

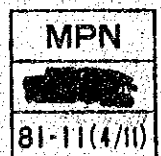
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NATIONAL POWER CORPORATION

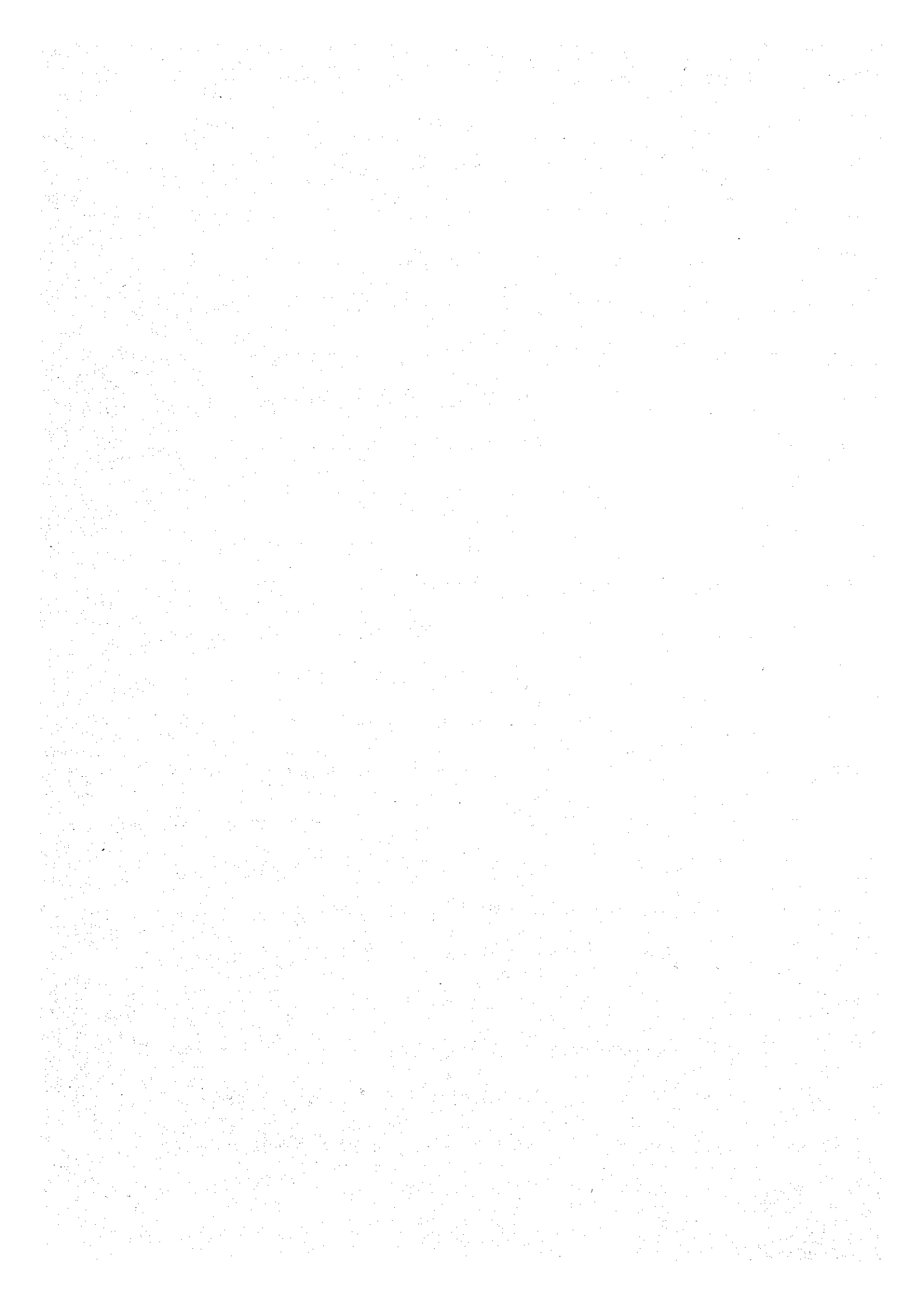
**FEASIBILITY REPORT
ON
AGOS RIVER HYDROPOWER PROJECT**

**APPENDIX C
POWER STUDY**

MARCH 1981

JAPAN INTERNATIONAL COOPERATION AGENCY





REPUBLIC OF THE PHILIPPINES
NATIONAL POWER CORPORATION

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**FEASIBILITY REPORT
ON
AGOS RIVER HYDROPOWER PROJECT**

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**APPENDIX C
POWER STUDY**

MARCH, 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

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AGOS RIVER HYDROPOWER PROJECT

FEASIBILITY REPORT

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Appendix	B	Geology and Construction Materials
Appendix	C	Power Study
Appendix	D	Optimization Study for the Development on the Agos River System
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APPENDIX C POWER STUDY

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ABBREVIATIONS AND UNIT

JICA	Japan International Cooperation Agency
NAPOCOR (NPC)	National Power Corporation of Philippines
NK	Nippon Koei Co., Ltd.
PICOREM	Presidential Inter-Agency Committee for re-study of the Marikina River Multi-purpose Project
NEA	National Electrification Administration
MOE	Ministry of Energy
MERALCO (MECO)	Manila Electric Company
MWSS	Metropolitan Waterworks and Sewerage System
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
BPW	Bureau of Public Works
ECAFE	Economic Commission for Asia and the Far East
CDM	Camp, Dresser and McKee International, Inc.
M + E (M & E)	Metcalf and Eddy, Ltd.
\$	United States Dollars
P (P)	Philippines Pesos
¥	Japanese Yen
FC	Foreign Currency
LC	Local Currency
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
O & M	Operation and Maintenance
L.F.	Load Factor

AMSL	Above mean sea level
EL.	Elevation in m AMSL
W.L. (WL)	Water level in m AMSL
H.W.L. (HWL)	High water level in m AMSL
L.W.L. (LWL)	Low water level in m AMSL
F.W.L. (FWL)	Flood water level in m AMSL
D.F.W.L. (DFWL)	Design flood water level in m AMSL
P.M.F.W.L. (PMFWL)	Probable maximum flood water level in m AMSL
mm	millimeter(s)
cm	centimeter(s)
m	meter(s)
km	kilometer(s)
m ³	cubic meter
km ²	square kilometer(s)
ha	hectare
m ³ /sec (cms)	cubic meter per second
m ³ /sec·month	Water volume equivalent to the discharge of 1 m ³ /sec for the duration of 1 month
kg	kilogram
t (ton)	metric ton
ℓ	liter
%	percent
°C	centigrade
o	degree
N	north
rpm	revolution per minute

Hz	Hertz (cycles per second)
kcal	kilocalorie
kV	kilovolt
kVA	kilovolt ampere
MVA	megavolt ampere
W	Watt
kW	kilowatt
MW	megawatt
kWh	kilowatt hour
MWh	megawatt hour
GWh	gigawatt hour
V	volt
BTU	British Thermal Unit

CHAPTER 1 ORGANIZATION

The power sector in Philippines is under the Ministry of Energy (MOE). The Government Agencies placed under the MOE are given on Chart-1. The major agencies sharing the responsibilities for electric power supply are National Power Corporation (NPC or NAPOCOR), National Electrification Administration (NEA). The Philippine Atomic Energy Commission and the Philippine National Oil Corporation are also attached to MOE.

The National Power Corporation was established as a public corporation under CA No.120 on November 3, 1936 to undertake the development of hydraulic and other power and later authorized to construct and operate all power facilities as specified in Annex II. All power generating facilities and transmission lines in the country were undertaken by NAPOCOR to accelerate the electrification in Philippine. NAPOCOR will be a sole supplier of the electric power to cooperative, public utilities and bulk consumers. The organization chart of NAPOCOR is given in Chart-2.

The power distribution is carried out by utilities cooperatives which is under control of NEA. The NEA was established on August 4, 1969 to handle the task of implementing the rural electrification program. The rural electrification is one of the top priority development project of the Government. On August 6, 1973 by Decree 269, NEA was converted into a public corporation to implement the total electrification of the country. NEA is responsible for reorganizing the distribution sector (setting up cooperatives for power distribution and determining which privately-owned public utilities should be permitted to remain in operation) and implementing rural electrification promotion and developments of rural cooperative in the country. As of 1979, NEA has connected 77 cooperatives in Luzon Island to NAPOCOR grid. Yet some cooperatives isolated from NAPOCOR grid, are supplying expensive power by their own small generating sets. The organization chart of NEA is given in Chart-3.

The Manila Electric Company (MECO or MERALCO), the biggest power company in the Philippines, has been undertaking power supply to the franchise area of the Metropolitan Manila area and its vicinity by their own power stations.

These MERALCO's power stations generated about 65 % of total generation in Luzon Island (Region I to V excluding the provinces of Marinduque, Occidental and Oriental Mindoro, Palawan, Romblon, Catanduanes and Masbate). But these power station was taken over by NAPOCOR in 1979 by the presidential Decree No.40, MERALCO became a power distribution company to the Metropolitan Manila (MMA) and its neighboring area. The organization of the company is shown in Chart-4.

CHAPTER 2

POWER SYSTEM

2.1 Power Station

Electric power in Luzon is being supplied mainly by NAPOCOR MERALCO grid with supplemental installation of private utilities. The total installation of the NAPOCOR MERALCO grid is about 3,000 MW as of December, 1979. Beside NAPOCOR-MERALCO grid, there are small scale power plants of cooperatives and industries but their details are not known although it is said that the total capacity of them is only a few percent of that of NAPOCOR-MERALCO grid. These plants will be retired depending on the extension of the grid. The installations of NAPOCOR-MERALCO grid is as follows:

Hydro P/S	544	MW (18.1 %)
Thermal P/S	2,230	MW (74.4 %)
Geothermal P/S	220	MW (7.3 %)
Diesel P/S	5.5	MW (0.2 %)
Total	2,999.5	MW (100 %)

Details of existing power plants of NAPOCOR and MERALCO are presented in Table 2-1. The distribution of power stations in three regions are in the Philippines given in Table 2-2.

2.2 Transmission Line

Existing transmission lines of Luzon grid are given on Dwg. 1. The 230 kV trunk line is stretched over 1,300 km from Ambuklao hydro power station in Central Luzon to Tiwi geothermal power station, southern Luzon near the port Legaspi and branches a line to the Bataan thermal power plant. A 115 kV transmission system covers the Metropolitan Manila, the franchise area of MERALCO with about 872 circuit km length. A 115 kV line from Baguio to Laoag about 220 km was constructed by NAPOCOR along the west coast of the island. Secondary transmission lines of 69 kV are extended by NAPOCOR to distribute power to the cooperatives, public utilities, and bulk power consumers. The total length of 68 kV is about 1,700 circuit km. Details of the existing transmission lines in the Philippines classified by rated voltage are shown on Table 2-2.

CHAPTER 3

PAST TREND OF ENERGY CONSUMPTION IN LUZON

3.1 The Energy Consumption

The energy consumption in Luzon Island from 1960 to 1978 are presented on Table 3-1 to 3-4 and Fig. 3-1, 3-2. Energy consumption had increased from 1,649 to 5,449 million kilowatthours during the period from 1960 and 1969. The average annual compound growth rate was 13.8 % during this period. The growth rate of 4 years period after 1969 to 1973 decreased by annual growth rate of 8.5 %. This drastic decline of growth rate was the reaction of Philippine business community to the Peso devaluation. The growth rate in 1973 of only 0.9 % was caused by the worldwide oil crisis. After this panic condition, the growth rate increased by moderate rate of 7.4 %.

The relation between annual growth rate of energy consumption and GNP by per capita basis is given on Table 3-5 and Fig. 3-3. These table and graph shows that the elasticity of electricity consumption to Gross National Product has changed twice in 1964 and 1971. These changes were caused by variation of economic conditions. The change in 1971 might be caused by the drastic increase of oil price, after this year the elasticity was kept almost constant at 1.01 until 1978.

Total electric power generation and consumption in the country amounted to 12,488 GWh and 1,099.7 GWh, respectively in 1978. About 89 % of the electric power was consumed in Luzon grid, 9 % in Mindanao grid, while only 2 % was consumed in Visaya grid. Per capita consumption of electric power in Philippines was 237 kWh in 1978.

Electrification ratio is still in low level of 32 % in the whole country. About two million house holds have benefited from electrification. Main figure of electric power consumption and electrified condition in Philippines are presented in Table 3-6 and 3-7.

The specific variations in energy consumption pattern for the past eighteen years are briefly described in the NAPOCOR Report on Historical Energy Consumption in Luzon Mainland. The abstract of this report, partially revised according to new available data, is attached in Annex I. The electric energy resources in Philippines are mainly depending upon imported fossil fuel. The amount of imported petroleum product was about 1,000 million US\$ in 1978, this amount is about 23 % of the total imported commodities of Philippines. It is not favourable for the Philippine economy to use the imported oil for electric power generation. The development of the indigenous power resources should be forced more strongly.

Table 3-4 shows that the load factor was increased from 58 % to 69 % until 1978. The system loss of the grid is declining from 17 % in 1964 to 9 % in 1978. This system loss is only NAPCOR and MERALCO and not including distribution loss of cooperatives. It is reported that the loss of these cooperatives is about 28 %. If this is included, the system loss becomes more than 10 %.

3.2 The Sectoral Energy Consumption

The sectoral energy consumption in Luzon Island is presented on Table 3-3. The typical load curves and load duration curves in 1979 are displayed on Fig. 3-4 and 3-5. It is understood from these curves that the percentage of day time load such as industrial load and air conditioning load is heavier than the lighting load like other developed countries. This trend will be emphasized more and more in future.

The monthly energy output of the integrated Luzon grid and energy from hydro power stations are presented on Fig. 3-6. This figure shows that the maximum load month in a year is mainly May and June, in this season energy production by hydro power station was only 15 % of total generated energy in 1979.

3.3 The Total Developed Capacity

The total developed capacity of hydro power plant in Luzon is only 544 MW compared with the total installation of 3,000 MW as of 1978. The prospective hydro power station sites are located only mountainous northern area far from the load center of Metro Manila Area (MMA) except the Agos river project site. This will be one of the reason why the hydro power plant was developed in low level. Until now, the thermal power plant was mainly constructed by MERALCO to supply to the MMA and its vicinity. The Ten Year Plan of the development of power station is limited to the indigenous power resources and nuclear power instead of oil fired thermal power station by the sky high oil prices in recent years.

The increasing condition of the numbers of customers of NAPCOR are presented on Table 3-8. This table shows that number of customers of NAPCOR is decreased from 1974 to 1977. This is caused by the integration of small cooperatives to provincial scale big cooperatives. But the number of consumers of other two categories have been increasing though very slow.

CHAPTER 4

LOAD FORECAST

The load forecast for the integrated Luzon grid was carried out by Lahmeyer International GmbH (LI) in December 1977 in the Report of Power System Luzon Generation Expansion Study. NAPOCOR revised the forecast several times until 1980 for its Ten Year Development Plan. Latest forecast is issued on June 1980.

The electrical load forecast was carried out by following assumptions.

4.1 The Distribution of Gross Generated Energy

The distribution of gross generated energy is presented on Table 3-9 in integrated grid of NAPOCOR and MERALCO. The percentage of station use in the system was 4.5 to 3.6 % in period 1973 - 1978. The system loss was 7 to 9.2 % in same period. The low value of system loss may be caused by the following reasons.

- a) Most of power stations are located near the biggest load center of MMA.
- b) NAPOCOR is supplying to utilities. The exact supply date from the utilities and cooperatives to consumers were not available. Although the loss of these utilities is reported Mainland, but only the transmission and distribution loss of NAPOCOR and MERALCO system was considered in the analysis.

4.2 Load Factor

The yearly load factor in Luzon grid was gradually increased from 58 to 69 % during the 18 years from 1960 to 1979. The load factor is assumed to the 69 % until 1982 and 70 % after 1983.

The load curve of the Luzon grid is shown in Fig. 3-4 and 3-5 as typical curve of light and heavy load seasons. In Fig. 3-7, seasonal load curves for 1978 and 1979 and yearly load curve for 1978 are displayed.

The yearly load factor in 1978 was 71.6 %. The curve B in this figure shows the load curve of 70 % load factor. This curve is used for the study the plant factor the hydro power station.

4.3 The Load Forecast in Luzon

The load forecast of Luzon grid was carried out by only macro method. As the past long years record of Gross Domestic Regional Product (GRDP) was not available. The historical relation of electrical energy consumption and GNP by per capita base is displayed in Table 3-5. It is reported in long term and Five Year (1978-82) Development Plans that the growth rate of per capita GDP is not the same as that of per capita GRDP in Luzon. The difference between the elasticity of electricity consumption to GNP and GRDP in Luzon per capita base was only 0.01 as shown in Table 3-5 and Table 3-12.

The world wide trend of the elasticity of energy consumption to GNP is generally declining by sharp escalation of oil prices. In this report lower value of elasticity 1.01 was applied for the load forecast.

Based on these assumption, the load forecast in Luzon Island is carried out. The results are shown in Table 3-10 and 3-11. The latest load forecast by NAPOCOR is presented in Table 3-13. The forecasted value by JICA Team is slightly higher than the value forecasted by NAPOCOR. The peak demand estimated by JICA Team is 4420 MW in 1990, while the forecasted value of 4120 MW by NAPOCOR.

CHAPTER 5

EXTENSION OF POWER SYSTEM

The total capacity in 1990, end of the ten years plan in each regions are shown in Table 5-1 and the detail plan of Luzon grid is given in Table 5-2. The expansion programs in other regions are given in Table 5-3 and 5-4. The locations of the existing, proposed and under-construction power plants and transmission lines in Luzon Island are shown on Dwg. 2.

This plan is intended to exploit the indigenous energy resources such as hydro power, coal-fired and geothermal power according to the national policy to minimize the consumption of the imported fossil fuel. There will be no construction plan of an oil fired thermal power plant until 1990 in Luzon grid. The extension of power supply system is planned with due consideration for the system reserve and reliability. The power extension program in Luzon is summarized hereunder.

- a) Geothermal power plants of total capacity 550 MW will be constructed until 1980 in the Mak Ban and Tiwi areas. And on the other hand geothermal plant Tongonan Project of 225 MW capacity in Leyte will be constructed in this decade. The surplus power of of this project in this area will be transmitted to MMA through a cross strait D.C. transmission line.
- b) The Kalayaan pumped storage hydro power plant, with initial capacity of 300 MW (150 MW x 2 units), which is now under construction, will be completed by 1983. The plant will be extended up 600 MW No.3 and 4 units in future.
- c) The first nuclear power plant of 620 MW capacity is under construction in Bataan peninsula. This plant is scheduled to be on stream by the middle of 1986.
- d) Until 1990, five hydro power plants are expected to be completed. The Magat power plant, one of the above five, will be constructed by 1983. Other four projects, San Roque, Gened, Agos, and Chico IV are planned to be constructed in 1987, 1988, 1989, and 1990 respectively.
- e) Two coal fired thermal power plants of 300 MW each are scheduled to be constructed in Batangas area by 1986 to utilize the coal available from the coal mines in the adjacent area, Cebu, Semirara, Surigao, Zamboanga and Batan islands.

The peak power and energy balance between anticipated power demand and the planned installation in future is illustrated on Fig. 5-1 and 5 2, respectively. The most predominant characteristic of the plan is to reduce heavy dependence on imported oil during the projected period by utilizing indigenous energy sources such as hydropower, geothermal and coal thermal. Particularly, hydro power development is emphasized which is expected to dominate 25.3 % of the total installed capacity at the end of the planned period. The shares of geothermal plant and coal-fired thermal plant are also expected to grow considerably with the planned target of 14% and 7 %, respectively. The oil-fired thermal plant, on the contrary, will reduce its share from present 72 % to 40 %.

The Agos hydro power project is included in the power expansion plan with the installed capacity of 140 MW. The project construction is expected to start from 1983 and planned to be completed in 1988. Fig. 5-1 presents the relation between planned power plant expansion program and projected peak demand. From this figure it is proven that the expansion power plan considers enough allowance for the capacity even if the peak power demand grows with relatively higher increase ratio as estimated in the preceding section. Fig. 5-2 shows the relation between available energy and projected energy demand. According to this graph, supply energy will be not sufficient enough in 1985 and 1990 considering the yearly stop for maintenance of thermal power stations.

CHAPTER 6

EXPANSION OF TRANSMISSION SYSTEM

Along with the progress of the development of the power plants, transmission lines and substations are also to be extended in stage by stage.

The total circuit kilometers of the transmission lines and total capacity of the substations to be constructed in this ten years period are 10,000 km and 8,800 MVA respectively as shown in Table 6-1 and 6-2.

The expansion plan of the transmission lines are shown on Dwg. 2, and single line diagram of Luzon grid including proposed plan is presented on Dwg. 3. According to the plan, ultra high voltage (UHV) transmission lines are considered to be constructed between Ablug and Chico hydro power station to Manila area.

(Note)

This UHV transmission line might be extended to Legaspi in case the development of geothermal power in Southern Luzon and Leythe is accelerated.

T A B L E S

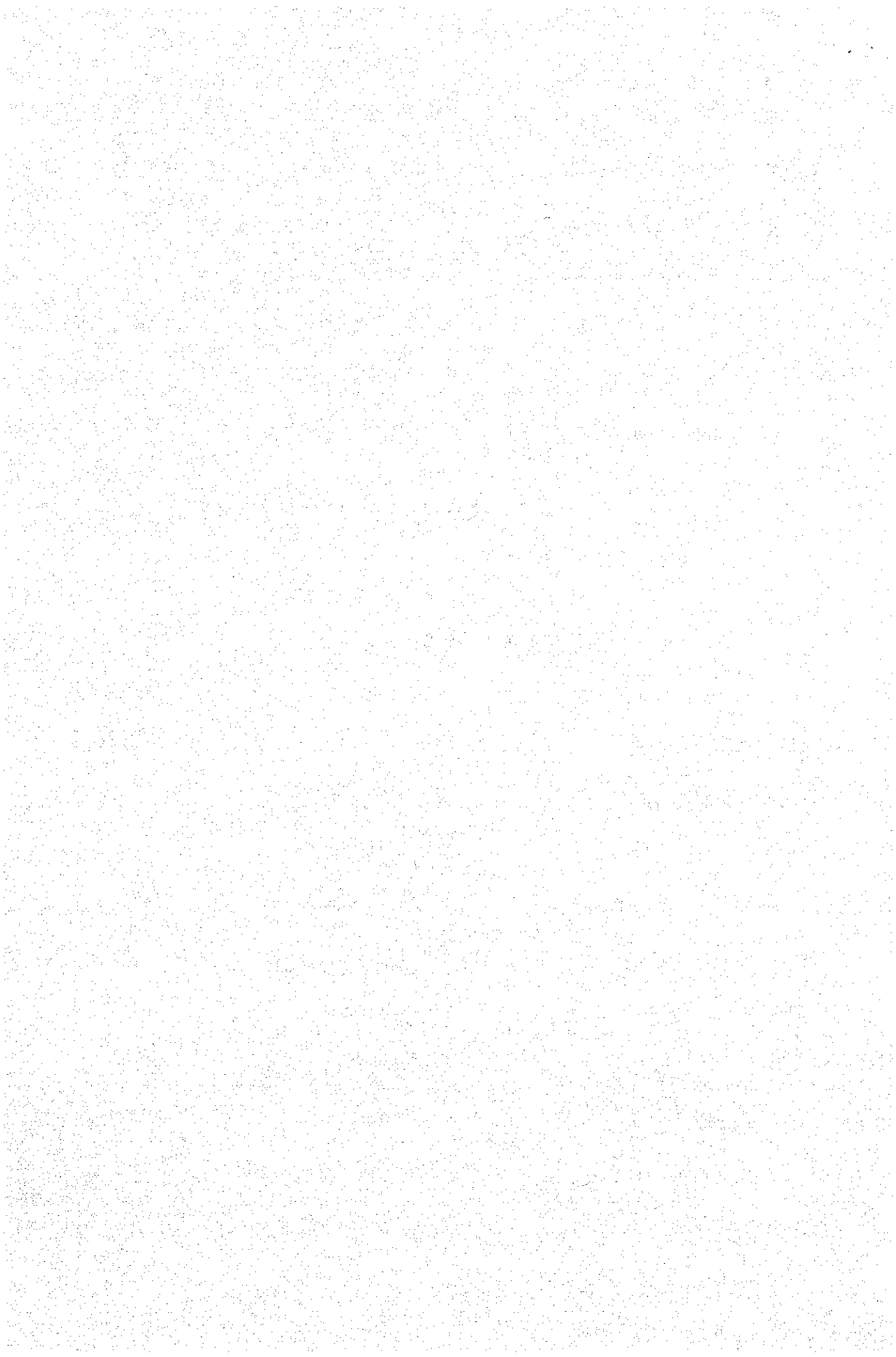


Table 2-1 List of Existing Power Stations in Luzon

HYDRO ELECTRIC PLANT									
No. PLANT	No. & Cap. of GEN. No. x MW	CROSS HEAD m	EFFECTIVE STORAGE CAP. OF RESERVOIR 10 ⁶ m ³	TOTAL INSTALLED CAPACITY MW	EFFECTIVE CAPABILITY MW	ANNUAL AVAILABLE ENERGY GWH	YEAR COMM.		
1. Caliraya	4 x 8	271	43.8	32	32	192	1945/50		
2. Ambuklao	3 x 25	180	258	75	75	459	1956		
3. Lak Bubi-Barit	1 x 1.8	19.2 Ef.	Run of River	1.8	1.8	12	1957		
4. Cawayan	1 x 0.4	77.2 Ef.	Run of River	0.4	0.4	3.1	1959		
5. Binga	4 x 25	155	48.2	100	100	610	1960		
6. Angat	4 x 50	-	630						
7. Patanbangan	3 x 6	119	208.3	218	218	505	1967		
8. Botocan	2 x 50	91		100	100	224	1977		
	2 x 8.0								
	1 x 0.96			16.96	15.0/1	60.0	1946		
Total capacity of Hydro Electric Plant				544.16	542.2	2,065.1			
THERMAL POWER PLANT INCLUDING DIESEL PLANT									
No. PLANT	No. & Cap. of Gen. No. x MW	Capaci. Ton/H	Boiler Temp. OC	Pressure kg/cm ²	TOTAL INSTALLED CAPACITY MW	Net Capacity MW	Annual Available Energy GWH	Year Comm.	
1. Rock well	5 x 25	125	482	61.5			574	1950-1958	
	3 x 60	204	538	129.4	305	315	985	1960-1963	
2. Tegen	2 x 100	343	538	129.4	200	220	1,248	1965-1966	
3. Ligao	2 x 1.5		Diesel		3.0	3.0	17.0		
4. Gardner	1 x 150	507	540	130		165	920	1968	
	1 x 200	726	540	196	350	220	1,182	1970	
5. Snyder	1 x 200	726	540	196		220	1,248	1971	
	1 x 300	1,032	540	196	500	330	1,905	1972	
6. Bataan	1 x 75	1,295	538	127		75	473	1972	
	1 x 150		538	165	225	150	940	1977	
7. Malaya	1 x 300	1,205	540	175	300	330	1,905	1978	
	1 x 350	1,205	540	175	350	390	2,491	1979	
8. Tivi	5 x 0.3		Diesel		2.5	2.5	4.76	1975	
9. Tivi Geothermal	2 x 55				110	110	794	1979	
10. Mak-Ban Geothermal	2 x 55				110	110	794	1979	
Total capacity of Thermal Power Plant				2,455.5	2,455.5	2,640.5	15,480.76		
Total of Plant				2,999.66 MW	3,182.7 MW	17,545.86 GWH			

Source. Statistics data of NAPOCOR operating plant NAPOCOR Jan. 1978, and MERALCO generating capability 1947-1976
 1: The effective capability of Botocan with all three units operating as full load is reduced to 15,000 kW by age.

Table 2-2 Electric Supply System in the Philippine
(As of 1979)

	Luzon	Visayas	Mindanao	Total	(%)
Installed Capacity (MW)					
a) Hydro	544	2	385	931	25.8
b) Steam (oil)	2,230	10 (coal)	-	2,240	62.1
c) Diesel	5.5	137	70	212.5	5.9
d) Geothermal	220	3	-	223.0	6.2
Total	2,999.5	152	455	3,606.5	100.0
%	83.2	4.2	12.6	100	
Length of T/L (Circuit km)					
a) 230 kV	1,525	-	-	1,525	15.6
b) 138 kV	-	97	727	824	8.4
c) 115 kV	1,087	-	-	1,087	11.1
d) 69 kV & below	5,449	345	570	6,364	64.9
Total	8,061	442	1,297	9,800	100.0
%	82.3	4.5	13.2	100.0	

Source: Luzon-Visayas-Mindanao Grid Expansion Program,
NAPOCOR 1979.

Table 3-1 Historical Growth of Net Electricity Generation of Luzon Mainland

Year	NAPOCOR		MERALCO		NAPOCOR + MERALCO			Self Generation		Luzon Grand Total	Average Rate Increase over Prev. Year
	Steam (2) (GWh)	Hydro (3) (GWh)	Steam (4) (GWh)	Hydro (5) (GWh)	Steam (6) (GWh)	Hydro (7) (GWh)	Sub-Total (8) (GWh)	Total Utility & Non-Utility/1 (9) (GWh)	(10) (GWh)		
1960		918.0	863.5	67.4	863.5	985.4	1848.9	61.1	1910.0	13.5	
1961		927.7	1197.4	53.3	1197.4	981.0	2178.4	65.4	2243.8		
1962		947.0	1492.3	58.1	1492.3	1005.1	2497.4	94.8	2592.2		
1963		1089.9	1660.2	48.8	1660.2	1138.7	2798.9	87.3	2886.2		
1964		1174.5	1939.3	71.2	1939.3	1245.7	3185.0	88.2	3273.2		
1965		1103.4	2336.5	63.2	2336.5	1166.6	3503.1	93.3	3596.4		
1966		1139.7	2796.2	56.8	2796.2	1196.5	3992.7	136.0	4128.7		
1967		1427.7	2955.8	58.9	2955.8	1486.6	4442.4	181.6	4624.0		
1968		1286.9	3760.9	37.7	3760.9	1324.6	5085.5	213.8	5299.3		
1969		1175.1	4530.1	41.1	4530.1	1216.2	5746.3	233.7	5980.0		
1970		1617.6	4465.2	60.7	4465.2	1678.3	6143.5	248.7	6392.2		
1971		2042.1	4586.1	74.9	4586.1	2117.0	6703.1	281.8	6984.9		
1972	175.6	2086.0	4912.8	65.0	5088.4	2151.0	7239.4	304.3	7543.7		8.25
1973	452.4	1313.3	6026.8	59.4	6479.2	1372.7	7851.9	330.0	8181.9		
1974	321.2	1749.6	5775.3	58.8	6096.5	1808.4	7904.9	332.3	8237.2	0.67	
1975	465.5	1585.4	6535.0	65.0	7000.5	1650.4	8650.9	363.6	9014.5		
1976	381.5	1934.3	6927.7	62.1	7309.2	1996.4	9305.6	391.2	9696.8	7.90	
1977	1050.1	1159.4	7670.3	57.3	8720.4	1216.7	9937.1	417.7	10354.9		
1978/2	1955.6	1685.0	7085.7	59.4	9041.3	1744.4	10785.7	453.4	11239.1		

Remarks /1 Self Generation is expected to decrease by interconnection with NAPOCOR System. This energy will be transferred to column(8) gradually by the interconnection. For convenience, this power generation is independently calculated in the column(9). The power demand in the column(9) supplied by the self generating cooperatives and industries is estimated to increase by the same rate of NPC and MERALCO systems after 1971.

/2 Malaya, Snyder and Gardner thermal power plants were acquired by NAPOCOR from MERALCO on Nov. 1, 1978.
Source: 1960-1971 Power System Luzon Generation Expansion Study.
1972-1978 NAPOCOR System Planning Division of Luzon Regional Office.

Table 3-2 Historical Growth of Peak Demand on Luzon Mainland

Year (1)	Service Area		NAPOCOR + MECO (4) (MW) ^{/1}	Self- Generation (5) ^{/2} (MW)	Total (6) (MW)	Average Rate of Increase Over Previous Year (7) (%)
	NAPOCOR (2) (MW)	MECO (3) (MW)				
1960	35.8	331.8	356.6	17.7	374.3	11.7
1961	54.8	377.9	419.7	18.7	438.4	
1962	62.3	417.8	465.7	24.4	490.1	
1963	71.1	474.1	528.9	21.5	550.4	
1964	85.8	513.4	581.2	21.3	602.5	
1965	119.6	551.5	651.0	22.7	673.7	
1966	135.6	613.1	726.2	26.1	752.3	
1967	148.9	670.3	794.6	32.9	827.5	
1968	182.6	731.1	886.3	37.9	924.2	
1969	211	819	1,020	43.0	1,063	
1970	268	851	1,111	45.4	1,156	
1971	299	924	1,205	53.3	1,258	
1972	318	1,054	1,331	59	1,390	0.3
1973	333	1,043	1,335	60 ^{/1}	1,395	
1974	389	1,033	1,379	62	1,441	6.4
1975	438	1,122	1,513	68	1,581	
1976	441	1,218	1,659	74	1,733	
1977	445	1,290	1,709	76	1,785	
1978		1,393	1,780	80	1,860	

Source: 1960-1971 Power System Luzon Generation Expansion Study/1972-1978 NAPOCOR System Planning Sect.

Note: ^{/1} Coincident maximum demand of total system NAPOCOR and MERALCO.
^{/2} The increase rate is assumed to be the same as that of NAPOCOR + MERALCO.

Table 3-3 Historical Growth of Electricity Sales (Consumption) in Luzon Mainland

Year	NAPOCOR Energy Sales ^{1/}													Total Energy Sales GWH	A.G.R. ^{4/}
	Utilities GWE	Industrial GWH	Miscellaneous GWH	Total GWH	Residential GWH	Commercial GWH	Industrial GWH	Street Light GWH	Resale GWH	Transportation GWH	Total GWH	Sub-total Solid Energy GWH	Self Generation GWE/3		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1960	55	74	5	134	458	424	516	10	54	-	1,462	1,596	53	1,649	
1961	83	91	6	180	507	470	631	11	69	-	1,688	1,868	56	1,924	
1962	106	98	8	212	578	514	748	13	86	-	1,939	2,151	84	2,235	
1963	146	111	14	271	640	569	854	17	95	-	2,175	2,446	79	2,525	
1964	176	135	33	344	737	656	976	22	102	-	2,493	2,837	82	2,919	
1965	204	158	39	401	801	723	1,073	26	98	-	2,721	3,122	87	3,209	
1966	232	206	39	487	889	825	1,187	30	124	-	3,055	3,542	130	3,672	
1967	285	209	36	530	959	935	1,354	34	149	-	3,431	3,961	175	4,136	
1968	348	307	48	703	1,037	1,084	1,523	35	174	-	3,853	4,556	206	4,762	
1969	401	394	57	852	1,221	1,299	1,634	37	181	-	4,372	5,224	225	5,449	
1970	448	530	53	1,031	1,262	1,372	1,708	36	177	-	4,555	5,586	240	5,826	
1971	493	631	183	1,307	1,287	1,433	1,894	29	201	-	4,894	6,141	273	6,414	
1972	540	637	290	1,487	1,362	1,522	1,964	43	210	-	5,101	6,588	293	6,881	
1973	626	676	341	1,643	1,447	1,649	2,202	44	225	-	5,567	7,210	320	7,530	
1974	645	791	400	1,836	1,302	1,629	2,248	44	216	-	5,439	7,275	323	7,598	
1975	791	883	469	2,143	1,418	1,814	2,386	45	228	-	5,891	8,034	357	8,391	
1976	806	967	496	2,269	1,485	1,958	2,571	47	252	-	6,313	8,582	381	8,963	
1977	889	901	392	2,182	1,623	2,177	2,764	50	281	-	6,895	9,077	404	9,481	
1978	1,072	841	441	2,354	1,713	2,349	3,000	53	318	-	7,433	9,787	430	10,217	

Source: ^{1/} Actual NAPOCOR Demand and Energy Sales Luzon (NAPOCOR System Planning Section)

^{2/} Utility Economic Forecast Date Nov. 1978 MERALCO

^{3/} Power System Luzon Generation Expansion Study (December 1977) until 1971, from the growth rate over previous year is assumed to be the same as that of the sum of NAPOCOR and MERALCO after 1972.

^{4/} AGR: Annual Average Growth Rate

Table 3-4 General Power Statistics in Luzon Island

Year	Net Energy Generation GWh	Max. Demand MW	Load Factor %	Energy Sales GWh	System Loss %/1 (6)
(1)	(2)	(3)	(4)	(5)	(6)
1960	1,910.0	374.3	58.2	1,648.6	13.7
1961	2,243.8	438.4	58.4	1,924.4	14.2
1962	2,592.2	490.1	60.4	2,235.0	13.8
1963	2,886.2	550.4	59.9	2,524.7	12.5
1964	3,273.2	602.5	62.0	2,719.2	16.9
1965	3,596.4	673.7	60.9	3,209.0	10.8
1966	4,128.7	752.3	62.6	3,670.9	11.1
1967	4,624.0	827.5	63.8	4,136.7	10.5
1968	5,299.3	924.2	65.5	4,762.9	10.1
1969	5,980.0	1,063	64.2	5,450	8.9
1970	6,392	1,156	63.1	5,826	8.9
1971	6,985	1,258	63.3	6,414	8.2
1972	7,544	1,390	61.9	6,881	8.8
1973	8,182	1,395	67.0	7,530	8.0
1974	8,237	1,441	65.3	7,598	7.8
1975	9,015	1,581	65.1	8,391	6.9
1976	9,697	1,733	63.9	8,963	7.6
1977	10,355	1,785	66.2	9,481	8.4
1978	11,239	1,860	69.0	10,217	9.1

Source: Power System Luzon Generation Expansion Study
 NAPCOR System Planning Section, Luzon Regions Office
 MERALCO Yearly Report

1 : System Loss (6) = $\frac{(2) - (5)}{(2)} \times 100$

Table 3-5 Relation between Energy Consumption and GNP Per Capita Base in Luzon

Year	Per Capita Energy ^{/1} Consumption (kWH)	A.G.R.	GNP ^{/2} 10 ⁶ US\$	Per Capita GNP (US\$)	A.G.R.	Elasticity Energy Consump. to GNP
(1)	(2)	(3)	(4)	(5)		
1960	128.3	11.48	4,020.1	148.4	3.19	3.60
1961	144.7		4,298.9	154.0		
1962	162.5		4,535.9	157.6		
1963	177.3	9.08	4,851.1	163.5	1.77	5.13
1964	198.1		5,016.9	164.1		
1965	210.5		5,269.3	167.2		
1966	232.7		5,498.7	169.2		
1967	253.4		5,763.2	172.1		
1968	281.9	3.70	6,072.0	175.9	3.66	1.01
1969	311.6		6,395.6	179.7		
1970	321.9		6,671.3	181.9		
1971	344.0		7,056.1	186.2		
1972	358.1		7,403.5	189.9		
1973	380.3		8,117.5	202.3		
1974	372.4		8,631.9	209.5		
1975	399.1		9,141.5	215.0		
1976	413.6	9,756.3	223.0			
1977	424.4	10,350.4	229.9			
1978	443.6	11,100.0	239.5			

^{/1} Energy consumption per capita is only for Luzon main land.

^{/2} Constant 1972 prices from 1978 Philippines Statistical year Book, of NEDA. Exchange rate applied is one US\$ = 7.50 P

A.G.R. Annual Growth Rate by average.

Table 3-6 Electric Power Generated and Consumed
in the Philippines

(NAPOCOR & MERALCO System only)

(in 1978)

	(GWh)			
	Luzon	Visayas	Mindanao	Total
Peak Demand MW	1,860	52.3	207	2,119.3 ^{/1}
Energy Generated GWh Gross	11,222.0	224.1	1,041.9	12,488.0
Electricity Consumed GWh	9,787	219.9	983.8	10,990.7
% of Electricity Consumed	89.0	2.0	9.0	100.0

^{/1} Only aggregate peak demand.

Table 3-7 Status of Philippine Electrification

(As of December 1978)

	Luzon	Visayas	Mindanao	Total
Total Household (1,000)	3,524	1,499	1,521	6,544
Household Electrified (1,000)	1,659	240	206	2,105
% Electrified	47.1	16.0	13.5	32.2

Source: Annual Report, NEA, 1978

Table 3-8 Number of NAPOCOR's Customers in Luzon

Year	Utilities	Industries*	Miscellaneous**	Total
1957	23	2	1	26
1958	32	4	1	37
1959	58	4	5	67
1960	77	5	7	89
1961	83	6	10	99
1962	84	7	11	102
1963	97	9	15	122
1964	103	11	18	132
1965	108	12	20	140
1966	113	20	15	148
1967	124	24	19	167
1968	133	26	27	186
1969	134	31	26	191
1970	138	34	28	200
1971	138	32	29	199
1972	144	39	34	217
1973	144	37	35	216
1974	127	39	35	201
1975	126	40	34	200
1976	96	47	47	190
1977	70	47	52	169
1978	77	44	54	175

Source : NAPOCOR Market Survey and Load Studies, LRO

NAPOCOR: Utility Operations

* - Commercial

** - Municipality, Government, Non Utilities

Table 3-9 Distribution of Generated Energy in System
(NAPOCOR & MERALCO only)

(Loss and station used energy)

Year	Gross Energy Production (GWh)	Station Use (%)	Net Energy Delivered (GWh)	System Loss (%)	Energy Sales (GWh)	Percentage of System Loss and Station Use (%)
1973	8,226	4.5	7,852	8.2	7,210	12.4
1974	8,262	4.3	7,905	8.0	7,275	11.9
1975	9,037	4.3	8,651	7.1	8,034	11.1
1976	9,652	3.6	9,306	7.5	8,612	10.8
1977	10,348	4.0	9,937	8.7	9,077	12.3
1978	11,222	3.9	10,786	9.2	9,787	12.7

Table 3-10 Projected Power Consumption and Peak Demand in Luzon Mainland

Year (1)	Consolidated Sales (GWh) (2)	Loss (%) (3)	Net Energy Production (GWh) (4)	Load Factor (%) (5)	Peak Power Demand (MW) (6)
1979	10,963	7.5	11,850	69	1,960
1980	11,760	7.5	12,710	69	2,100
1981	12,600	7.5	13,620	69	2,250
1982	13,490	7.5	14,580	69	2,410
1983	14,610	7.0	15,710	70	2,560
1984	15,830	7.0	17,020	70	2,780
1985	17,140	7.0	18,430	70	3,000
1986	18,540	7.0	19,940	70	3,250
1987	20,070	7.0	21,580	70	3,520
1988	21,690	6.5	23,200	70	3,780
1989	23,450	6.5	25,080	70	4,090
1990	25,350	6.5	27,110	70	4,420
1991	27,320	6.5	29,220	70	4,760
1992	29,460	6.5	31,510	70	5,140
1993	31,750	6.5	33,960	70	5,540
1994	34,230	6.5	36,610	70	6,970
1995	36,900	6.5	39,460	70	6,430

Table 3-11 Projection of Power Consumption Growth in Luzon Mainland

Year	Population Growth Rate ^{/1} (%)	Per Capita GRDP Growth Rate _{/2} (%)	Elasticity kWh Consumption To GRDP Per Capita Base	Estimated Per Capita Power Consumption Growth Rate (%)	Total Power Consumption Growth Rate (%)
1979	3.09	4.05	1.01	4.1	7.3
1980	3.09	4.05	1.01	4.1	7.3
1981	2.90	4.05	1.01	4.1	7.1
1982	2.90	4.05	1.01	4.1	7.1
1983	2.90	5.25	1.01	5.3	8.3
1984	2.90	5.25	1.01	5.3	8.3
1985	2.90	5.25	1.01	5.3	8.3
1986	2.76	5.25	1.01	5.3	8.2
1987	2.76	5.25	1.01	5.3	8.2
1988	2.76	5.10	1.01	5.2	8.1
1989	2.76	5.10	1.01	5.2	8.1
1990	2.76	5.10	1.01	5.2	8.1
1991	2.43	5.10	1.01	5.2	7.8
1992	2.43	5.10	1.01	5.2	7.8
1993	2.43	5.10	1.01	5.2	7.8
1994	2.43	5.10	1.01	5.2	7.8
1995	2.43	5.10	1.01	5.2	7.8

^{/1} Medium Rate Assumption of the Population Dimension of Planning III Population Projections of Cities and Municipalities in the Philippines, 1980-2000, NEDA.

_{/2} Long-Term and Five Year (1978-1982) Development Plans, Draft Summary, NEDA 1977.

Table 3-12 Per Capita Gross Regional Domestic Product and KWh Consumption in Luzon Island

Year	Per Capita ^{/1} G.R.D.P. in Luzon		Per Capita KWh Consumption		Elasticity of KWh Consumption to G.R.D.P.
	US\$	A.G.R. %	KWh	A.G.R. %	
1975	254.8		399.1		
1976	263.7		413.6		
1977	272.9	3.49	424.4	3.59	1.03
1978	282.4		443.6		

^{/1} G.R.D.P. Gross Regional Output by US\$

Source Long-Term and Five Year (1978 - 82)
Development Plans (Draft Summary)
by N.E.D.A.

Table 3-13 Historical and Projected Energy Sales, Generation and Peak Demand
Luzon Grid

Calendar Year	Consolidated Sales (GWh)	Energy Req't (GWh)	Peak Load (MW)	Load Factor (%)
(1)	(2)	(3)	(4)	(5)
<u>Actual</u>				
1968	4,996	5,387	903	68.1
1969	5,639	6,087	1,020	68.1
1970	6,046	6,386	1,111	65.6
1971	6,596	7,048	1,205	66.8
1972	7,131	7,555	1,331	64.8
1973	7,723	8,212	1,335	70.2
1974	7,804	8,240	1,379	68.2
1975	8,585	9,014	1,513	68.0
1976	9,453	9,626	1,659	66.2
1977	9,813	10,357	1,709	69.2
1978	10,414	11,223	1,780	71.9
1969-1978*	7.6%	7.0	7.0	
<u>Forecast</u>				
1979	11,140	12,010	1,960	70.0
1980	11,925	12,850	2,100	70.0
1981	12,760	13,750	2,240	70.0
1982	13,650	14,710	2,400	70.0
1983	14,605	15,740	2,565	70.0
1979-1983*	7.0%	7.0	7.6	70.0
1984	15,630	16,840	2,745	70.0
1985	16,725	18,020	2,940	70.0
1986	17,900	19,280	3,145	70.0
1987	19,145	20,630	3,365	70.0
1988	20,485	22,075	3,600	70.0
1989	21,920	23,620	3,850	70.0
1990	23,455	25,275	4,120	70.0
1984-1990*	7.0%	7.0	7.0	
1979-1990*	7.0	7.0	7.2	

* Average annual compound growth
Excludes pumping requirements

Source: NAPOCOR Expansion Program on June 1980

Table 5-1 Total Capacity of Power Stations
in 1990

Region	Hydroelectric P/S			Thermal P/S				Total	%	
	Ordinary Type	Pumped Storage	Geo	Oil	Coal	Power Barge	Diesel P/S			Nuclear
Luzon	2,276	300	550	1,525	300			620	5,571	70.5
Visaya	99		343.5		285	64	199.1		990.6	12.5
Mindanao	975.6				150	32	184.3		1,341.9	17.0
Total	3,350.6	300	893.5	1,525	735	96	383.4	620	7,903.5	100.0
%	42.4	3.8	11.3	19.3	9.3	1.2	4.9	7.8	100.0	

Table 5-2 Generation Expansion Program
(A) Luzon Grid

Year of Commiss.	Plant Addition	Installed Capacity (MW)	Available Energy (GWh)		
Existing	Hydro P/S	544	2,065		
Plants	Oil Therm. P/S	2,230	13,871		
	Geo Therm. P/S	220	1,588		
1980	Retire Rockwell #1 - #5	(125)	(574)		
80/3	Tiwi Geo. #3	55	397		
80/6	Tiwi Geo. #4	55	397		
80/10	Mah Ban #3	55	397		
80/12	Mah Ban #4	55	397		
1981	Rehab. GOP	-	1,198		
	Masiway	12	48		
1982	Kalayaan (Pumped storage) #1	150	150		
	Retire Rockwell 6.7.8	(180)	(985)		
82/3	Kalayaan (Pumped storage) #2	150	150		
82/4	Tiwi #5	55	397		
82/7	Tiwi #6	55	397		
1983	Magat #1 - #4	360	1,103		
	Retire Gardner	(200)	(1,182)		
	Retire Snyder	(200)	(1,248)		
1984	Coal Therm.	300	1,989		
1986	PNPP	620	3,910		
1987	San Roque	260	900		
1988	Gened	600	1,153		
1989	Agos	140	711		
1990	Chico IV	360	804		
Summary		MW	%	GWh	%
	Hydro.	2,576	46.2	7,084	25.3
	Oil Therm.	1,525	27.4	11,080	39.5
	Coal Therm.	300	5.4	1,989	7.1
	Geo Therm.	550	9.9	3,970	14.1
	Nuclear	620	11.1	3,910	14.0
	T o t a l	5,571	100.0	28,033	100.0

Note: The number in () means negative value.

Source: NAPOCOR Luzon-Visaya-Mindanao Grid Expansion Program (June 1980)

Table 5-3 Generation Expansion Program
(B) Mindanao Grid

Year of Commiss.	Plant Addition	Installed Capacity (MW)	Available Energy (GWh)		
1979	Agus VI Hyd. #1 - #5	200	1,369		
Existing	Agusan Hyd. #1	1.6	11		
Plants	Aplaya I Diesel #1, #2	11.0	72		
	Agus II Hyd. #1, #2, #3	180	875		
	DLPC Dies.	58.7	386		
	Talmo Hyd.	3.5	27		
1980/2	Aplaya II Dies. #1	18.65	118		
1980/4	Aplaya II Dies. #2	18.65	118		
1980/5	Aplaya II Dies. #3	18.65	118		
1980/7	Davao Dies.	36	236		
1980/10	Aplaya II Dies. #4	18.65	118		
1980/12	Aplaya II Dies. #5	18.65	118		
1981/3	Aplaya II Dies. #6	18.65	118		
1982/7	Gen. Santos Dies.	21.9	144		
1982/7	Power Barge	32	196		
1982/7	Agus VII Hyd. #1	27	228		
1982/7	Agus I Hyd. #1	40	350		
1982/9	Agus VII Hyd. #2	27	-		
1982/9	Agus I Hyd. #2	40	58		
1983/6	Agus V Hyd. #1	27.5	241		
1983/8	Agus V Hyd. #2	27.5	82		
1983/8	Agus IV Hyd. #1	50	438		
1983/9	Agus IV Hyd. #2	50	403		
1983/10	Agus IV Hyd. #3	50	-		
1984/2	Pnlangi IV Hyd. #1	85	745		
	Pnlangi IV Hyd. #2	85	344		
	Pnlangi IV Hyd. #3	85	-		
1985	Retire DLPC	(58.7)	(386)		
1986	Coal Therm.	150	989		
1990					
Summary		MW	%	GWh	%
	Hydro	975.6	72.7	5,144	68.4
	Diesel	184.3	13.7	1,187	15.8
	Coal Therm.	150	11.2	989	13.2
	Power Barge	32	2.4	196	2.6
	T o t a l	1,341.9	100.0	7,516	100.0

Table 5-4 Generation Expansion Program
(C) Visayas Power Grids

Year of Commiss.	Plant Addition	Installed Capacity (MW)	Available Energy (GWh)		
1979	Loboc Hyd.	1.2	7.0		
Existing Plants	Amlan Hyd.	0.8	5.0		
	Cebu Diesel I	21.9	270		
	Tongonan Geo.	3.0	20		
	Amlan Diesel	11.0	67		
	Tagbilaran Diesel	11.0	67		
	Veco Diesel (pick up)	49.3	281		
	Veco Therm.	10	61		
1980	Dingle Diesel	14.6	90		
	Panitan Diesel	11	67		
	Talisay Diesel	14.6	89		
	Bacolod Diesel	22.4	118		
1980/3	Dingle Diesel #3, #4	14.6	90		
1981	Cebu Diesel	18	110		
1981/3	Naga Therm. I	55	337		
1981/3	Retire Veco Diesel	(9)	(51)		
1981/4	Cebu Diesel II #1	18	110		
1981/7	Cebu Diesel II #2	18	110		
1981/7	Palimpinon Geo.	3	20		
1981/8	Power Barge #1, #2	64	392		
1982/8	Tongonan Geo. #1	37.5	245		
1982/11	Tongonan Geo. #2	37.5	245		
1983	Palimpinon Geo. #1	37.5	245		
	Retire Veco Diesel	(13.5)	(77)		
1983/2	Tongonan Geo. #3	37.5	245		
1983/4	Palimpinon Geo. #2	37.5	245		
1983/7	Palimpinon Geo. #3	37.5	245		
1984	Naga Therm. II (Coal)	55	337		
1984	Retire Bacolod Diesel	(9)	(47)		
1985	Negros Therm. (Coal)	55	337		
1985	Tongonan Geo. #4	37.5	245		
1986	Panay Therm. I (Coal)	55	337		
1986/7	Bago II Hyd. #1, #2	7.0	43		
1987/7	Catubig Hyd. #1, #2	30	131		
	Bago I Hyd. #1, #2	30	66		
1988	Negros Therm. II	55	337		
	Upper Loboc Hyd.	10	29		
	Retire Veco Diesel	(15)	(86)		
1989	Mambucal Geo. #1	37.5	245		
1990	Aklan Hyd.	20	44		
	Mambucal Geo. #2	37.5	245		
	Retire Bacolod Diesel	(8)	(42)		
Summary		MW	%	GWh	%
Hydro		99	10	325	5.5
Diesel		199.1	20	1,166	19.9
Geo.		343.5	34.7	2,245	38.2
Power Barge		64	6.5	392	6.9
Coal Therm.		285	28.8	1,746	29.7
Total		990.6	100.0	5,874	100.0

Table 5-5 Expansion Program of Substations
(1979 - 1990)

(Over 69 kV Primary Voltage only)

Region	Primary Rated Voltage kV	500kV MVA	230kV MVA	138kV MVA	115kV MVA	69kV MVA	Total MVA	%
Luzon		1,800	2,870	-	300	85	5,055	57.2
Visaya				387.5		178.75	566.25	6.4
Mindanao				1,728		1,482	3,210	36.1
Total		1,800	2,870	2,115.5	300	1,745.75	8,831.25	100
%		20.3	32.5	24.0	3.4	19.8	100	

Source: Luzon-Visayas-Mindanao Grids Expansion Program October 1979

Table 5-6 Expansion Program of Transmission Lines
(1979 - 1990)

by Circuit Kilometer

Region	Rated Voltage kV	500 km	230 km	138 km	115 km	69 km	Total km	%
Luzon		503	2,305	-	219	1,598	4,625	45.9
Visaya		-	-	1,089	-	1,395	2,484	24.6
Mindanao		-	-	1,566	-	1,413	2,979	29.5
Total		503	2,305	2,655	219	4,406	10,088	100
%		5.0	22.8	26.3	2.2	43.7	100	

Source: Luzon-Visayas-Mindanao Grids Expansion Program June 1980

FIGURES

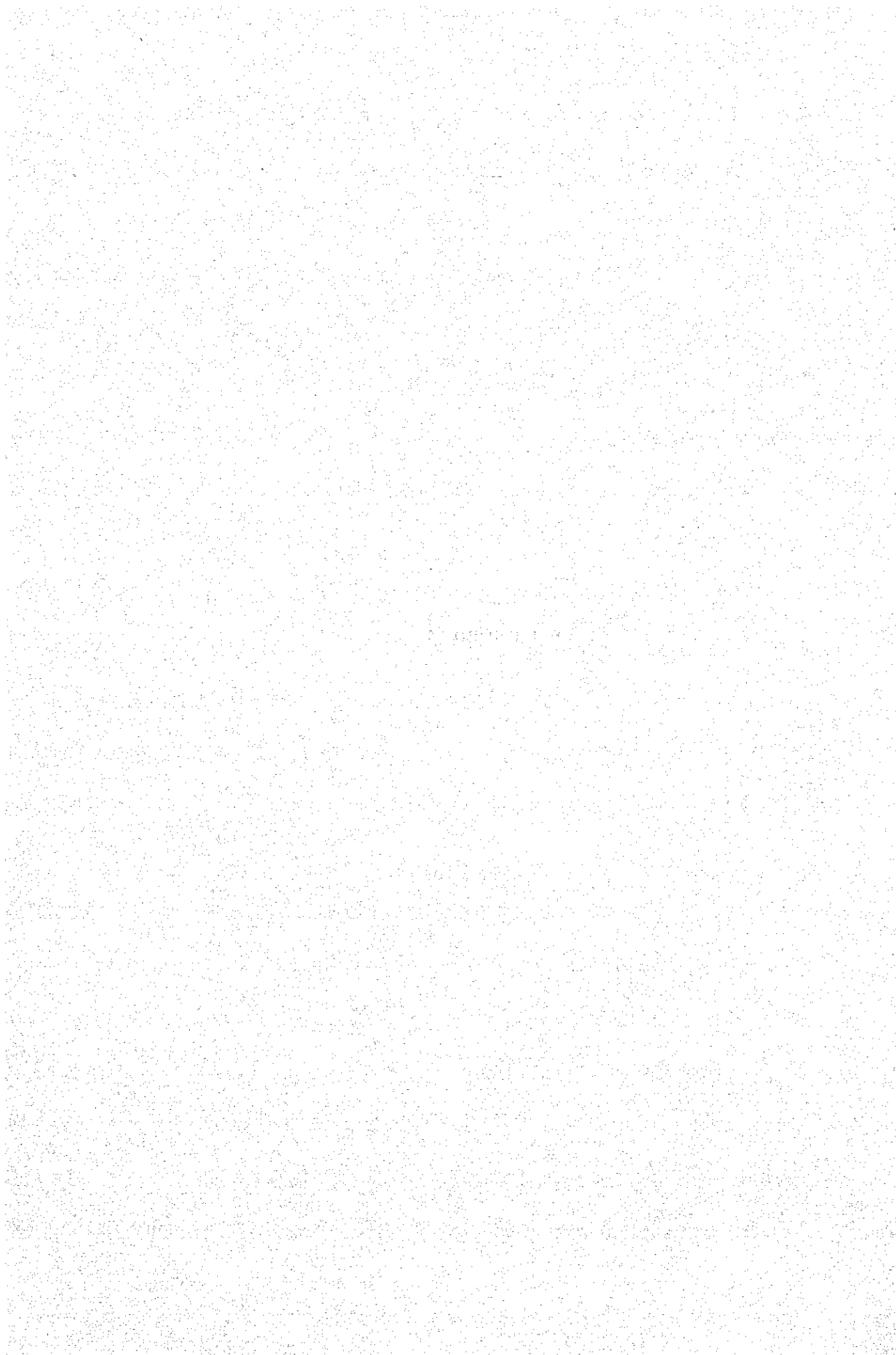


Fig. 3 - 1 GNP & Energy Consumption in Luzon Main Land

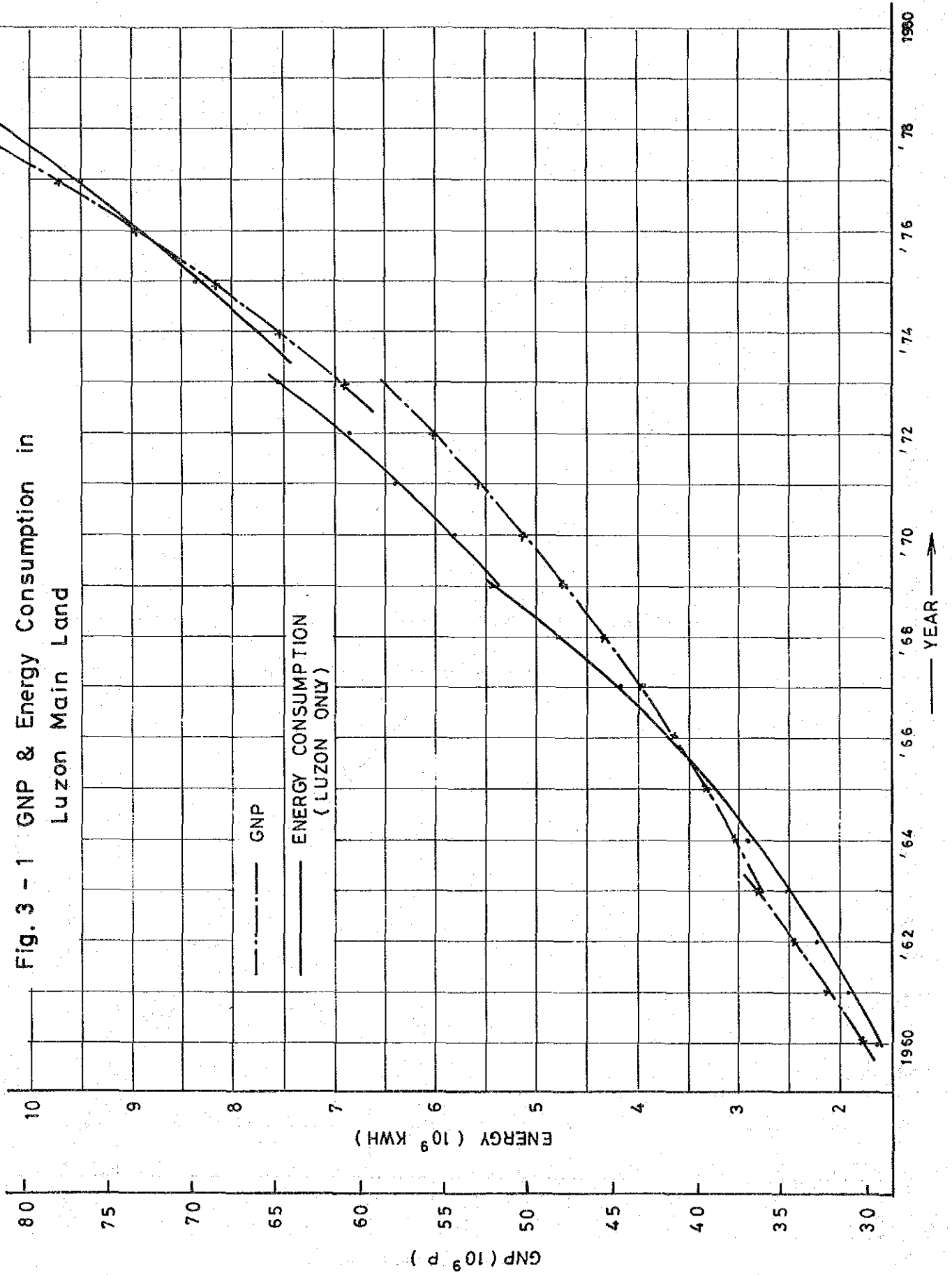
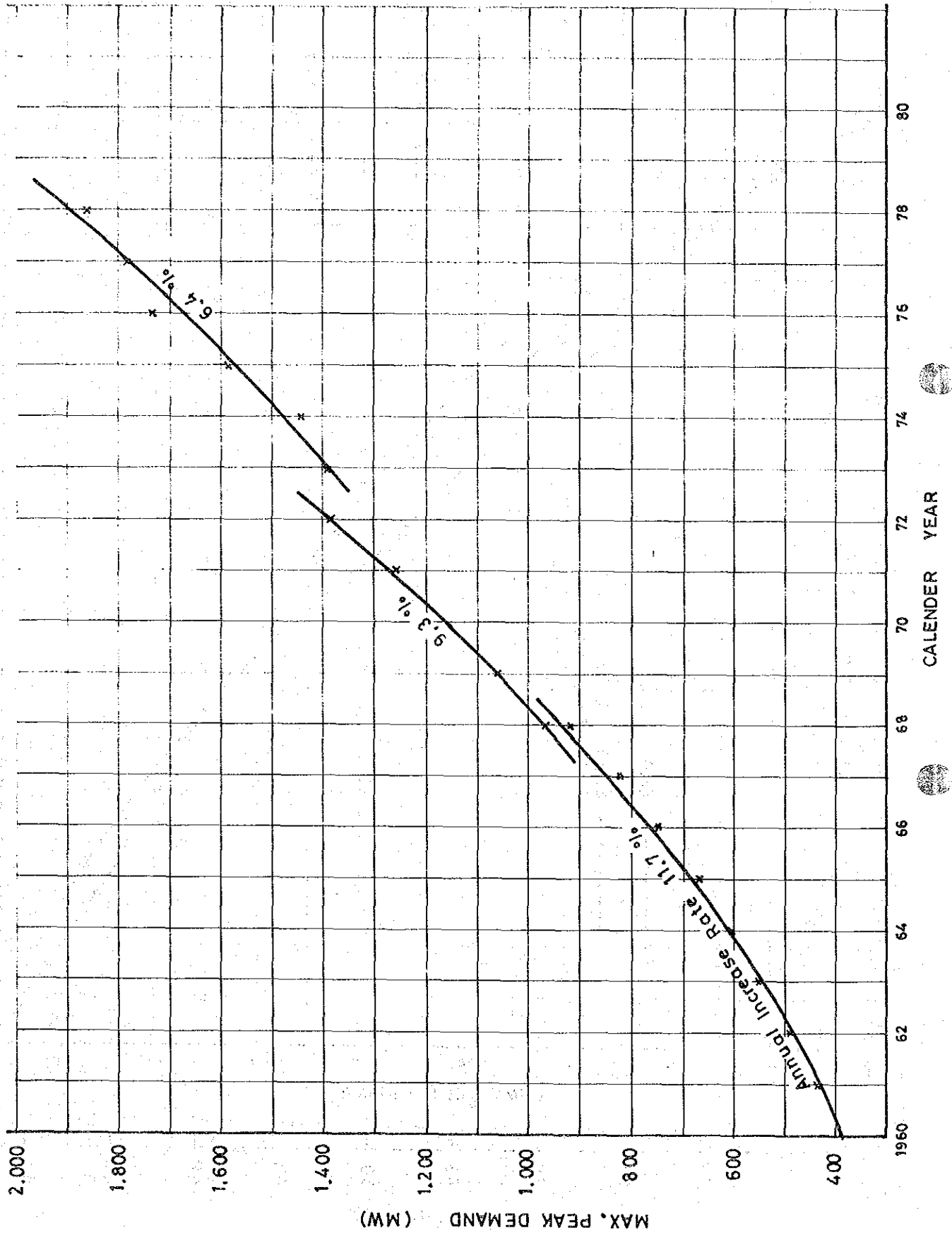


Fig. 3 - 2 Max. Peak Demand Luzon Island



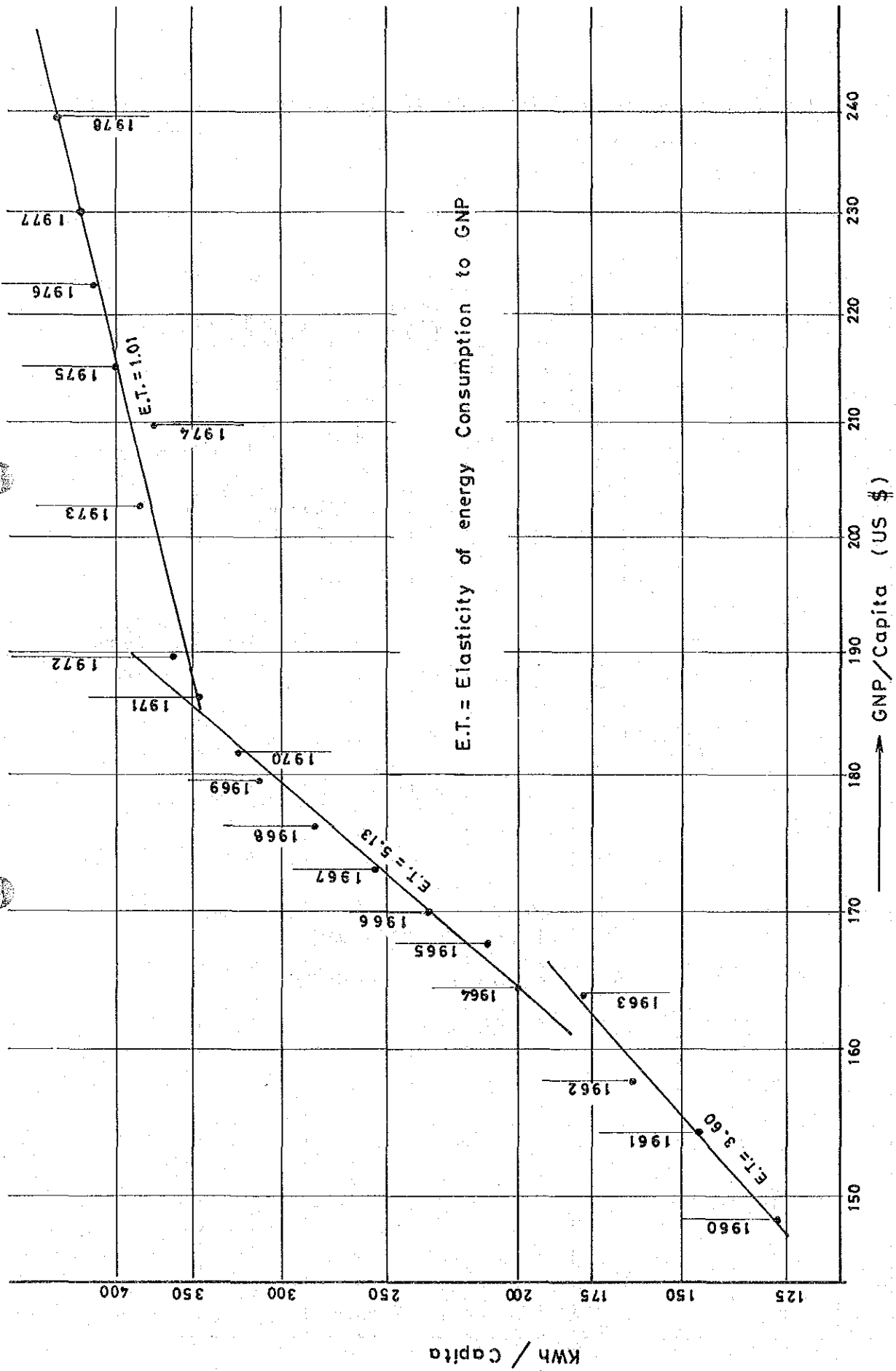


Fig. 3 - 3 Energy Consumption & GNP by Per Capita Base

Fig. 3-4 Typical Load Curves & Its Duration Curves of Luzon Grid

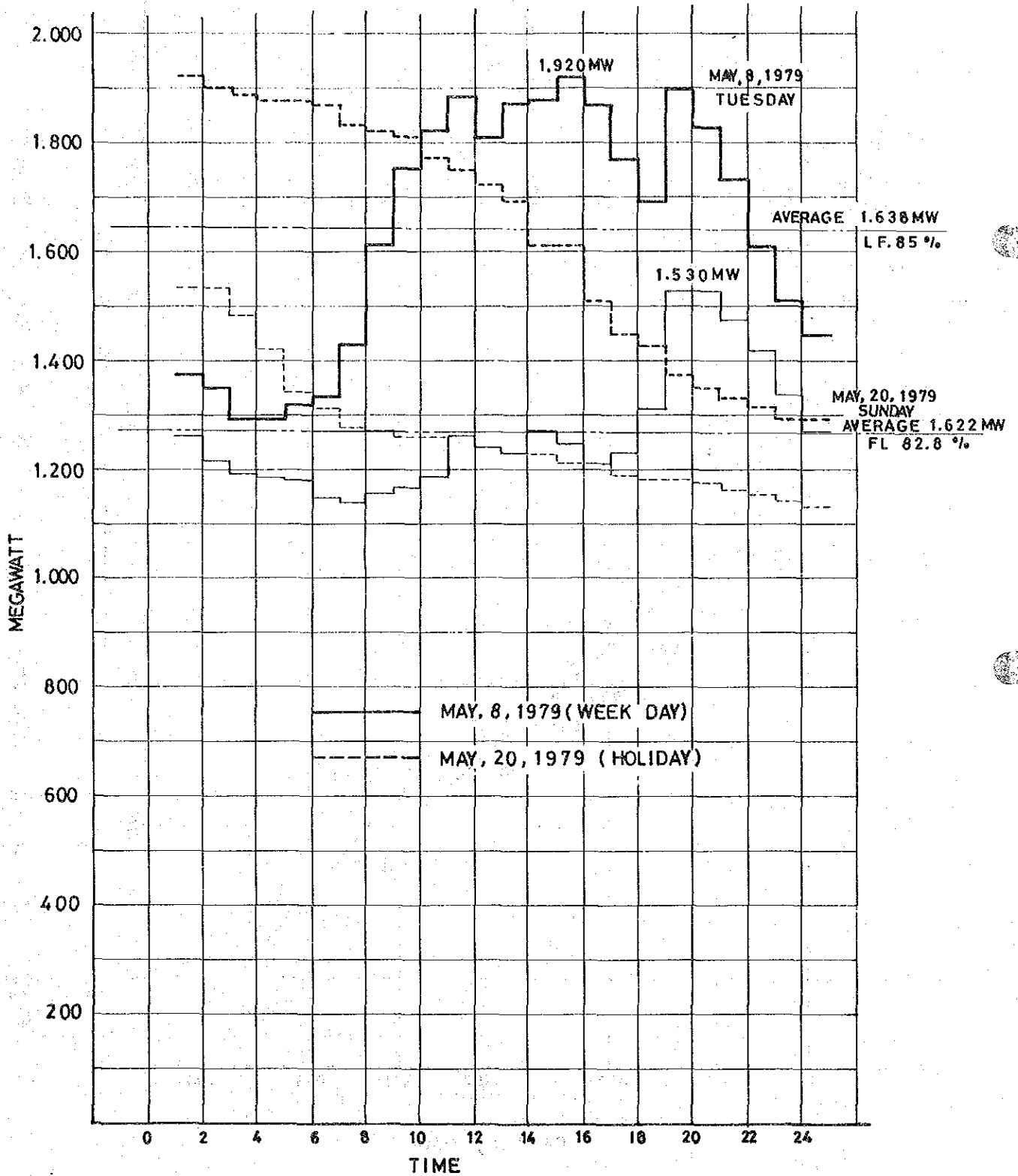


Fig. 3 - 5 Typical Curve & Its Duration Curve of Luzon Grid

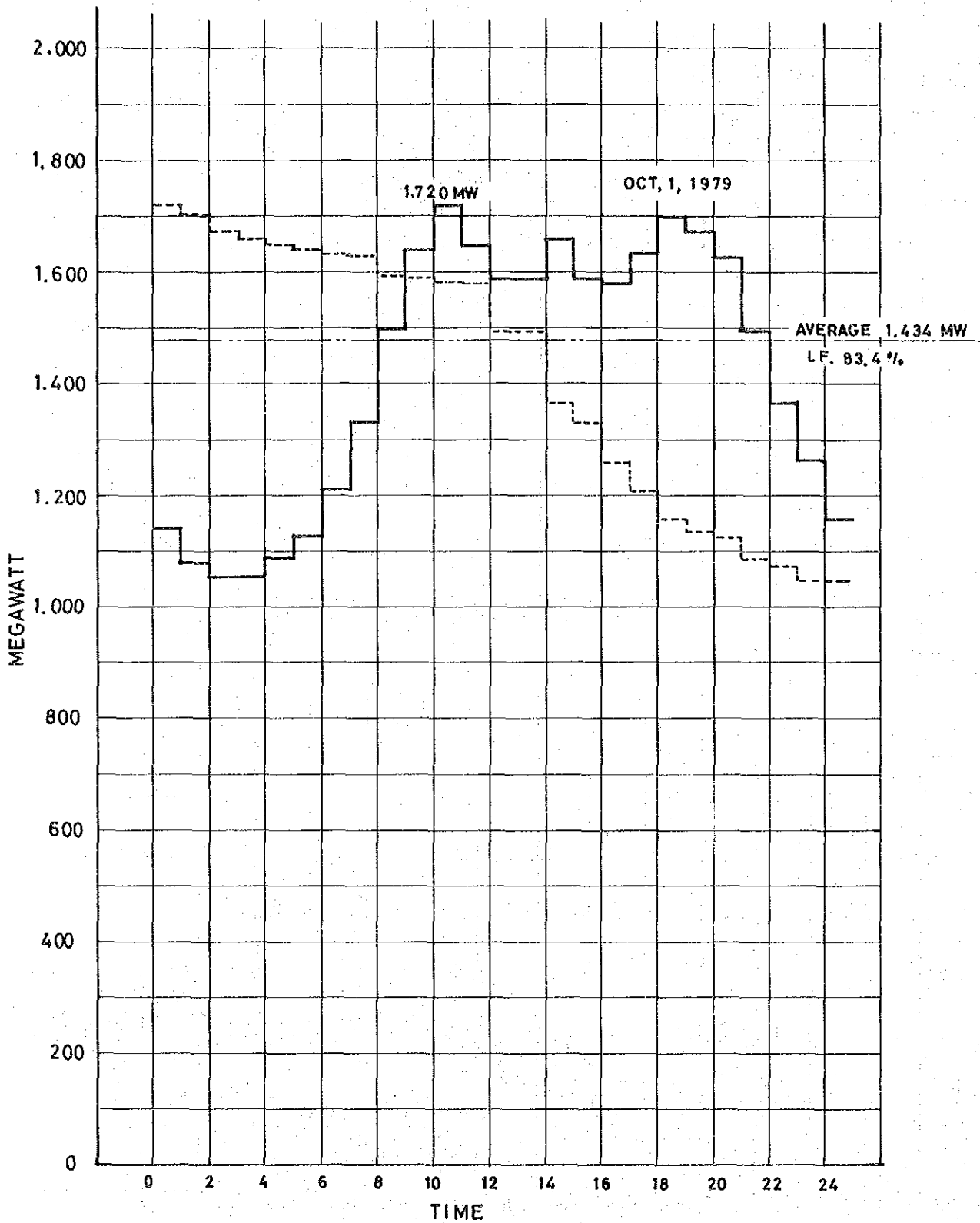


Fig. 3-6 Monthly Gross Energy Production in Luzon Grid

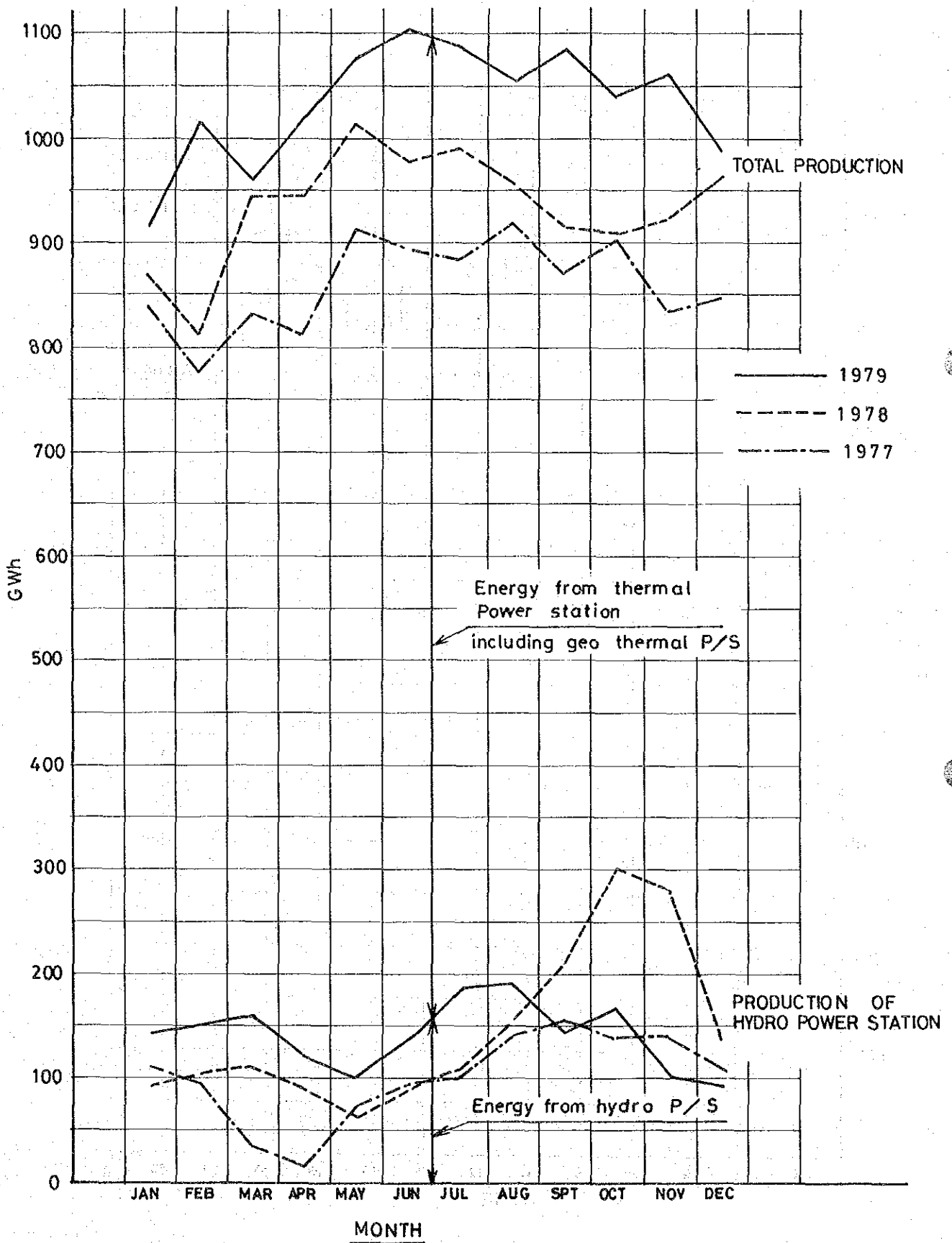


Fig. 3-7 Annual Load Duration Curve & Typical Daily Load Duration Curve in Luzon Grid

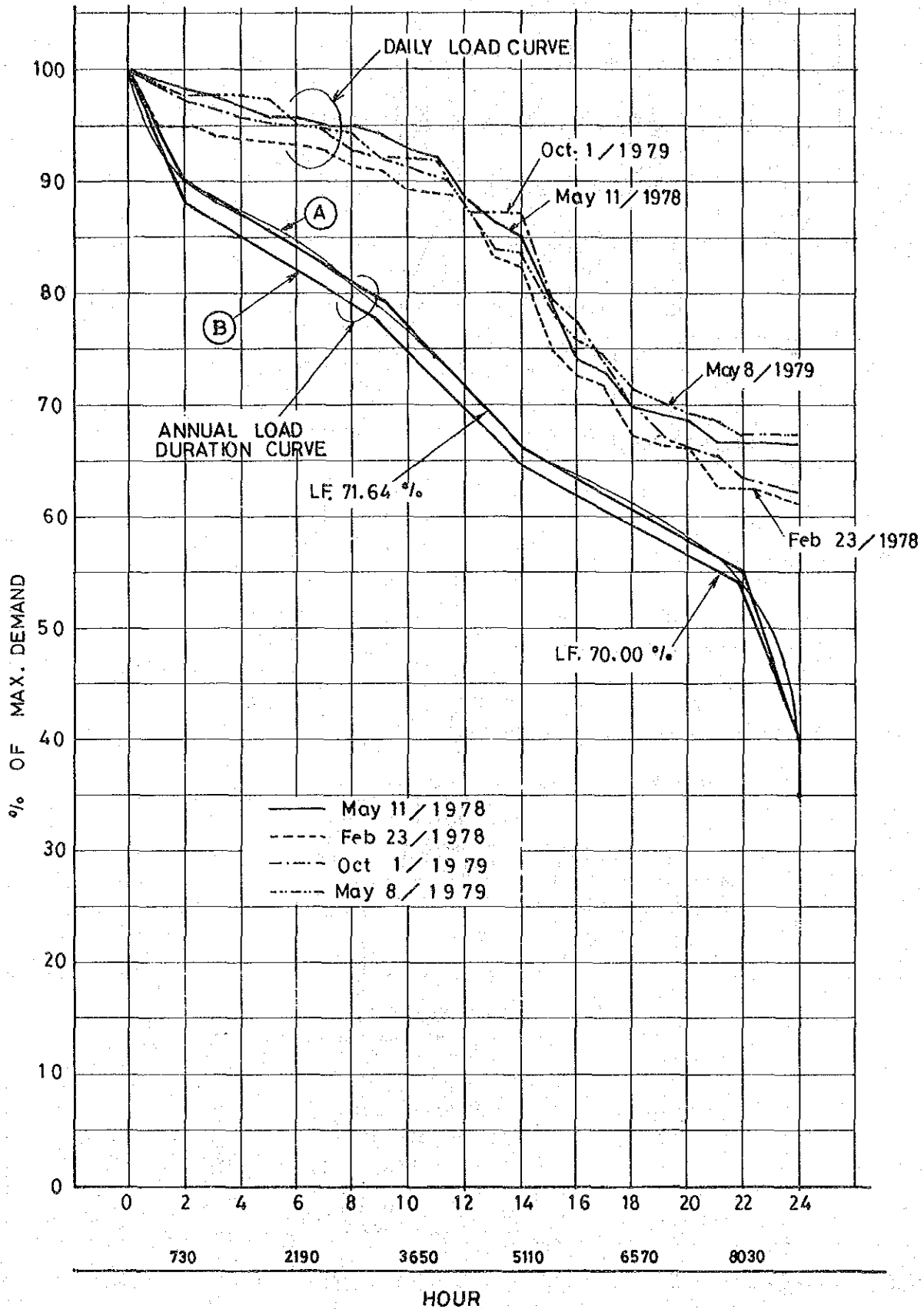


Fig. 5-1 System Peak Demand & Supply Capacity

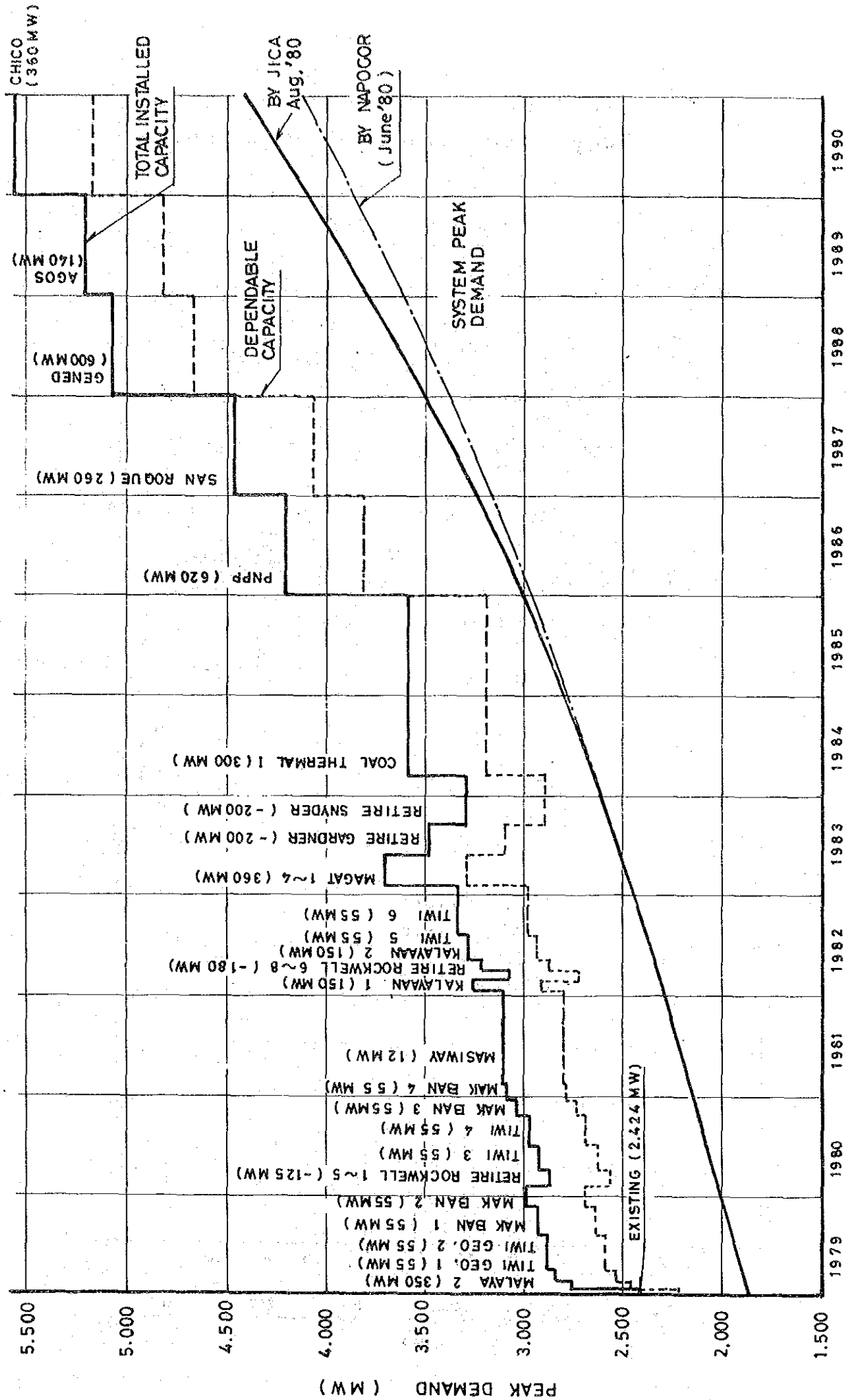
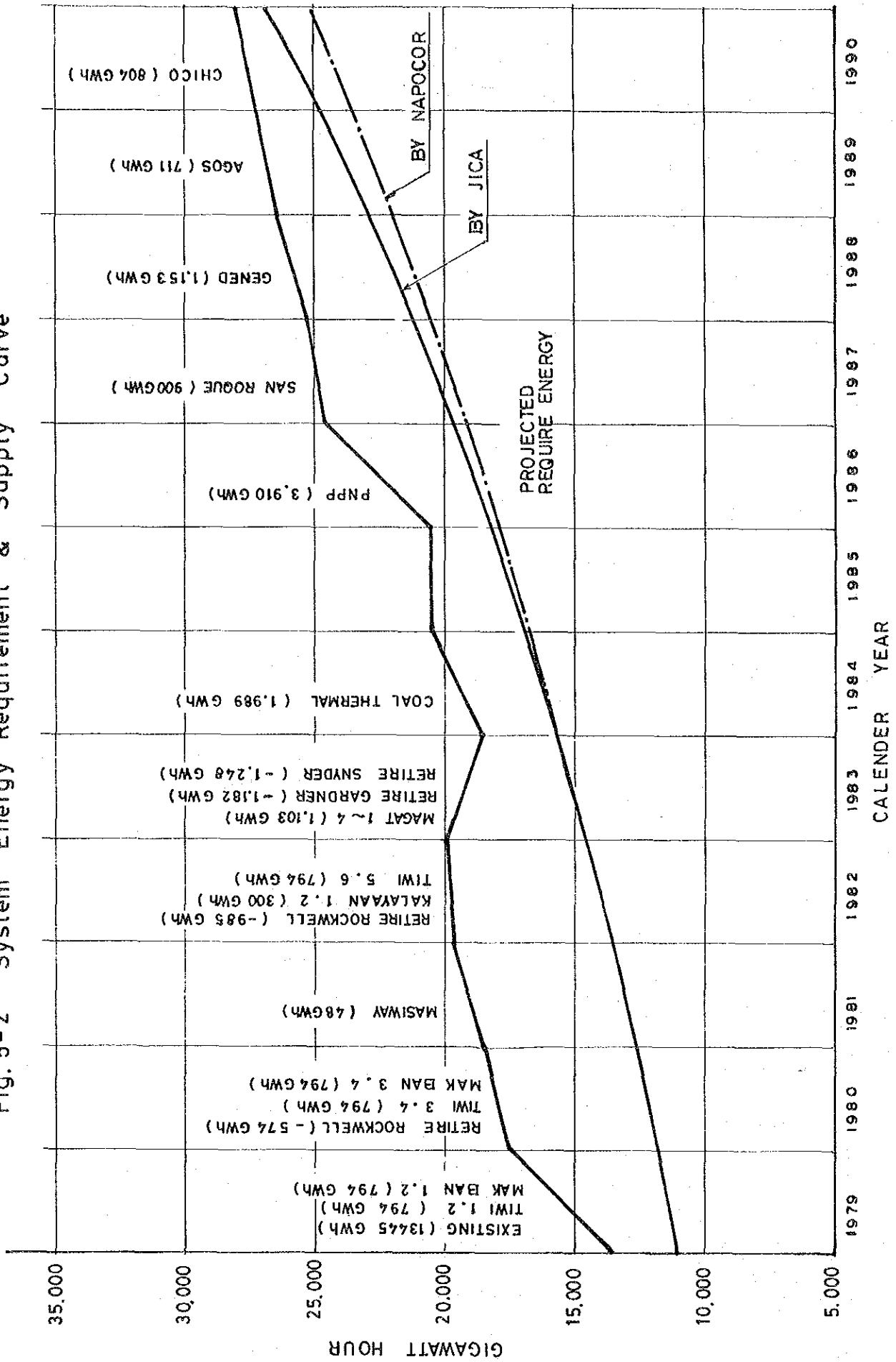


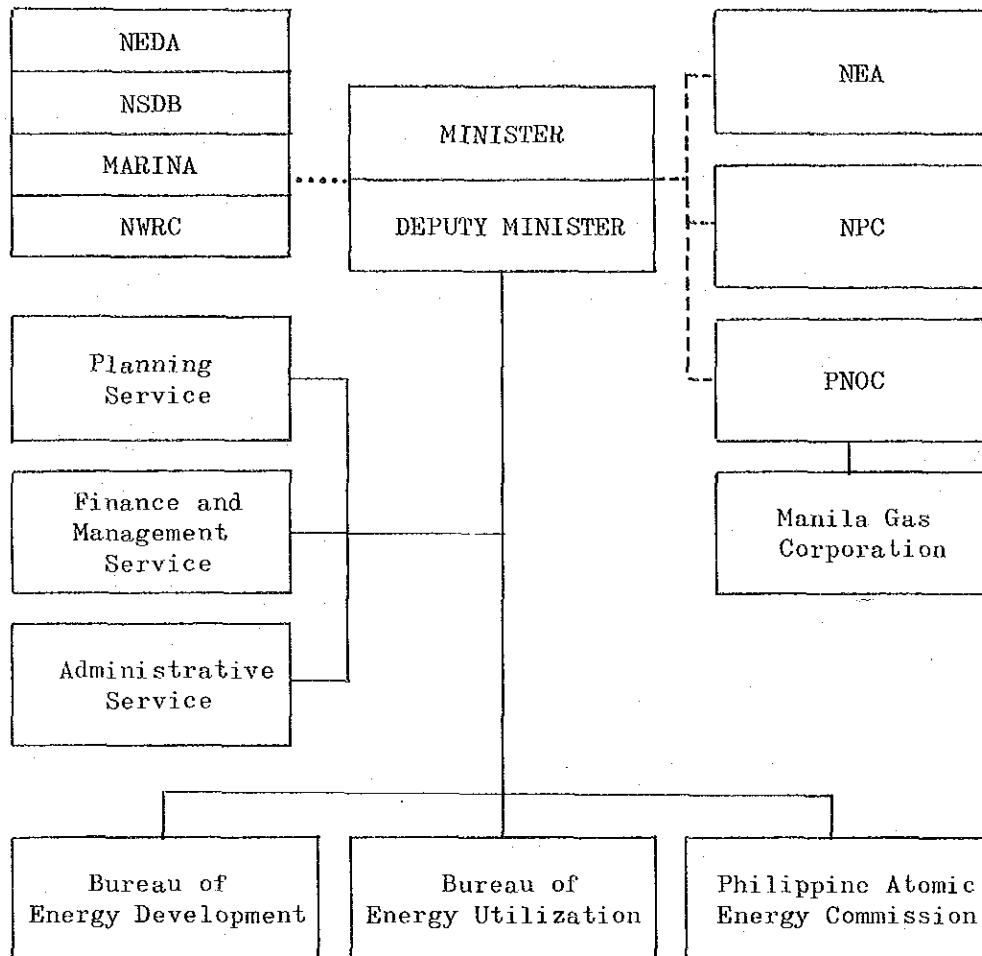
Fig. 5-2 System Energy Requirement & Supply Curve



C H A R T S

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MINISTRY OF ENERGY
ORGANIZATIONAL CHART



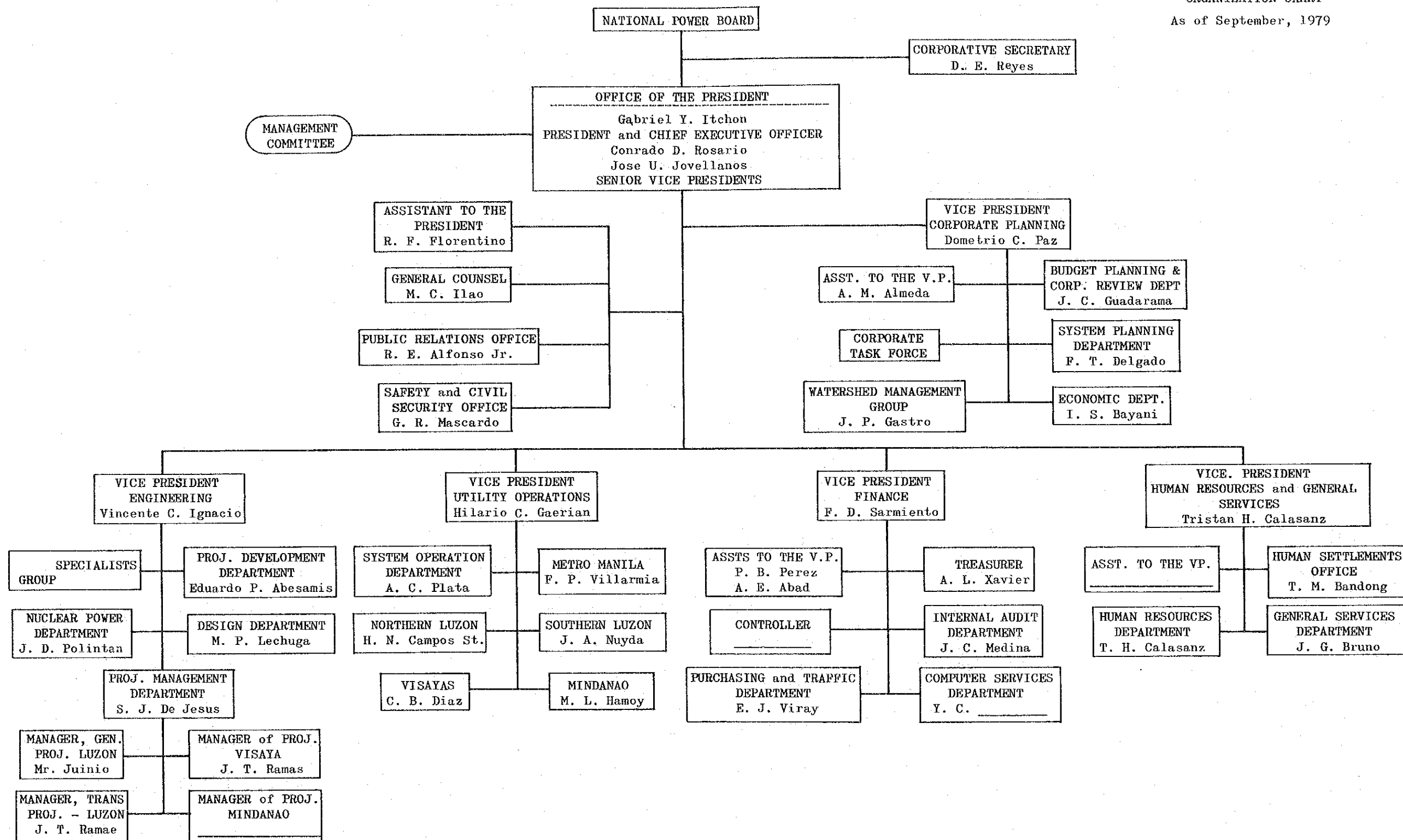
Legend: ——— Supervision and control
 Additional membership in governing boards
 - - - - - Attached for policy and program coordination

- MARINA - Maritime Industry Authority
- NEA - National Electrification Administration
- NEDA - National Economic and Development Authority
- NPC - National Power Corporation
- NSDB - National Science Development Board
- NWRC - National Water Resources Council
- PNOC - Philippine National Oil Company

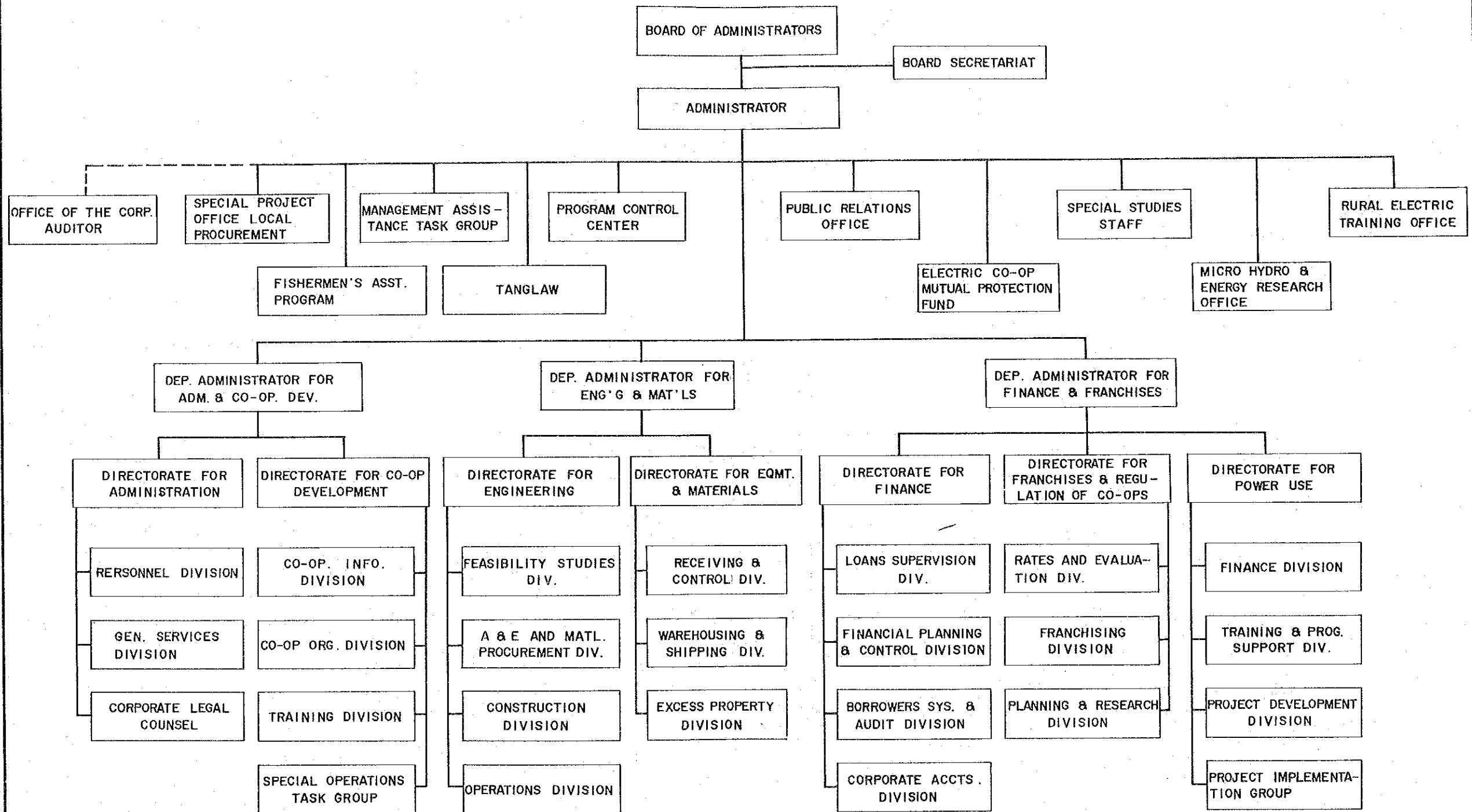
Chart - 2

NATIONAL POWER CORPORATION
ORGANIZATION CHART

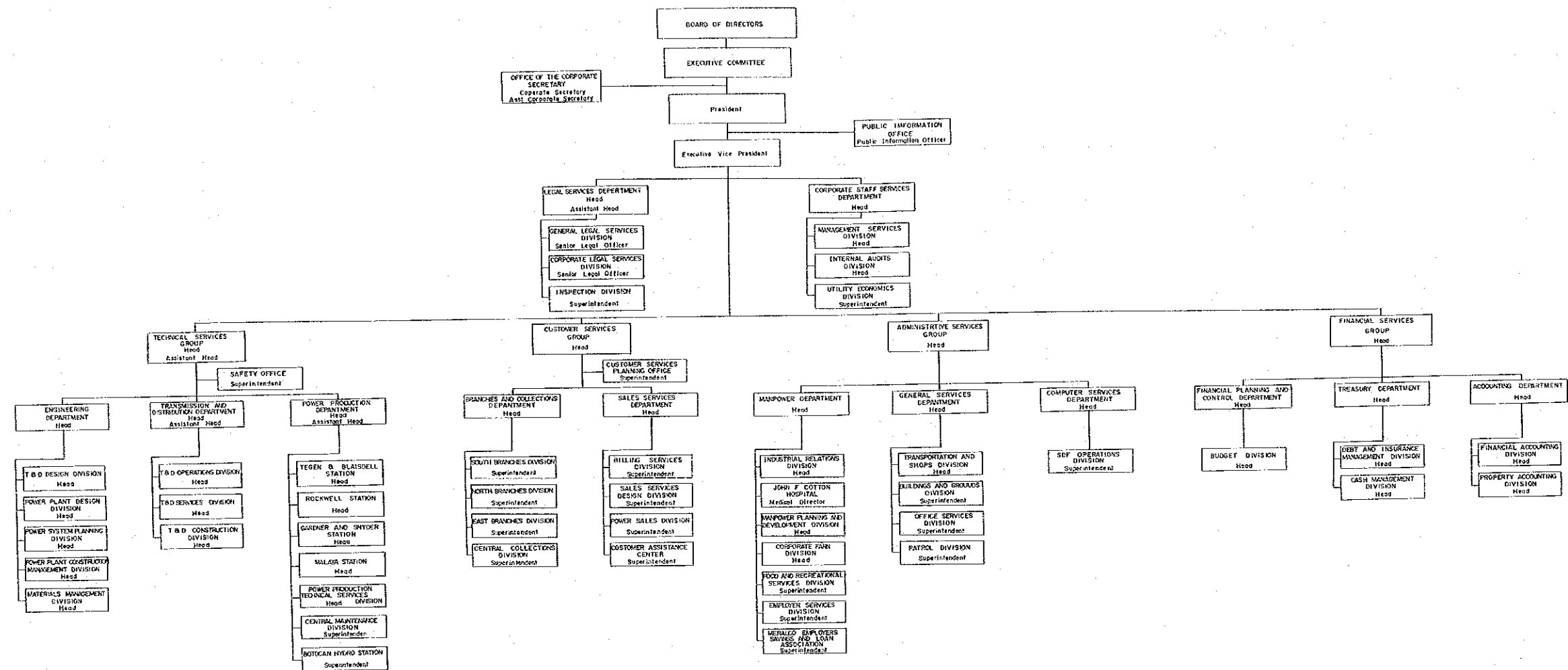
As of September, 1979



NATIONAL ELECTRIFICATION ADMINISTRATION
ORGANIZATION CHART

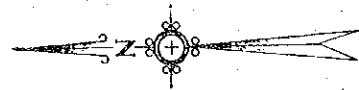


MANILA ELECTRIC COMPANY
ORGANIZATION CHART

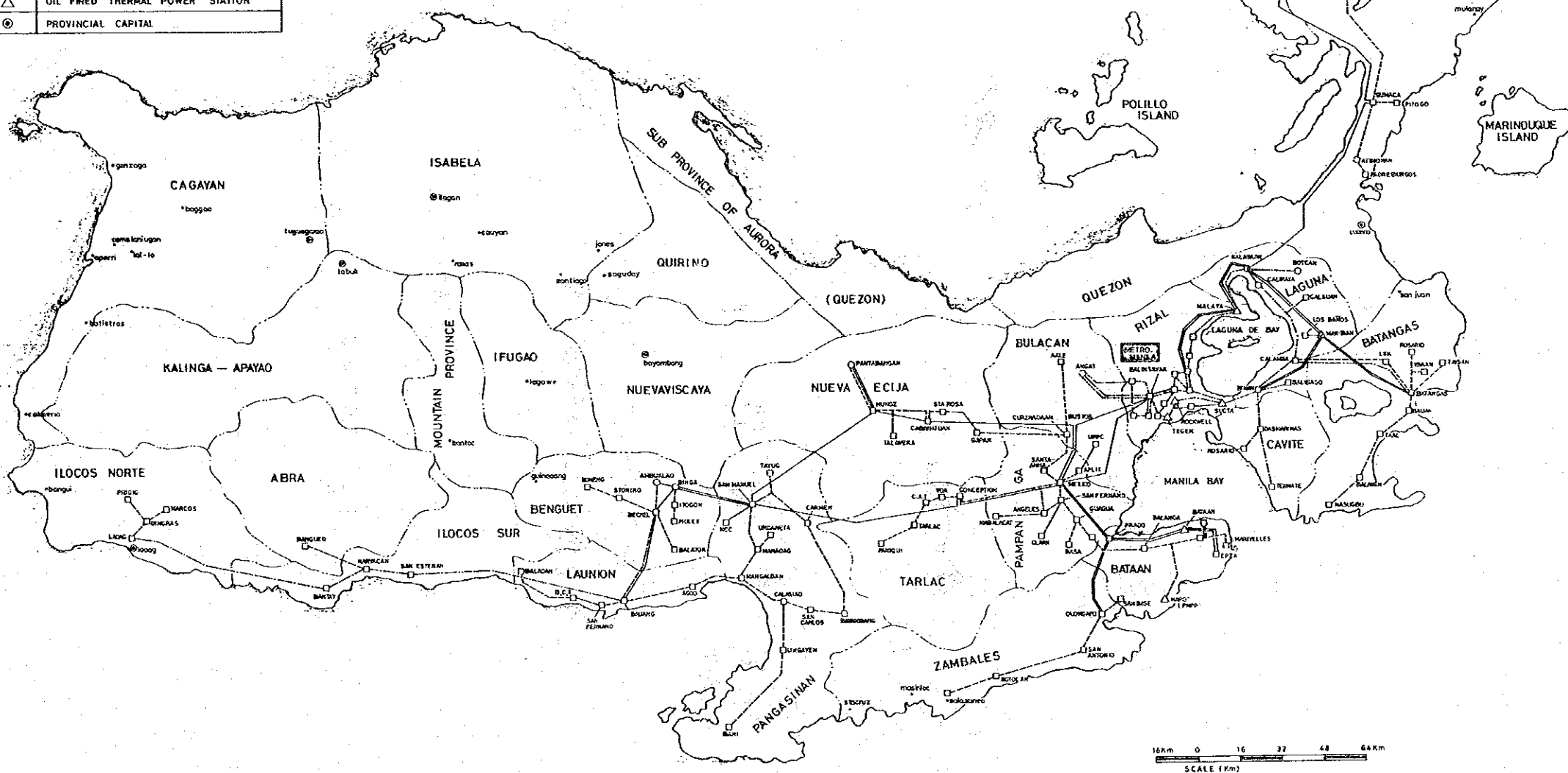
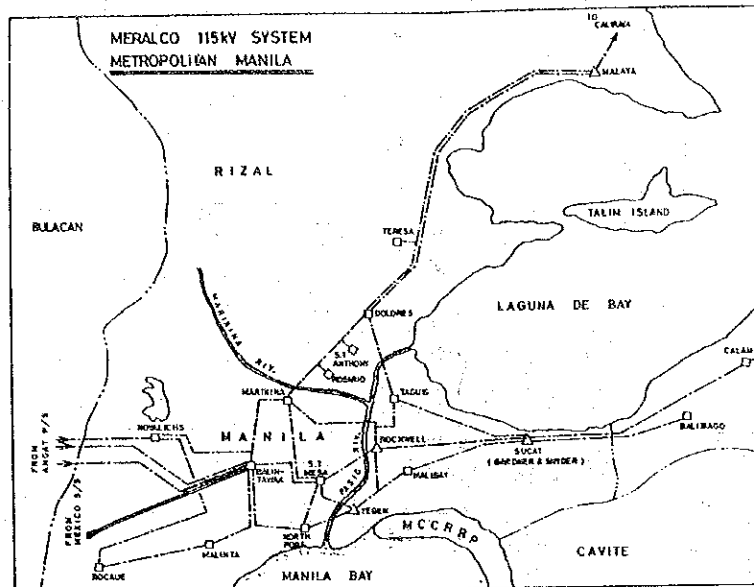


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DRAWINGS

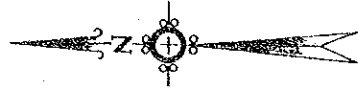


LEGEND	
—●—●—●—	69kV TRANSMISSION LINE
—●—●—●—	115kV — DITTO —
—●—●—●—	230kV — DITTO —
□	SUBSTATION
○	HYDROELECTRIC POWER STATION
⊖	PUMPED STORAGE HYD. POWER STATION
⊕	THERMAL POWER STATION DIESEL — DITTO —
⊕	GEO THERMAL — DITTO —
⊕	NUCLEAR — DITTO —
⊕	OIL FRED THERMAL POWER STATION
⊙	PROVINCIAL CAPITAL



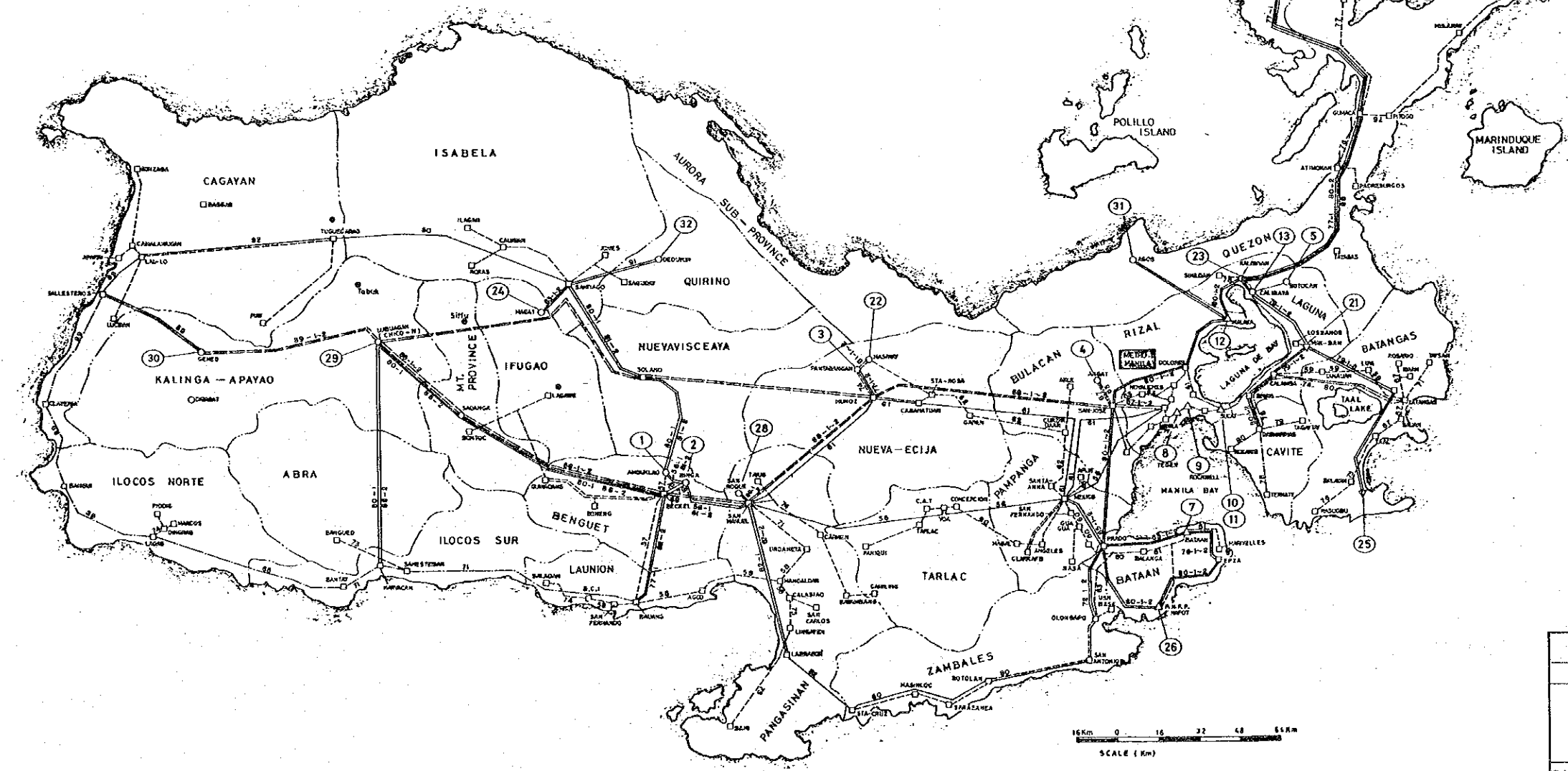
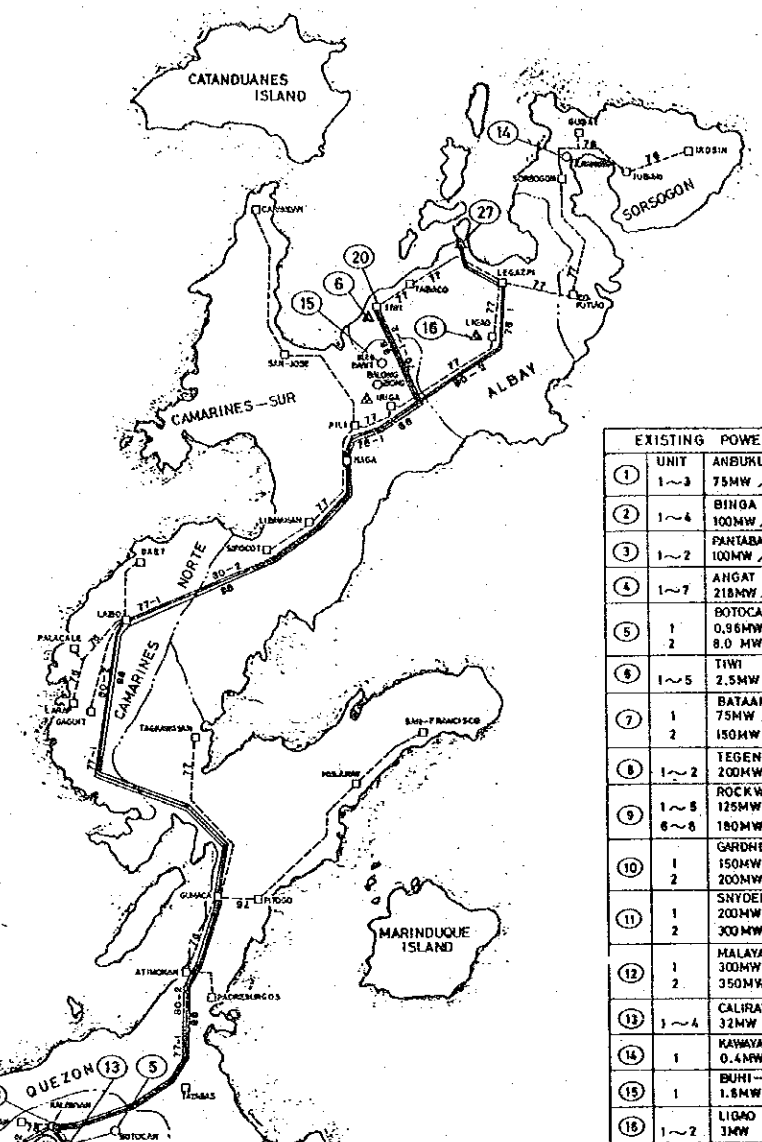
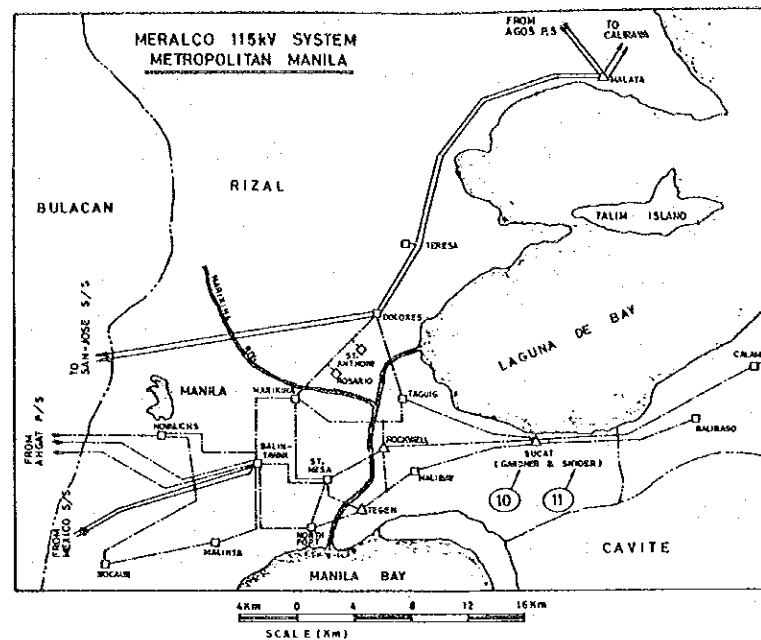
BOTCAN	2 x 6 MW	1 x 0.95 MW
GARONER	1 x 150 MW	1 x 200 MW
SNYDER	1 x 200 MW	1 x 300 MW
ROCKWEL	5 x 25 MW	3 x 60 MW
TEGEN	2 x 100 MW	
ANGAT	4 x 50 MW	3 x 6 MW
MALAYA	1 x 300 MW	
BINGA	4 x 25 MW	
AMBUKLAO	3 x 25 MW	
PANTABANGAN	2 x 50 MW	
CAWAYAN	1 x 0.4 MW	
TIWI	1 x 2.5 MW	2 x 55 MW
LIGAO	1 x 3 MW	
BUIJI	1 x 1.8 MW	
BALONGBONG	1 x 0.7 MW	
MAK-BAN	2 x 55 MW	
CARIRAYA	4 x 8 MW	
DATAAN	1 x 75 MW	1 x 150 MW

REPUBLIC OF THE PHILIPPINES NATIONAL POWER CORPORATION	
AGOS RIVER HYDROPOWER PROJECT	
EXISTING TRANSMISSION SYSTEM LUZON MAINLAND	
DATE	DEC 1980
DWG. NO.	1
JAPAN INTERNATIONAL COOPERATION AGENCY	



PROPOSED POWER STATION			
UNIT	CHICO	IV	YEAR
29	1~6	360MW / 852GWH	1990
30	1~6	GENED 600MW / 1153GWH	1988
31	1~2	AGOS 140MW / 711 GWH	1989
32	1	DEDUYON 140MW / 475GWH	1991

LEGEND	
75-1	EHV TRANSMISSION LINE & COMPLETION YEAR & CIRCUIT No.
75-1	750KV DITTO
75-1-2	115KV DITTO
75-1-2	69KV DITTO
□	SUBSTATION
○	HYDROELECTRIC POWER STATION
⊖	PUMPED STORAGE HYD. POWER STA.
△	THERMAL POWER STA. COAL FIRED
△	DITTO DIESEL
△	DITTO GEOTHERMAL
△	DITTO OIL FIRED
⊙	NUCLEAR THERMAL POWER STATION
●	PROVINCIAL CAPITAL



EXISTING POWER STATION			
UNIT	ANBUKLAO	H.E	YEAR
1	1~3	75MW / 416GWH	1956
2	1~4	BINGA 100MW / 550GWH	1960
3	1~2	PANTABANGAN 100MW / 293GWH	1977
4	1~7	ANGAT 218MW / 517GWH	1967
5	1 2	BOTOCAN 0.96MW / 289GWH	1948
6	1~5	TIWI 2.5MW / 4.76GWH	1975
7	1 2	BATAAM 75MW / 500GWH	1972
8	1~2	TEGEN 200MW / 1236GWH	1968
9	1~5 6~8	ROCKWELL 125MW / 286GWH	1958
10	1 2	GARDNER 150MW / 95.2GWH	1988
11	1 2	SNYDER 200MW / 961GWH	1971
12	1 2	MALAYA 300MW / 1418GWH	1975
13	1~4	CALIRAYA 32MW / 194GWH	1942
14	1	KANAYAN 0.43MW / 3GWH	1959
15	1	BUNI-BARIT 1.8MW / 11GWH	1987
16	1~2	LIGAO 1MW / 17GWH	1957

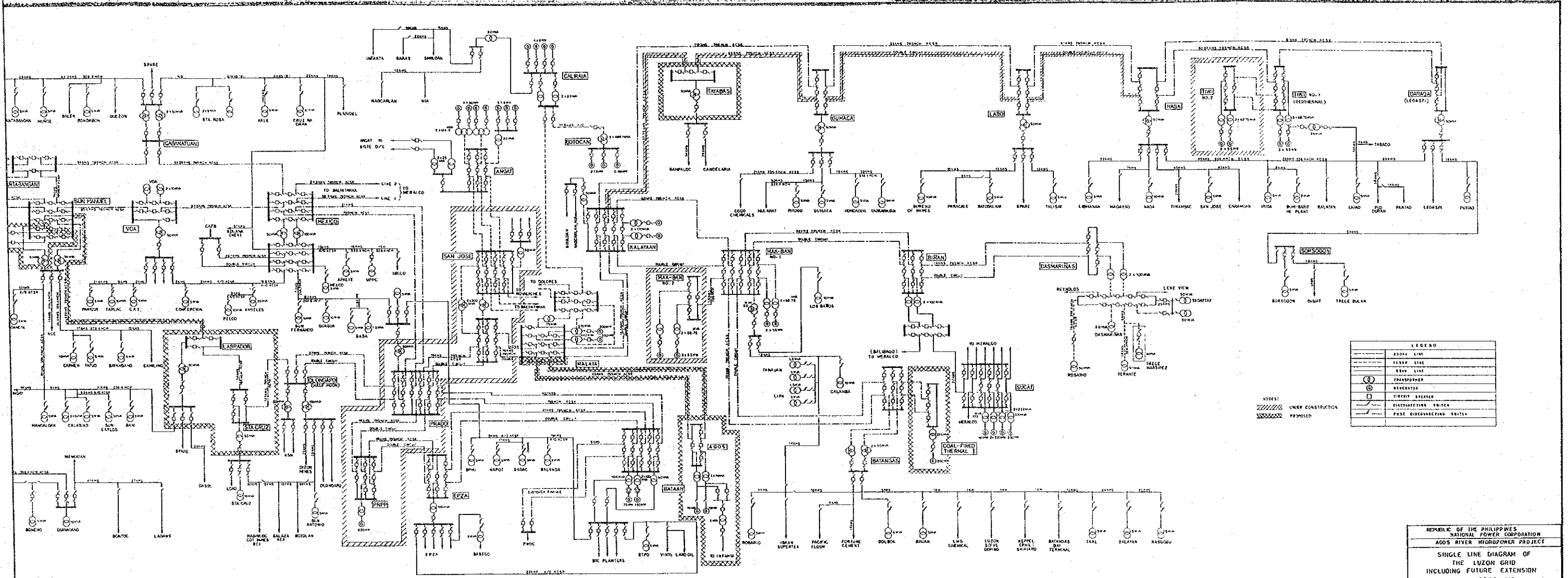
PROPOSED POWER STATION			
UNIT	TIWI	YEAR	
20	1~3	165MW / 1080GWH	1979
	4	55 MW / 360 GWH	1980
	5	55 MW / 360 GWH	1985
21	1~2 3~4 5 6	MAK-BAN 100MW / 720GWH 100MW / 720GWH 55 MW / 360 GWH 55 MW / 360 GWH	1979 1981 1985 1986
22	1	MASINAY 12MW / 35GWH	1981
23	1~2	KALAYAN 300MW / 280GWH	1982
24	1~4	MAGAT 360MW / 1203GWH	1983
25	1~2	COAL FIRED TH. 300MW / 1577GWH	1983
26	1	NUCLEAR (NAPOT) 620MW / 3911GWH	1984
27	1~2	COAL FIRED TH. 300MW / 1577GWH	1986
28	1~2	SAN ROQUE 260MW / 845GWH	1987

REPUBLIC OF THE PHILIPPINES
NATIONAL POWER CORPORATION
AGOS RIVER HYDROPOWER PROJECT

EXTENSION PROGRAM
TRANSMISSION SYSTEM
LUZON MAINLAND

DATE: DEC 1980 DWG. NO. 2

JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND

---	EXISTING LINE
- - - -	PROPOSED LINE
⊕	TRANSFORMER
⊗	GENERATOR
□	CIRCUIT BREAKER
⊠	DISCONNECTING SWITCH
⊞	POST DISCONNECTING SWITCH

NOTES:
 Hatched area: UNDER CONSTRUCTION
 Dashed area: PROPOSED

REPUBLIC OF THE PHILIPPINES
 NATIONAL POWER CORPORATION
 AGOS RIVER HYDROPOWER PROJECT

SINGLE LINE DIAGRAM OF
 THE LUZON GRID
 INCLUDING FUTURE EXTENSION
 PROGRAMS

DATE: DEC 1960 DWE. NO. 3
 JAPAN INTERNATIONAL COOPERATION AGENCY

A N N E X



ANNEX I

HISTORICAL ENERGY CONSUMPTION IN LUZON MAINLAND

On the basis of energy sales records of MERALCO and NAPOCOR, estimates of annual energy consumption levels in the Luzon mainland during the past eighteen years, 1960 to 1978 were developed. These are presented in Table 3-3, broken down according to end-use.

Due to data limitations, consumption of energy delivered by self-generating utilities and firms in Luzon is not included. Preliminary surveys indicate that said deliveries accounted for at most the equivalent of 17 % of combined MERALCO-NAPOCOR sales in early sixties progressively declining to less than 4.0 % by 1978.

As can be gleaned from Table 3-3, energy consumption in Luzon have increased from 1649 to 10217 million kilowatthours between 1960 and 1978, representing an average annual compound growth rate of 10.7 % for the period. The eighteen year growth in energy consumption reflects the continuous expansion of the market base in all the sectors in terms of increased number of users as well as improved energy use. In particular, the relatively stable increases in residential and commercial consumption as well as the slightly erratic but nonetheless positive growth in industrial use have accounted for the overall healthy profile of energy consumption in Luzon.

Actual year-to-year growth in energy consumption, however, exhibited progressively declining trends at both aggregate and sectoral levels. The slowdown in growth rates is attributable to various factors including the normal tapering off of additional energy demand in areas where electrification levels are near approaching their peak as well as the coming of new economic orders and conditions of energy supply limitations.

The movement in growth rates registered over the years serve to demarcate the periods of high growth from those of sluggish performance. For instance, it is easily noted that the pace of energy expansion in the sixties was significantly faster than that established in the seventies. This marked difference is clearly illustrated in Table I-1, I-2, I-3, I-4 and in Figures I-1, I-2, and I-3.

I.1 1960 to 1964: Accelerated Expansion of Market Base

During the four (4) years period, 1960 to 1964, energy consumption in Luzon grew at an average annual rate of 15.3 % reaching 2,919 GWh by 1964. The remarkable growth in consumption levels was largely attributable to substantial improvement in energy sales within MERALCO's franchise area which alone accounted for 88 % of total sales

in Luzon as of 1964.^{/1} Specifically, the period was characterized by marked increases in the use of air-conditioning facilities in Greater Manila, the connection of major firms to MERALCO and the construction boom in the city suburbs.

At the same time, NAPOCOR sales in the provinces registered dramatic growth rates averaging at 27 % annually due to new utility and industrial load connections following the commissioning of the Binga hydroelectric plant in Benguet and of several isolated plants in La Union, Nueva Ecija, Bicol and Ilocos.

Further encouraging the growth in energy sales was the relatively low and stable electricity rates that prevailed during the period. With respect to movement in sectoral consumption, the industrial sector posted the highest energy consumption growth rates with an annual average of 16.8 % reflecting a significant increase in the number of industrial users as well as the solid growth in energy demand of existing loads.

Annual growth in sales to residential and commercial load average at stable rates of 15.7 and 11.2 % respectively. A corresponding expansion of customer base involving some 81 thousand additional residential customers and over 8 thousand commercial customers was recorded in MERALCO's franchise area alone.^{/2}

Sales to miscellaneous customer loads registered a high average annual growth rate of 36 % but contributed minimally to the overall consumption growth rate due to its relatively small market size. As a result of the change in sectoral consumption growth levels, a gradual shift in the distribution of energy use among the different sectors occurred during the period.

1.2 1965 to 1969: Sustained Growth in Energy Sales

The latter half the sixties saw continuing expansion in the power market base in Luzon. Annual growth rates average at 13.1 % such that by 1969, energy sales level had topped the 5,450 GWh mark with MERALCO sales accounting for 84 % and NAPOCOR provincial sales as increased share of 16 %.^{/3}

In 1965, an abrupt drop in growth rate of aggregate consumption was recorded due to a slump in MERALCO sales. The decrease in growth rate was attributable to the tight credit conditions which prevailed,

^{/1} Table I-5 and Fig. I-4 present the contribution of energy sales by NAPOCOR and MERALCO.

^{/2} Table I-6 shows the number of customers of MERALCO in every year

^{/3} Energy sales of NAPOCOR to various area are given on Table I-7.

resulting in reduced purchases of electric home appliances as well as the slackening of industrial production and commercial activity in the Greater Manila area. Likewise, growth of NAPOCOR sales, slipped from 27 % to 16 % as additional power requirements of existing utility and non-utility customers tapered off to more normal levels.

The subsequent four-year period showed renewed growth rate in both MERALCO and PAPOCOR sales resulting in an annual increase in total energy consumption of 15 % by 1969. Aside from the rapidly rising population level in Manila, the sustained expansion in sales was due to overall improvement in economic conditions evidenced by a renewed bustle in commercial and industrial activities, and by generally stable income growth coupled with moderate inflation.

The growth in energy sales in Luzon was likewise spurred by the commissioning of several MERALCO generating stations with higher capacity rating as well as of NAPOCOR's hydroplant units in Angat resulting in substantial improvement in the system's capability to meet the growing energy needs of the region.

During the same period, industrial consumption maintained its lead share of 39 % of total energy use. Sales to the residential sector slipped slightly relative to the commercial sector's while that to miscellaneous customer continued to account for a stable 2.0 to 1.8 % of aggregate sales.

I.3 1970 to 1974: Stagnant Growth Period

In sharp contrast to the high growth patterns established in the sixties, energy consumption growth levels drastically declined in the seventies. In 1970, total energy sales in Luzon increased by more 7 % (down from 15 % in 1969), and except for an abrupt rise in 1971, the rate of growth continued to deteriorate, plunging to a record low of 1 % growth in 1974. The average annual rate from 1970 to 1974 was 7.1%.

The sharp reduction in the growth of energy sales manifested the initial reaction of the Philippine business community to the Peso devaluation that greeted the decade. It also reflected the impact to the domestic economy of the worldwide shortage of food and raw materials, not to mention the new economic order that ensued following the OPEC decision on a quadruple increase in oil prices.

During the same period, the Luzon mainland experienced unfavorable weather conditions including typhoon "Yoling" in November 1970 and the July-August floods of 1972 affecting much of the region's food production centers as well as causing massive damages to the power transmission and distribution facilities in the area.

The continued expansion in local consumer and industrial demand in the face of deteriorating domestic and international supply situations triggered an economy-wide recession and the country's worst post war inflation fever. Inflation was further fueled by the oil crisis resulting in major increases in electricity prices. Thereafter, energy conservation became a matter of national concern.

The decline in energy consumption growth levels was first observed in the MERALCO franchise area in 1970, NAPOCOR provincial sales did not show signs of distress until 1972. Although the period's economic turbulence had its reminifications on commercial and industrial demand in the provinces, the effects on energy sales were not as dramatic as those experienced in Metro Manila partly because of the lesser concentration of import-oriented industries and partly because of the more stable electricity rates permitted by the hydro-base NAPOCOR power system. Consequently, as the first half of the decade drew to a close, NAPOCOR sales accounted for an improved market share of 25 % up from 16 % in 1969. A look at the sectoral performances reveals that except for the abnormally high growth rate posted by the miscellaneous sector, energy consumption by various customer groups registered depressed growth rates.

The phenomenal rise in energy sales to miscellaneous load 241.4 % in 1971 (see Table I-3) was due to the connection of US military installations to NAPOCOR. Sales to residential, commercial, and industrial consumers grew by 4.3 %, 5.0 % and 7.8 % respectively, reflecting real cutback in energy demand among the users rather than significant slowdown in new load connections.

Resulting movements in sectoral shares of aggregate energy consumption were as follows: residential share dropped from 34 % to less than 30 %, commercial share slipped slightly from 25 % to 22 %, industrial share improved to 41.8 % while miscellaneous share accounted an increased 6 %.

I.4 1975 to 1978: Slight Recovery in Energy Sales

The recent period 1975 to 1978 showed some signs of recovery in energy consumption growth levels in residential and commercial sectors as the average annual growth rate improved to 7.7 and 8.8 % respectively. A sudden increase in aggregate consumption of 10 % was posted in 1975, partly in correction of the abnormally poor performance in 1974, after which the growth rate leveled off to 6.8 % in 1976 and 6.7 % in 1978.

The general improvement in sales reflected the moderate but encouraging achievements in the Philippine economy despite the continuance of worldwide recessionary trends. This was evidenced by steady gains in food production, higher employment levels, modest success in non-traditional exports, bullish construction activity and

substantial decline in inflation rates from the all-time high of 31.3 % in 1974 to an average of 8.5 % during the period. (See Table I-8)

Needless to say, the growth levels in energy consumption registered during the last four (4) years were still considerably below the pace established in the sixties. Economic recovery was still threatened by a depressed demand for the country's traditional exports, growing trade protectionism abroad, and high import costs.

In 1977, a slight resurgence in inflation rate (9.4 %) was experienced coupled with high interest rates. The new round of oil price increases in the early part of the year contributed to the deteriorating price situation. Moreover, total investments minimally increased as the demand for durable equipment waned and construction activities slackened. However, manufacturing and mining industries finally recovered and turned out to be the year's growth pacesetters.

Mixed performance in sectoral energy consumption reflected the varying degrees and timing of economic recovery among the different sectors. Marked improvement in energy consumption was most evident within the MERALCO service area particularly among residential and commercial customers. MERALCO sales to industries remained sluggish but managed to expand over the years. In contrast, NAPOCOR provincial sales suffered reversals in growth rates due to the inability of the system to meet increasing energy demand. Substantial load curtailment had to be imposed on NAPOCOR customers particularly on non-utilities. Consequently, whereas overall energy consumption by residential and commercial sectors increased at favorable average annual rates of 7.7 % and 8.8 % respectively, expansion in industrial and miscellaneous energy use slumped to an annual average 5.7 % and 6.3 % during the period.

By the end of 1978, energy sales level in Luzon reached 9,787 GWh with MERALCO sales accounting for 76 % of the total. Distribution of sales among customer groups stood as follows: 31.2 % residential, 24 % commercial, 40.2 % industrial, and 4.6 % others.

I.5 MERALCO - NAPOCOR Breakdown of Total Energy Consumption in Luzon

A breakdown of the annual energy consumption levels in Luzon for the past eighteen (18) years according to major service areas namely MERALCO's and NAPOCOR's is presented in Table I-1.

As can be gleaned from the supporting Fig. I-1, I-2, I-3, and I-4 energy consumption growth patterns for the two (2) service areas differ markedly: movement in MERALCO sales have been moderate and stable while that for NAPOCOR high and erratic. The contrast is attributable to the disparate nature of the markets served.

MERALCO's market is characterized by a dense population, a good customer mix, higher income affordability, and intensified energy use. NAPOCOR's market, although certainly more expansive in area coverage, is less densely populated and consists of smaller but more distant load and represents a poorer and less diverse economic base. Accordingly, while MERALCO's urban market has grown more stable and solid since the mid-fifties, NAPOCOR's provincial market has continued to represent new provincial frontier for energy sales development. The upsurge in provincial energy demand that has been observed with the opening up of new rural areas to electricity service has accounted for the dramatic growth levels in NAPOCOR sales. Consequently, although MERALCO's sales continued to dominate the energy market, NAPOCOR sales has managed to gradually improve its share of total energy consumption in Luzon mainland as cleared in Table I-5.

ANNEX II

BASIC POLICIES OF NATIONAL POWER CORPORATION

Presidential Decree No.40 issued in November 1972 nationalized the generation and transmission of power and expanded the scope of responsibility of NAPOCOR through the promulgation of the following statements of policy:

(1) The attainment of total electrification on an area coverage basis, which is declared policy of the State, shall be effected primarily through:

- a) The setting up of island grids with central linked-up generation facilities.
- b) The setting up of cooperatives for distribution of power.

(2) The setting up of transmission line grids and construction of associated generation facilities in Luzon, Mindanao and major islands of the country, including the Visayas, shall be the responsibility of the National Power Corporation (NAPOCOR) as the authorized implementing agency of the State.

- a) Plant addition necessary to meet the increase in power demand of the area embraced by any grid set up by the NAPOCOR shall be constructed and owned by the NAPOCOR.
- b) In areas not embraced by the NAPOCOR grid, the State shall permit cooperatives, private utilities and local governments to own and operate isolated grids and generation facilities, subject to State regulation.

(3) The distribution of electric power generated by the NAPOCOR shall be undertaken by:

- a) Cooperatives
- b) Private utilities
- c) Local governments
- d) Other entities duly authorized subject to state regulation.

(4) Within the area embraced by a grid set up by the NAPOCOR, the State shall determine privately owned generating facilities which should be permitted to remain in operation.

(5) It is the ultimate objective of the State for the NAPOCOR to own and operate as a single integrated system all generating facilities supplying electric power to the entire area embraced by any grid set up by the NAPOCOR.

(6) The Power Development Council shall be expanded and strengthened to make it more effective in the planning and implementation of power and electrification projects and in the re-direction and re-orientation of the various sectors of the industry towards national development goals.

Presidential Decree No. 380 signed January 22, 1974 amended certain sections of Republic Act No. 6395 (which revised the NAPOCOR Charter) most salient points of which are as follows:

- a) Sale of power in bulk to enterprises registered with the Board of Investment.
- b) Providing a five-year prescriptive limitation for compensation for damages or for compensation on rights-of-way.
- c) NAPOCOR authorized to establish subsidiaries to exercise powers and carry out business in cooperation with the Power Development Council, National Electrification Administration, and other public service agencies.
- d) NAPOCOR entrusted with the responsibility of enhancing conservation and development of natural resources to promote tourism and prevent environmental pollution and to provide corporate funds therefor.
- e) Rate of return fixed at not more than 10 %, but charges are to be determined independently by region.
- f) NAPOCOR capital stock raised to P2 billion (from P300 million).
- g) Raising total indebtedness of NAPOCOR to P3 billion.
- h) Raising ceiling on foreign loans not to exceed \$1 Billion U.S.
- i) Exemption from all taxes, duties, fees, imposts, etc. (due to non-profit character of NAPOCOR).
- i) NAPOCOR placed under direct supervision of the Office of the President.
- k) Industrial disputes to be settled by compulsory arbitration.

Letter of Instruction No.220 issued by the President of the Philippines on October 15, 1974 gave full protection to the NAPOCOR when carrying out its development projects throughout the country.

ANNEX III

ELECTRICITY RATE IN PHILIPPINES

The sales revenue of electric power by NAPOCOR is presented in Table III-1. This table shows that energy value of NAPOCOR changed by regions. The Mindanao region is supplied by hydro power mainly and so they can enjoy the cheapest energy in Philippines.

Next is Luzon region, this region is supplied about 85 % by oil fired thermal power station and remaining 15 % is by hydro power stations. The energy value is higher than Mindanao.

The highest energy region is Visaya. This region consists of small scattered islands. These islands are mainly supplied by small diesel power stations. This condition caused high energy cost.

Present tariff rate is presented as follows. This rate is effective after February 27, 1980.

III.1 Schedule I: Luzon Grid

Utilities

Applicable to electric power and energy supplied to electric utilities in Luzon served by the Luzon grid of NAPOCOR.

Demand Charge	Per Meter per Month
First 500 kW of Billing Demand	P12.00 per kW
Next 19,500 kW of Billing Demand	P16.00 per kW
Over 20,000 kW of Billing Demand	P22.00 per kW
Energy Charge	
First 200 kWh per kW of Billing Demand	P0.2900 per kWh
Next 200 kWh per kW of Billing Demand	P0.3100 per kWh
Over 400 kWh per kW of Billing Demand	P0.3320 per kWh

Industries and Non-utilities

Applicable to electric power and energy supplied to industries and non-utilities in Luzon served by the Luzon grid of NAPOCOR.

Demand Charge	Per Meter Per Month
First 1,000 kW of Billing Demand	P18.00 per kW
Next 9,000 kW of Billing Demand	P19.00 per kW
Over 10,000 kW of Billing Demand	P20.10 per kW
 Energy Charge	
First 200 kWh per kW of Billing Demand	P0.3650 per kWh
Next 250 kWh per kW of Billing Demand	P0.3300 per kWh
Over 450 kWh per kW of Billing Demand	P0.3000 per kWh

III.2 Schedule II: Cebu and Panay Grids

Utilities

Applicable to electric power and energy supplied to electric utilities in Cebu and Panay served by NAPOCOR.

Demand Charge	Per Meter Per Month
First 100 kW of Billing Demand	P14.00 per kW
Next 900 kW of Billing Demand	P17.00 per kW
Over 1,000 kW of Billing Demand	P20.00 per kW
 Energy Charge	
First 100 kWh per kW of Billing Demand	P0.3160 per kWh
Next 150 kWh per kW of Billing Demand	P0.3476 per kWh
Over 250 kWh per kW of Billing Demand	P0.3822 per kWh

Industries and Non-utilities

Applicable to electric power and energy supplied to industries and non-utilities in Cebu and Panay served by NAPOCOR.

Demand Charge	Per Meter Per Month
First 100 kW of Billing Demand	P23.00 per kW
Over 100 kW of Billing Demand	P20.00 per kW

Energy Charge

First 300 kWh per kW of Billing Demand	₱0.4000 per kWh
Over 300 kWh per kW of Billing Demand	₱0.3896 per kWh

III.3 Schedule III: Bohol and Negros Grids

Applicable to all electric power and energy supplied to all customers in Bohol and Negros served by NAPOCOR.

Demand Charge	Per Customer Per Month
First 200 kW of Billing Demand	₱12.00 per kW
Over 200 kW of Billing Demand	₱10.00 per kW
Energy Charge	
First 100 kWh per kW of Billing Demand	₱0.2400 per kWh
Next 150 kWh per kW of Billing Demand	₱0.2600 per kWh
Over 250 kWh per kW of Billing Demand	₱0.3000 per kWh

III.4 Schedule IV: Mindanao Grid

Utilities

Applicable to electric power and energy supplied to electric utilities in Mindanao served by the Mindanao grid of NAPOCOR.

Demand Charge	Per Customer Per Month
First 500 kW of Billing Demand	₱10.00 per kW
Next 4,500 kW of Billing Demand	₱14.50 per kW
Over 5,000 kW of Billing Demand	₱18.00 per kW
Energy Charge	
First 100 kWh per kW of Billing Demand	₱0.0900 per kWh
Next 200 kWh per kW of Billing Demand	₱0.1200 per kWh
Over 300 kWh per kW of Billing Demand	₱0.1400 per kWh

Industries and Non-utilities

Applicable to electric power and energy supplied to industries and non-utilities in Mindanao served by the Mindanao grid of NAPOCOR.

Demand Charge	Per Customers Per Month
First 1,000 kW of Billing Demand	P18.00 per kW
Next 4,000 kW of Billing Demand	P19.00 per kW
Next 10,000 kW of Billing Demand	P21.00 per kW
Over 15,000 kW of Billing Demand	P23.00 per kW
Energy Charge	
First 100 kWh per kW of Billing Demand	P0.1500 per kWh
Next 150 kWh per kW of Billing Demand	P0.1400 per kWh
Next 200 kWh per kW of Billing Demand	P0.1300 per kWh
Over 450 kWh per kW of Billing Demand	P0.1200 per kWh

III.5 Schedule V: General Santos

Applicable to electric power and energy supplied to all customers served by the General Santos sub-grid of NAPOCOR:

Straight energy charge of P0.4000 per kWh

III.6 Fuel Cost Adjustment Clause

Applicable to both utilities and non-utilities/industries rates schedules in the respective NAPOCOR grids and sub-grids.

The FCA charge per kilowatthour shall be correspondingly increased or decreased by the following adjustment, rounded to the nearest P0.0001:

$$\text{Adjustment per kWh} = \frac{A \times B}{C}$$

Where A. The weighted average price increase above (or decrease below) the base price of fuel all actually burned during the billing period, net of all taxes, duties, fees and all other charges imposed by the Republic of the Philippines and its various instrumentalities to the extent that NAPOCOR is able to avail of or otherwise benefit from such exemption.

- B. Million BTU or liters of fuel oil actually burned to NAPOCOR's oil-burning generating plants in the individual sub-grid during the billing period.
- C. Kilowatthour sales by NAPOCOR in the individual grid or sub-grid during the billing period.

Where the base price of fuel is:

Luzon	:	P30.29 per MMBTU
Cebu	:	P1.204 per Liter
Panay	:	P1.218 per Liter
Negros	:	P1.213 per Liter
Bohol	:	P1.230 per Liter
General Santos	:	P1.227 per Liter
Mindanao (Agus) grid	:	P1.220 per Liter

III.7 Expected Income of NAPOCOR by Sold Energy

By the new rate, NAPOCOR is expected to get average revenue per kWh of 0.3649 Pesos in 1980 by projected income statement of Table III-2 on July 30th, 1980. But on September 12th, 1980, NAPOCOR intend to raise power rate by 10 % in all three regions because of the increase in prices of oil product on August 3rd, 1980. According to this information, for Luzon the average power rate is estimated at 0.4023 Pesos per kWh. For the Visaya, the average prices will be as follows,

Cebu	:	0.4803 Pesos
Negros	:	0.3549 Pesos
Bohol	:	0.3602 Pesos
Panay	:	0.4886 Pesos

For the Mindanao, the power rate increase will be very low of 0.00018 Pesos over current average rate of 0.17 Pesos per kWh. Under these circumstances, the projected income statement of Table III-2 will be revised.

Table I-1 Historical Energy Consumption in Luzon MERALCO and NAPOCOR Sales

Year (1)	Sold by MERALCO		Sold by NAPOCOR		Total Sale		Growth Rate of G.N.P. (8)	Elasticity (7) + (8) (9)
	GWh (2)	Growth Rate % (3)	GWh (4)	Growth Rate % (5)	GWh (6)	Growth Rate % (7)		
1960	1,461.6		134.1		1,595.7			
1961	1,688.1	15.5	180.1	34.3	1,868.2	17.1	6.9	2.5
1962	1,938.8	14.9	212.4	18.0	2,151.2	15.1	5.5	2.7
1963	2,175.3	12.2	270.7	27.4	2,446.0	13.7	7.0	2.0
1964	2,492.8	14.6	344.7	27.4	2,837.5	16.0	3.4	4.7
1965	2,721.3	9.2	401.1	16.3	3,122.4	10.0	5.0	2.5
1966	3,055.0	12.3	485.9	21.1	3,540.9	13.4	4.4	3.0
1967	3,431.4	12.3	529.9	9.1	3,961.3	11.9	4.8	2.5
1968	3,852.6	12.3	704.1	32.9	4,556.7	15.0	5.4	2.8
1969	4,372.5	13.5	851.7	21.1	5,224.2	14.6	5.3	2.8
1970	4,554.6	4.2	1,031.1	21.1	5,585.7	6.9	4.3	1.6
1971	4,833.7	6.1	1,307.8	26.8	6,141.5	10.0	5.8	1.7
1972	5,101.2	5.5	1,486.6	13.7	6,587.8	7.3	4.9	1.5
1973	5,566.7	9.1	1,642.8	10.5	7,209.5	9.4	9.6	1.0
1974	5,438.5	(2.3)	1,836.5	11.8	7,275.0	0.9	6.3	0.1
1975	5,890.5	8.3	2,143.2	16.7	8,033.7	10.4	5.9	1.8
1976	6,312.7	7.2	2,269.1	5.9	8,581.8	6.8	6.9	1.0
1977	6,894.8	9.2	2,182.4	(3.8)	9,077.2	5.8	6.1	0.95
1978	7,335.2	6.4	2,348.4	7.6	9,683.6	6.7	7.2	0.93

Note: () Negative increase rate

Table I-2 Annual Growth Rate of Sectors Energy Consumption in Luzon Mainland

(%)

Year	Residential		Commercial		Industrial		Miscellaneous		Total	
	Annual	Average	Annual	Average	Annual	Average	Annual	Average	Annual	Average
1960	16.48		10.73		22.47		3.32		16.7	
1961	16.71		9.54		17.13		25.69		16.1	
1962	14.43	15.70	10.55	11.22	14.12	16.84	47.69	36.3	13.0	15.3
1964	15.31		15.32		15.03		79.88		15.6	
1965	8.65		10.25		10.75		18.61		9.9	
1966	13.69		14.07		13.18		5.48		14.4	
1967	11.06	12.16	13.39	14.56	12.25	13.12	0.91	10.1	12.7	13.5
1968	11.97		15.91		17.06		18.78		15.1	
1969	15.63		19.88		10.78		13.19		14.4	
1970	4.59		5.55		10.38		14.19		6.9	
1971	5.06		4.47		12.39		135.77		10.1	
1972	6.56	4.31	6.21	4.96	4.23	7.75	57.14	46.2	7.3	7.4
1973	8.84		8.33		9.76		15.74		9.4	
1974	(5.88)		(1.19)		5.60		15.36		0.9	
1975	12.62		11.35		7.58		15.83		10.4	
1976	4.39	7.72	7.92	8.84	9.12	5.65	5.69	6.3	6.8	7.4
1977	9.83		11.20		2.74		(18.90)		5.8	
1978	8.33		6.68		6.18		0.36		7.8	

Table I-3 Annual Growth Rate of Sector Wise Energy Consumption of MERALCO and NAPOCOR (%)

Year (1)	NAPOCOR				MERALCO						
	Utilities (2)	Industrial (3)	Miscell. (4)	Total (5)	Residential (6)	Commercial (7)	Industrial (8)	Street light (9)	Resales (10)	Total (11)	
1960											
1961	50.9	23.8	9.9	34.3	10.9	10.7	22.3	6	29.1	15.5	
1962	28.5	7.1	37.9	18.0	13.8	9.5	18.6	18.9	23.7	14.9	
1963	36.9	13.7	68.6	27.4	10.8	10.6	14.2	34.1	11.3	12.2	
1964	21.2	21.1	143.1	27.4	15.2	15.3	14.2	28.4	6.8	14.6	
1965	15.6	17.2	16.9	16.3	8.7	10.2	9.9	21.2	(3.9)	9.2	
1966	18.4	30.2	(1.3)	21.1	10.9	14.1	10.7	15.6	26.3	12.3	
1967	18.1	1.7	(7.9)	9.1	7.9	13.4	14.1	12.2	20.2	12.3	
1968	22.2	46.9	36	32.9	8.1	15.9	12.5	0.9	17.2	12.3	
1969	15.2	28.1	17.6	21.0	17.8	19.9	7.3	7.0	3.9	13.5	
1970	11.6	34.6	(5.8)	21.1	3.3	5.5	4.5	(1.6)	(2.3)	4.2	
1971	10.3	19.2	241.4	26.8	2.0	4.5	10.3	(20.4)	13.6	6.1	
1972	9.3	4.1	58.6	13.7	5.8	6.2	4.3	47.9	4.6	5.5	
1973	16.0	2.9	17.5	10.5	6.3	8.3	12.1	3.8	7.1	9.1	
1974	3.1	17.7	17.5	11.8	(10.1)	(1.2)	2.1	(1.1)	(4.0)	(2.3)	
1975	22.5	11.6	17.2	16.7	8.9	11.4	6.1	3.4	5.4	8.3	
1976	1.95	9.5	5.8	5.9	4.7	7.9	7.8	4.7	10.5	7.2	
1977	10.0	(6.8)	(20.9)	(3.8)	9.3	11.2	7.5	4.7	11.8	9.2	
1978	20.1	(6.7)	12.5	7.9	10.0	6.7	8.1	3.2	(33.6)	7.8	

Note: The number in () is negative value.

Table I-4 Per Cent Distribution of Energy Sales of Each Sector

Year (1)	Residential	Commercial	Industrial	Miscellaneous
	<u>/1</u> (2)	(3)	(4)	<u>/2</u> (5)
1960	35.5	26.6	36.9	1.0
1961	35.3	25.1	38.7	0.9
1962	35.8	23.9	39.3	1.0
1963	36.0	23.3	39.5	1.2
1964	35.8	23.1	39.2	1.9
1965	35.3	23.2	39.4	2.1
1966	35.4	23.3	39.3	2.0
1967	35.2	23.6	39.5	1.7
1968	34.2	23.8	40.2	1.8
1969	34.5	24.9	38.8	1.8
1970	33.8	24.5	40.1	1.6
1971	32.3	23.3	41.0	3.4
1972	32.1	23.1	39.8	5.0
1973	31.9	22.9	39.9	5.3
1974	29.7	22.4	41.8	6.1
1975	30.3	22.6	40.7	6.4
1976	29.6	22.7	41.4	6.3
1977	30.7	24.0	40.4	4.9
1978	31.2	24.0	40.2	4.6

Note: Column /1 : Utilities of NAPOCOR
Residential use and Resales of MERALCO

/2 : Miscellaneous of NAPOCOR
Street light of MERALCO

Table I-5 Percent Distribution of Energy Sales
between MERALCO and NAPOCOR 1960-1978

Year	(%)	
	MERALCO	NAPOCOR
1960	92	8
1961	90	10
1962	90	10
1963	89	11
1964	88	12
1965	87	13
1966	86	14
1967	87	13
1968	85	15
1969	84	16
1970	82	18
1971	79	21
1972	77	23
1973	77	23
1974	75	25
1975	73	27
1976	74	26
1977	76	24
1978	76	24

Table I-6 Manila Electric Company
Annual Number of Customers

Year	Residential	Commercial	Indus- trial	Street Lights	Resale	Transpor- tation	Total
<u>Actual</u>							
1959	299,036	37,125	630	48	11	-	336,850
1960	312,594	37,603	713	52	12	-	350,974
1961	328,338	38,242	956	54	12	-	367,602
1962	344,586	39,870	984	62	14	-	385,516
1963	360,253	42,218	1,064	102	16	-	403,653
1964	373,302	44,433	1,191	120	16	-	419,062
1965	393,334	45,875	1,283	139	20	-	440,651
1966	412,775	47,589	1,235	167	20	-	461,786
1967	427,625	54,228	1,269	182	21	-	483,325
1968	447,661	61,864	1,346	190	21	-	511,082
1969	470,284	67,304	1,442	279	20	-	539,329
1970	448,778	68,707	1,467	-	21	-	558,973
1971	517,836	71,900	1,681	286	22	-	591,725
1972	536,796	73,414	1,859	362	23	-	612,454
1973	569,180	77,366	1,975	410	24	-	649,455
1974	592,902	81,771	1,982	426	25	-	677,106
1975	614,281	86,207	2,122	460	26	-	703,096
1976	638,757	91,793	2,279	507	27	-	733,363
1977	657,606	95,587	2,723	592	34	-	756,542
1978	706,902	100,522	2,719	653	34	-	810,830
<u>Forecast</u>							
1979	743,650	105,590	2,891	690	30	-	852,851
1980	778,330	110,640	3,070	727	27	-	892,794
1981	809,580	115,290	3,254	760	27	1	928,912
1982	842,680	120,020	3,441	793	27	1	966,962
1983	874,210	124,820	3,636	826	27	1	1,003,520
1984	904,400	129,810	3,835	859	27	1	1,038,932
1985	934,740	134,740	4,045	892	27	1	1,074,445
1986	963,600	139,730	4,263	924	27	1	1,108,545
1987	993,370	144,620	4,489	957	27	1	1,143,464
1988	1,024,040	149,390	4,723	990	27	1	1,179,171

Source: Utility Economic Forecast of MERALCO

Table I-7 Energy Sales of NAPOCOR to Various Areas and its Annual Growth Rate

Year	Laoag		San Fernando		Mexico Area		Calamba		Clark Air Base		U.S. Naval Base	
	MWh	G.R.%	MWh	G.R.%	MWh	G.R.%	MWh	G.R.%	MWh	G.R.%	MWh	G.R.%
1970	8,569.42		144,064.92		425,778.90		102,232.66					
1971	10,225.70	18.95	174,388.12	21.04	560,434.98	31.62	138,517.89	35.49				
1972	13,202.96	29.12	184,290.67	5.68	270,365.80	-51.76	156,707.16	13.13	151,536.00		77,615.88	
1973	15,169.34	14.89	214,217.71	16.24	205,004.83	-24.17	176,814.97	12.83	161,697.23	6.70	111,048.00	43.07
1974	27,603.43	81.97	199,162.06	-7.03	237,710.66	15.95	179,842.83	1.71	181,408.50	12.19	143,592.00	29.31
1975	37,230.66	34.88	233,062.68	17.02	270,395.23	13.75	202,023.41	12.33	198,092.00	9.80	186,475.00	29.86
1976	37,785.73	2.03	243,611.57	4.53	280,646.97	3.79	220,771.94	9.28	201,432.00	1.69	213,765.60	14.63
1977	41,372.28	8.72	252,658.67	3.71	294,054.56	4.78	239,511.69	8.49	118,905.82	-40.97	194,306.40	-9.10

Year	Baguio (Bekel)		Sta Rosa		Angat Balintawak		Bicol Area		V.O.A.		Olongapo	
	MWh	G.R.%	MWh	G.R.%	MWh	G.R.%	MWh	G.R.%	MWh	G.R.%	MWh	G.R.%
1970	214,900.34		37,943.23		88,570.80		8,038.99					
1971	260,467.97	21.20	43,433.98	14.47	106,854.81	20.64	12,192.94	51.17				
1972	281,584.40	8.11	50,227.49	15.64	95,151.94	-10.95	12,965.51	6.34	23,640.00		169,292.46	
1973	292,888.42	4.01	67,461.91	34.31	115,350.95	21.12	14,935.11	14.10	23,460.00	-7.61	244,702.32	44.54
1974	354,594.37	21.07	75,839.26	12.42	111,974.10	-3.27	20,340.87	36.19	23,960.88	2.14	280,499.85	14.63
1975	433,907.15	22.37	88,791.88	17.08	141,061.94	26.43	21,885.34	7.59	25,200.00	5.17	305,084.07	8.76
1976	464,058.18	6.95	96,682.48	8.89	153,786.29	9.02	25,318.72	15.69	25,200.00	0	305,839.70	0.25
1977	439,095.95	-5.32	95,852.95	-0.36	145,503.61	-5.39	37,507.52	48.14	19,270.80	-23.53	304,022.30	-5.94

Table I-8 Price Index Numbers for Gross National Product
by Expenditure Shares, and Inflation Rate

Base Year 1972 = 100

Year	Price Index Number	Inflation Rate ^{/1}
1950	42.5	2.7%
1951	42.8	0.7
1952	41.9	2.1
1953	41.1	-1.9
1954	39.6	-3.6
1955	39.7	0.3
1956	40.2	1.3
1957	41.7	3.7
1958	42.5	1.9
1959	43.5	2.4
1960	45.9	5.5
1961	47.0	2.4
1962	50.1	6.6
1963	54.4	8.6
1964	56.8	4.4
1965	59.2	4.2
1966	62.4	5.4
1967	66.5	6.6
1968	69.8	5.0
1969	73.0	4.6
1970	83.4	14.2
1971	93.7	12.4
1972	100.0	6.7
1973	117.6	17.6
1974	154.4	31.3
1975	166.8	8.0
1976	180.5	8.2
1977	197.4	9.4

Source: Price Index Numbers 1978 Philippine Statistical Year Book.

^{/1} : Yearly increase rate of Price Index Number.

Table III-1 Sales Revenue of Electric Power, NAPOCOR

Year	LUZON			VISAYAS			MINDANAO			TOTAL		
	Revenue (10 ⁶ ₱)	Av. Value (₱/kWh)	Energy Sales (GWh)	Revenue (10 ⁶ ₱)	Av. Value (₱/kWh)	Energy Sales (GWh)	Revenue (10 ⁶ ₱)	Av. Value (₱/kWh)	Energy Sales (GWh)	Revenue (10 ⁶ ₱)	Av. Value (₱/kWh)	Energy Sales (GWh)
1969	-	-	-	-	-	-	-	-	-	37.9	-	1,288
1970	-	-	-	-	-	-	-	-	-	46.3	-	1,738
1971	-	-	-	-	-	-	-	-	-	60.9	-	2,110
1972	80.4	0.058	1,377	0.7	0.082	9	9.7	0.027	356	90.8	0.027	1,742
1973	101.8	0.063	1,608	0.6	0.085	7	10.8	0.027	396	113.2	0.027	2,011
1974	177.4	0.103	1,718	0.8	0.088	9	12.9	0.025	506	191.1	0.025	2,233
1975	221.1	0.111	1,988	1.5	0.180	8	14.8	0.029	495	237.4	0.029	2,491
1976/1	318.4	0.140	2,269	1.4	0.142	10	22.2	0.030	745	342.0	0.030	3,024
1977	395	0.181	2,182	15.0	0.292	51	37	0.043	868	447.0	0.043	3,101
1978	738.7	0.198	3,731	68.81	0.32	214.7	114.05	0.114	996.5	921.56	0.114	4,942.2

Source: Annual Report, NAPOCOR (1972-1977)
Project Planning, NAPOCOR (1969-1971)

/1 From 1976 Calendar Year is used.
Before 1976, Fiscal Year is used starting in July and ending in June.

Table III-2 Projected Income Statement
CY 1980-1990

Total Philippines - Basic Program (for NAPOCOR)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1.0 Energy Sales, GWh	14,048	15,185	16,438	18,327	19,929	21,768	23,410	25,162	27,058	29,141	31,379
1.1 Ave. Rate per kWh, P/kWh	0.3321	0.3321	0.3603	0.3845	0.4396	0.5220	0.5659	0.5968	0.6295	0.6677	0.7098
2.0 Cross Operating Revenue, MF	4,665	5,043	5,922	7,047	8,761	11,363	13,247	15,016	17,034	19,457	22,272
2.1 Fuel Cost Adjustment	554	854	1,273	1,609	1,833	1,548	1,730	2,507	3,549	5,153	7,412
2.2 PPD & Voltage Discount	93	101	118	141	175	227	265	300	341	389	445
3.0 Net Operating Revenue, MF	5,126	5,796	7,077	8,515	10,419	12,684	14,712	17,223	20,242	24,221	29,239
4.0 Operating Expenses, MF	4,082	4,713	5,698	6,493	7,679	8,724	9,628	11,558	13,905	17,109	21,235
4.1 Fuel Oil	3,274	3,491	4,076	4,304	4,265	3,223	3,286	4,411	5,849	8,038	11,028
4.2 Steam	208	318	425	617	726	811	902	1,002	1,109	1,236	1,372
4.3 Nuclear			99	109	826	1,817	340	404	471	526	578
4.4 Coal		75	99	109	826	1,817	1,999	2,199	2,419	2,660	2,927
4.5 Depreciation	319	469	654	922	1,233	1,981	2,260	2,578	2,956	3,387	3,886
4.6 Depletion	31	60	84	131	149	167	186	210	234	266	294
4.7 Other Operating Expenses	250	300	360	410	480	570	655	754	867	996	1,150
5.0 Net Operating Income, MF	1,062	1,083	1,379	2,022	2,740	3,960	5,084	5,665	6,337	7,112	8,004
6.0 Interest Expenses, MF	504	523	640	846	1,157	1,930	2,024	1,730	1,447	1,176	987
7.0 Other Income, MF	48	53	59	59	65	65	71	71	78	78	86
8.0 Other Expenses, MF	7	8	9	9	10	10	11	11	12	12	13
9.0 Net Income (loss), MF	599	605	789	1,226	1,638	2,085	3,091	3,995	4,956	6,002	7,170
10.0 Rate Base	9,134	12,181	17,234	25,272	34,248	49,504	63,548	70,817	79,212	88,905	100,055
10.1 Return on Rate Base	11.63	8.89	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
11.0 Internal Cash Generation	1,453	1,657	2,167	3,125	4,206	6,163	7,561	8,513	9,546	10,831	12,337
12.0 Debt Service	871	964	1,316	1,994	3,155	4,696	4,909	4,492	4,160	3,732	2,871
13.0 Capital Expenditures											
14.0 Average net per kWh	0.3649	0.3817	0.4305	0.4646	0.5228	0.5827	0.6284	0.6845	0.7481	0.8312	0.9318

Source: NAPOCOR, Income Statement on 7-30-80

Fig. 1-1 Annual Growth Rate of Total Energy Sales

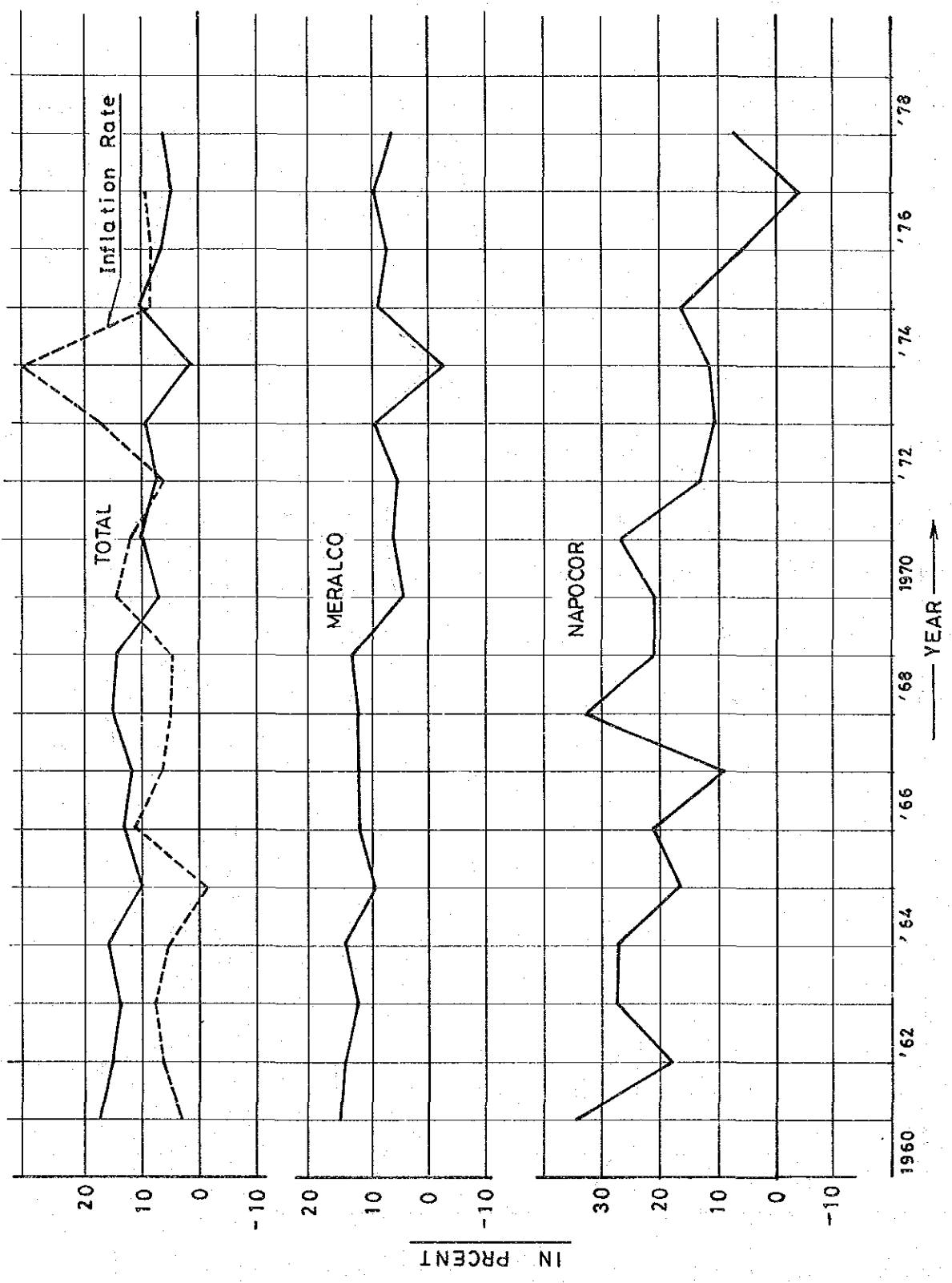


Fig. I - 2 Annual Growth Rate of Sectoral Energy Sales by NAPOCOR

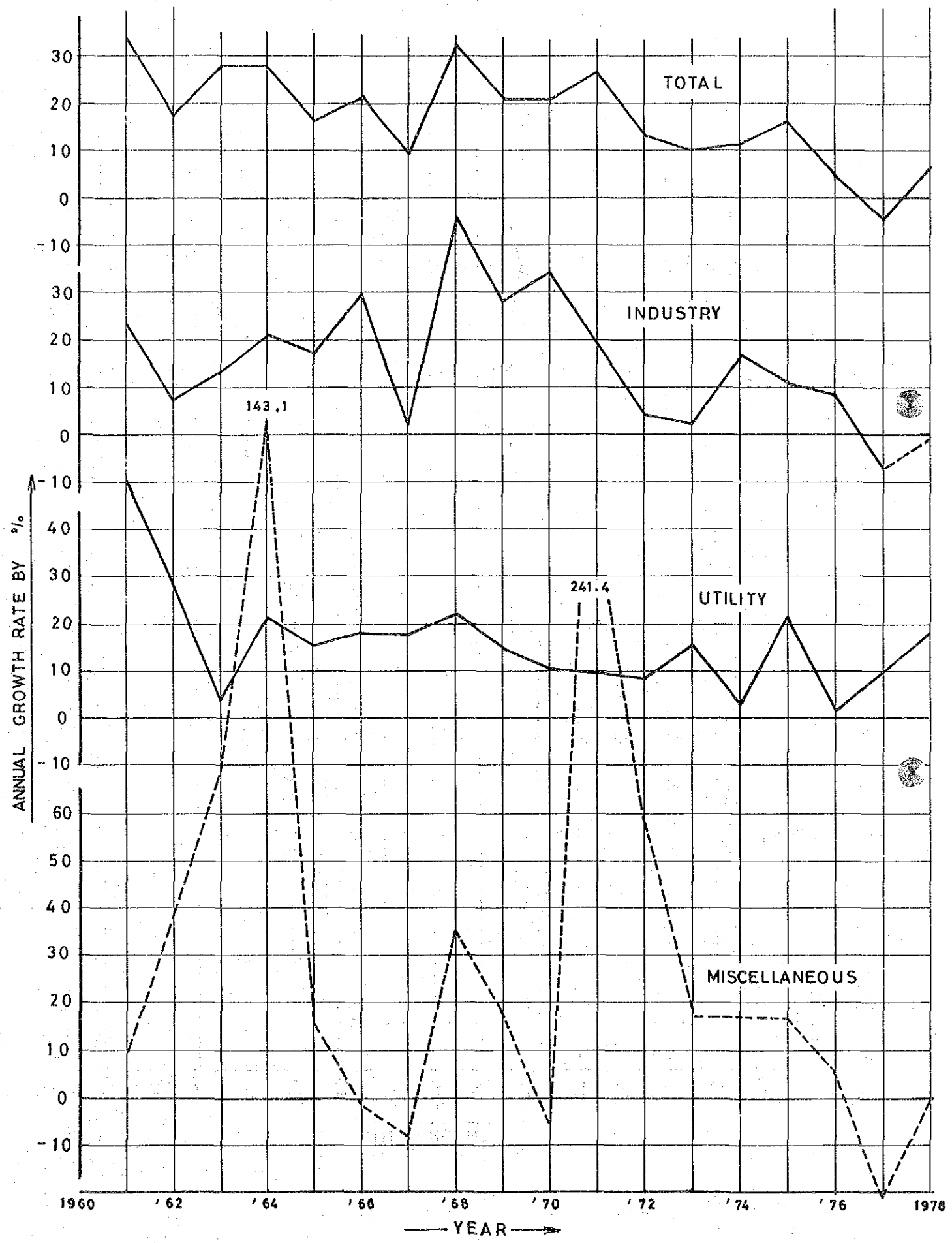


Fig. I - 3 Annual Growth Rate of Sectoral Energy Sales by MERALCO

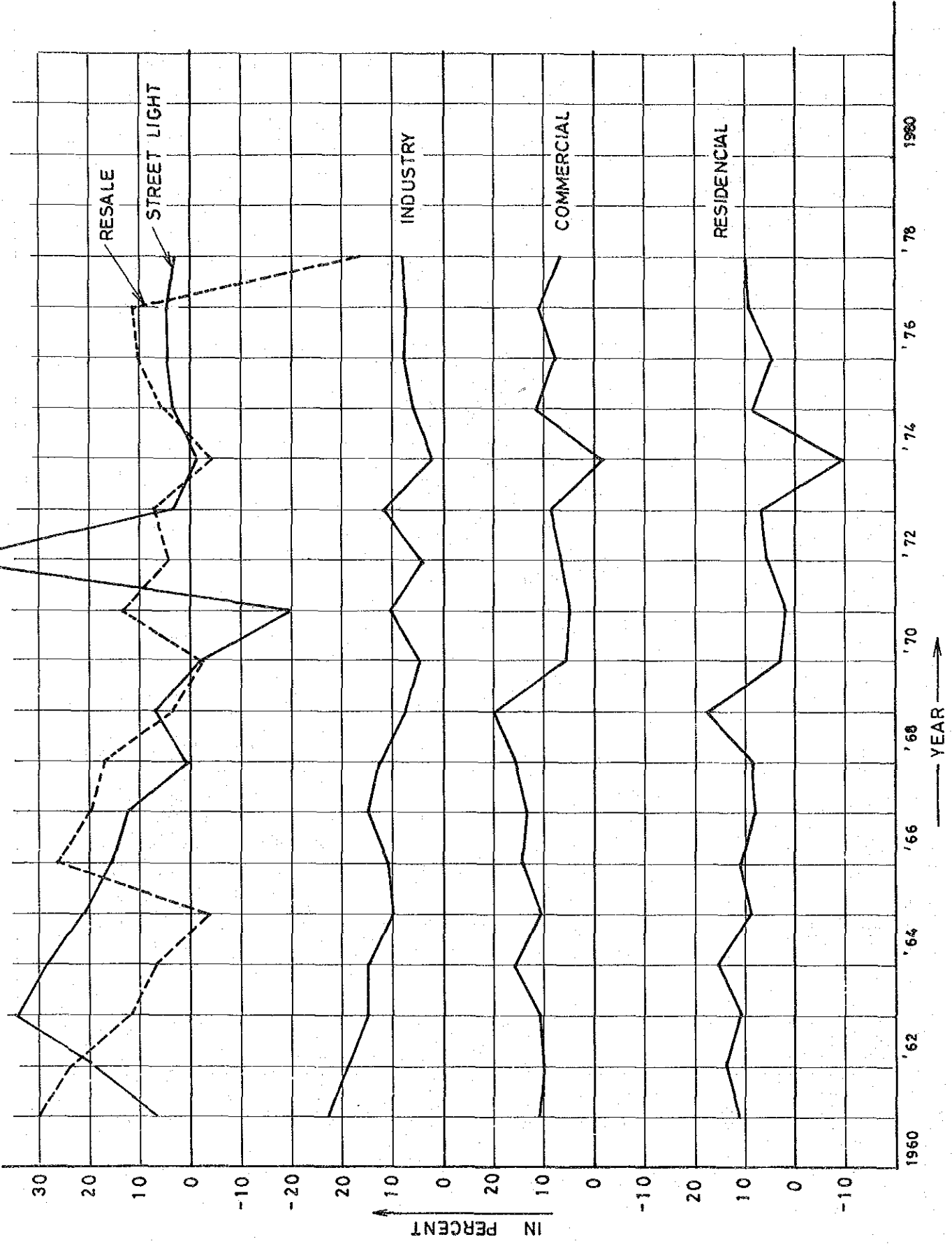
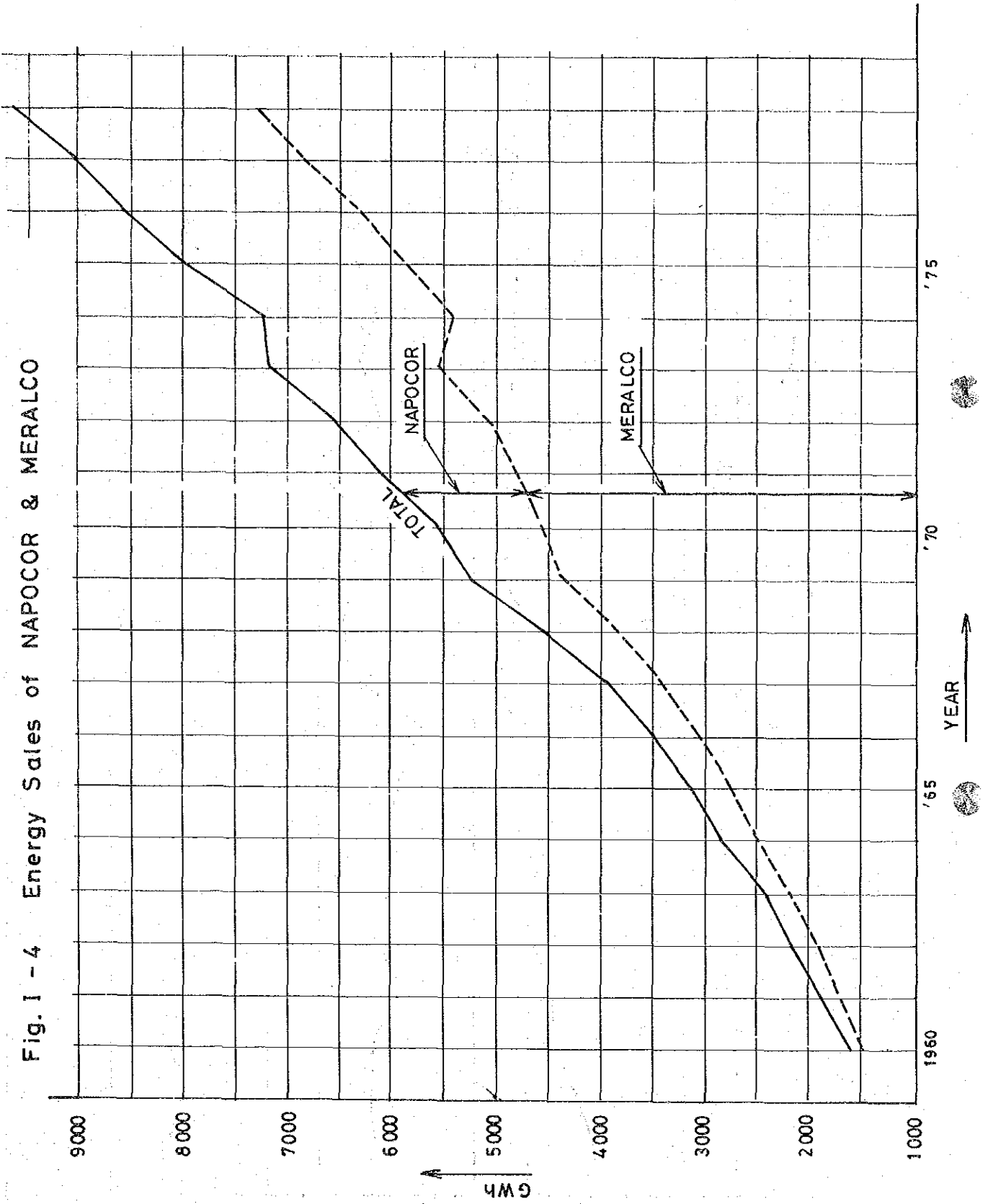


Fig. I - 4 Energy Sales of NAPOCOR & MERALCO



JICA