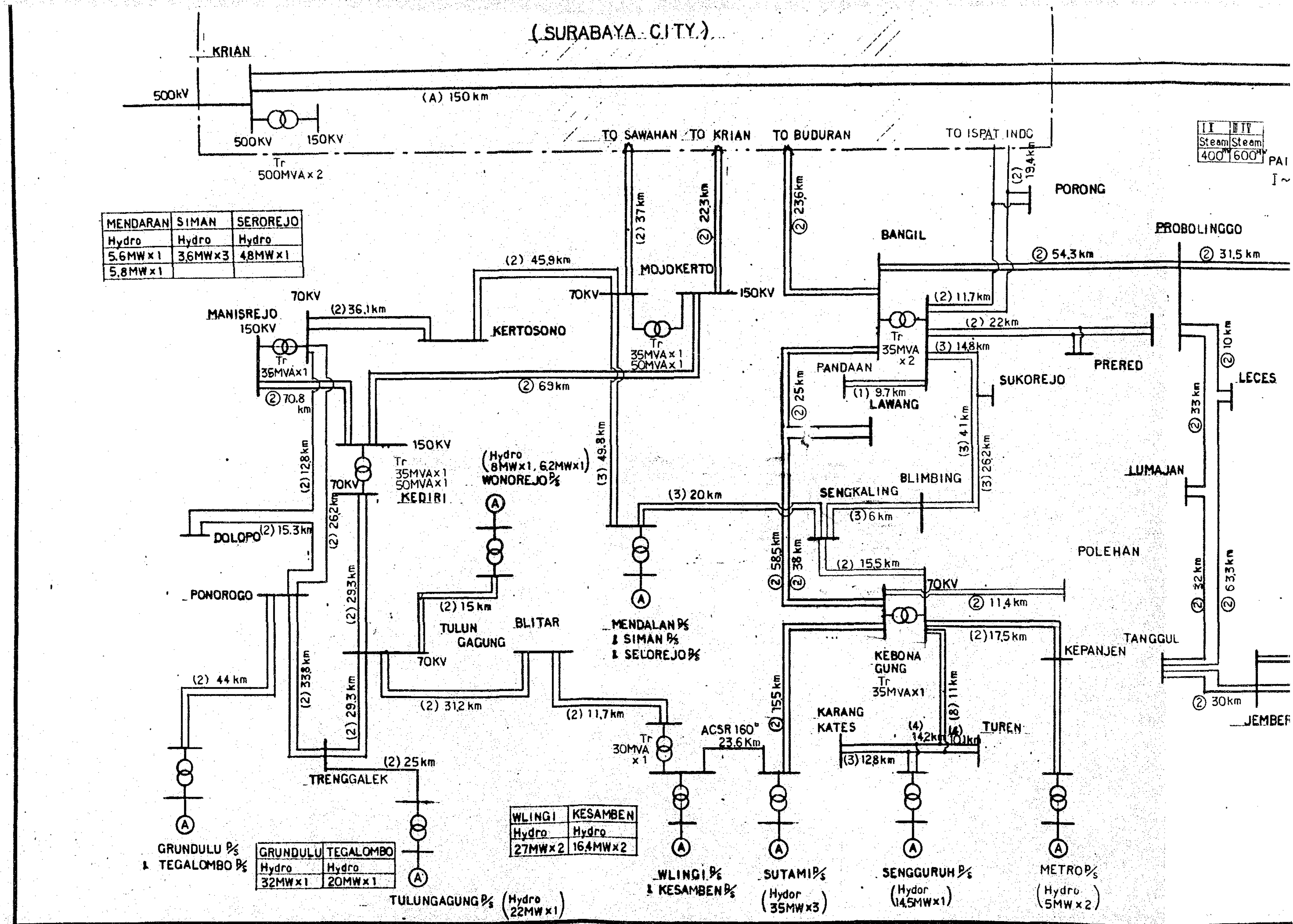
MENDARAN	SIMAN	SEROREJO
Hydro	Hydro	Hydro
5.6MW×1	3.6MW×3	4.8MW×1
5.8MW×1		



No.	CONDUCTOR	VOLTAGE	
①	ACSR 330° TWIN	150KV	
②	〃 330°	〃	
③	〃 240°	〃	
④	〃 DUCK (307°)	〃	
⑤	CABLE 800°	〃	
⑥	〃 300°	〃	
⑦	OF 240(4km) 330°(1.1km)	〃	
(1)	PIPER (152°)	70 KV	
(2)	OSTRICH (152°)	〃	
(3)	PIGEON (85°)	〃	
(4)	Cu - 50	〃	
(5)	UGCL CVT325	〃	
(6)	OSTRICH UG325	〃	(4 + 1.5km)
(7)	〃 Cu50	〃	(4.3 + 7.1km)
(8)	〃 〃	〃	(6.7 + 4.3km)
(A)	ACSR 282°×4	500 KV	

Note

As for each impedance described on TABLE 2.4-2~3


(SURABAYA CITY)
KRIAN
500kV
(A) 150 km
500KV 150KV
Tr 500MVA x 2
TO SAWAHAN
TO KRIAN
TO BUDURAN
TO ISPAT INDO
II Steam 400MW
III IV Steam 600MW
PAI
(2) 19.4km
PORONG
MENDARAN Hydro 5.6MW x 1 5.8MW x 1
SIMAN Hydro 3.6MW x 3
SEROREJO Hydro 4.8MW x 1
(2) 37 km
② 22.3km
② 23.6km
BANGIL
PROBOLINGGO
② 54.3 km
② 31.5 km
(2) 45.9km
MOJOKERTO
70KV
150KV
(2) 11.7km
70KV
MANISREJO 150KV
(2) 36.1km
KERTOSONO
Tr 35MVA x 1 50MVA x 1
Tr 35MVA x 2
(2) 22km
(3) 14.8km
PRERED
② 10km
Tr 35MVA x 1
② 70.8 km
② 69km
PANDAAN
(1) 9.7km
LAWANG
SUKOREJO
LECES
② 25km
② 33km
(2) 12.8km
150KV
Tr 35MVA x 1 50MVA x 1
KEDIRI
70KV
(Hydro 8MW x 1, 6.2MW x 1) WONOREJO P/S
(3) 49.8km
(3) 41km
(3) 26.2km
BLIMBING
LUMAJAN
SENGKALING
(3) 20km
(3) 6km
DOLOPO
(2) 15.3km
(2) 26.2km
② 58.5km
② 38km
POLEHAN
(2) 15.5km
② 32km
② 63.3km
PONOROGO
(2) 29.3km
(2) 15km
TULUN GAGUNG
BLITAR
70KV
MENDALAN P/S & SIMAN P/S & SELOREJO P/S
70KV
② 11.4km
KEBONA GUNG Tr 35MVA x 1
(2) 17.5km
KEPANJEN
TANGGUL
(2) 44km
(2) 33.8km
(2) 29.3km
(2) 31.2km
(2) 11.7km
Tr 30MVA x 1
ACSR 160° 23.6Km
② 15.5km
KARANG KATES
(8) 11km
(4) 14.2km
(4) 10.1km
TUREN
(3) 12.8km
② 30km
JEMBER
TRENGGALEK
(2) 25km
WLINGI Hydro 27MW x 2
KESAMBEN Hydro 16.4MW x 2
GRUNDULU P/S & TEGALOMBO P/S
GRUNDULU Hydro 32MW x 1
TEGALOMBO Hydro 20MW x 1
TULUNGAGUNG P/S (Hydro 22MW x 1)
WLINGI P/S & KESAMBEN P/S
SUTAMI P/S (Hydor 35MW x 3)
SENGGURUH P/S (Hydor 14.5MW x 1)
METRO P/S (Hydro 5MW x 2)

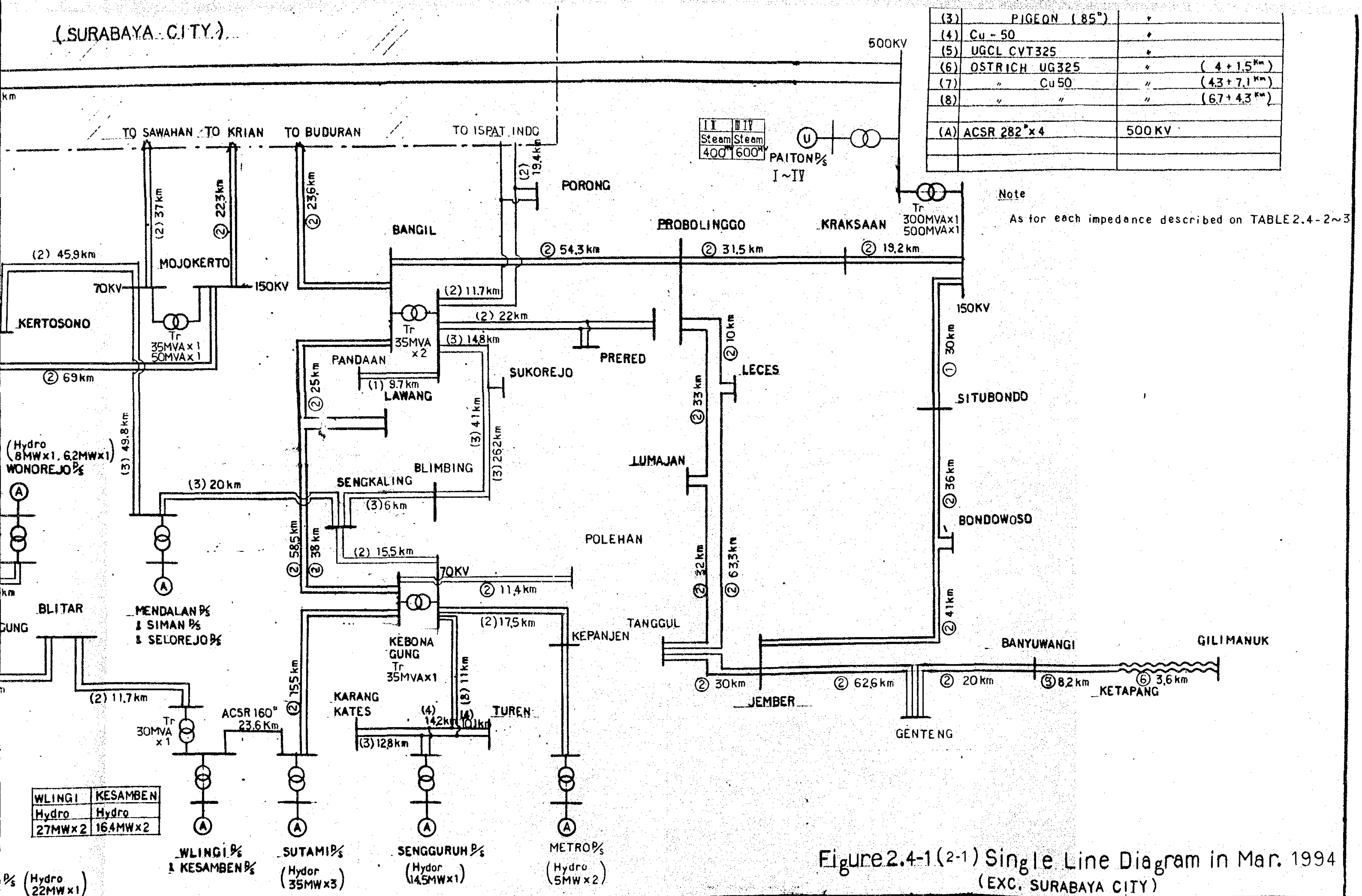


Figure 2.4-1 (2-1) Single Line Diagram in Mar. 1994
(EXC. SURABAYA CITY)

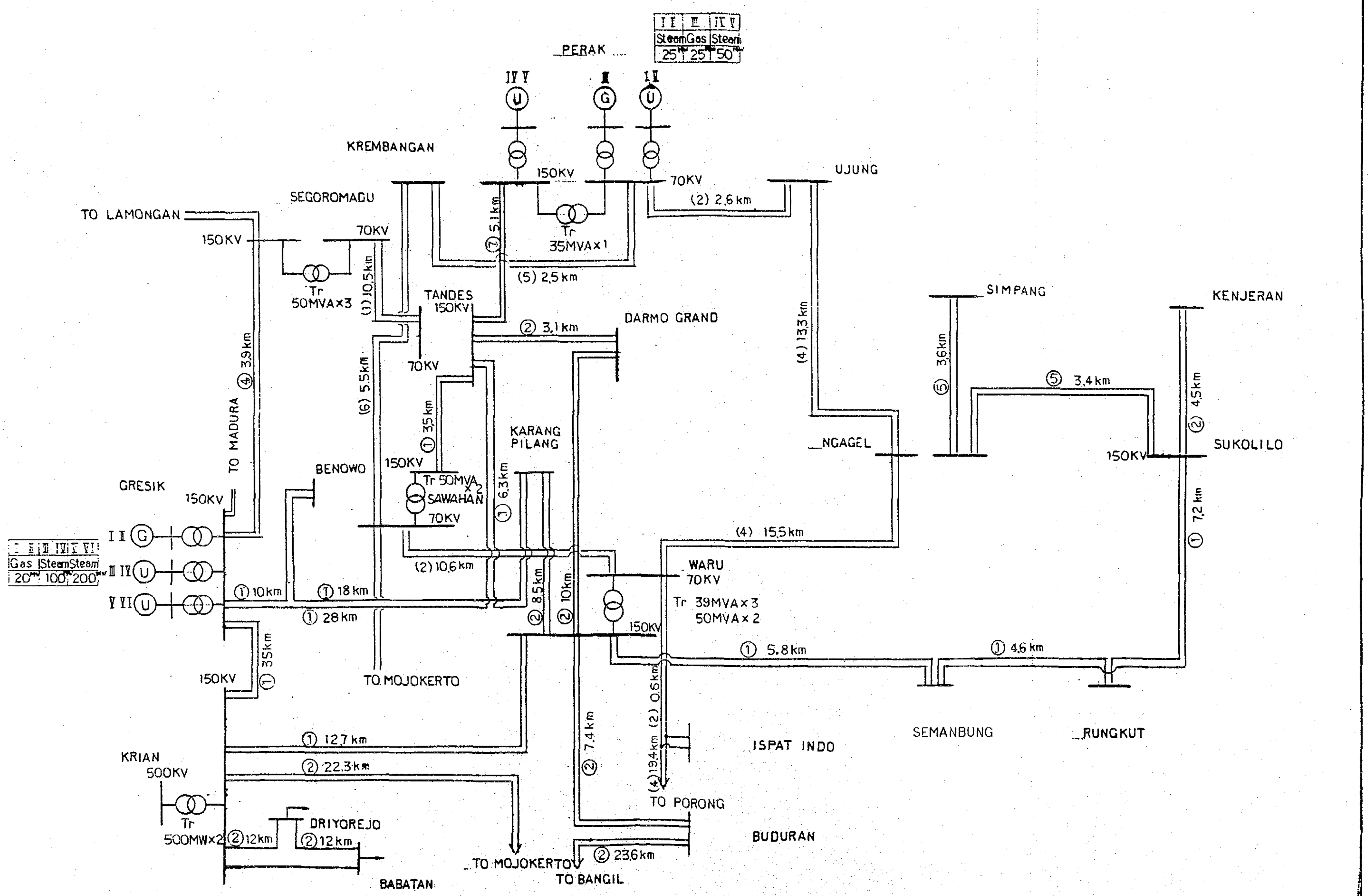


Figure 2.4-1 (2-2) Single Line Diagram in Mar. 1994
(SURABAYA CITY)