THE REPUBLIC OF THE PHILIPPINES

THE FEASIBILITY STUDY REPORT

ON

PLANT RENOVATION

(LUZON GRID TRANSMISSION SYSTEM)

MARCH 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

THE REPUBLIC OF THE PHILIPPINES

THE FEASIBILITY STUDY REPORT

ON

PLANT RENOVATION

(LUZON GRID TRANSMISSION SYSTEM)

MARCH 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

P R E F A C E

It is with great pleasure that I present this Feasibility Study Report on the Plant Renovation (Luzon Grid Transmission System) Project to the Government of the Republic of the Philippines.

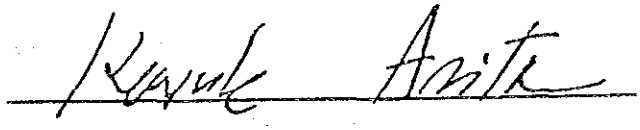
This report embodies the result of a series of field surveys carried out in Luzon from September to November, 1984 and in February, 1985 by a Japanese survey team commissioned by the Japan International Cooperation Agency following the request of the Government of the Philippines to the Government of Japan.

The survey team, headed by Mr. Yutaka MATSUMOTO, held close discussions on the Project with the officials concerned of the Government of the Philippines, conducted a wide-ranging field survey and has prepared this report.

I hope that this report will be useful as a basic reference for development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

March, 1985



Keisuke ARITA

President

Japan International Cooperation Agency

LIST OF CONTENTS

CONTENTS PAGE

CONTENTS PAGE

CONTENTS PAGE

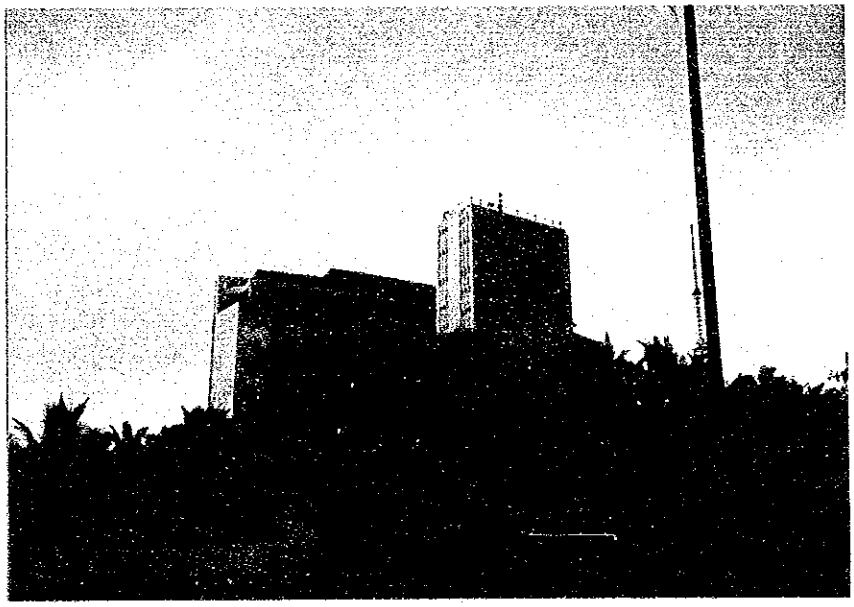
LIST OF FIGURE AND TABLE

(Figure)

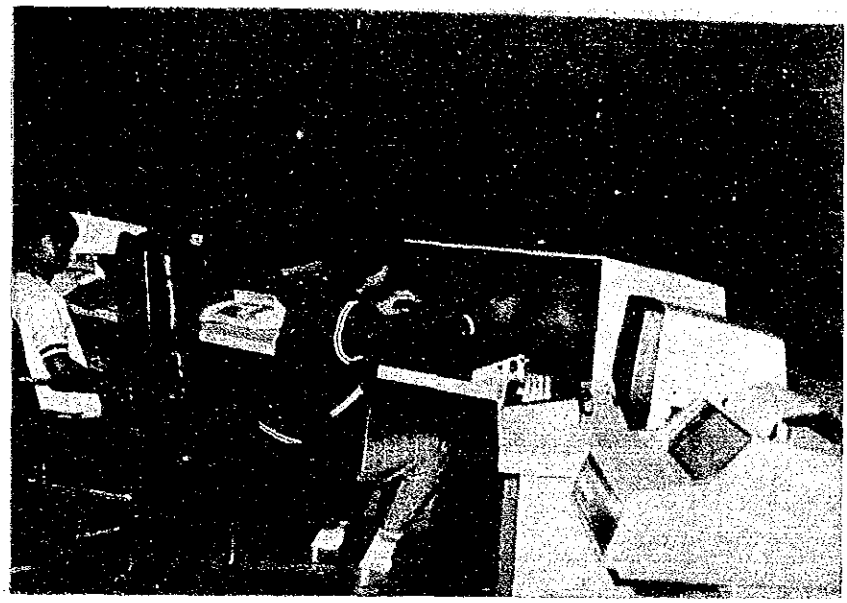
(Table)

PHOTOGRAPHES

NAPOCOR Head Office



MERALCO Head Office



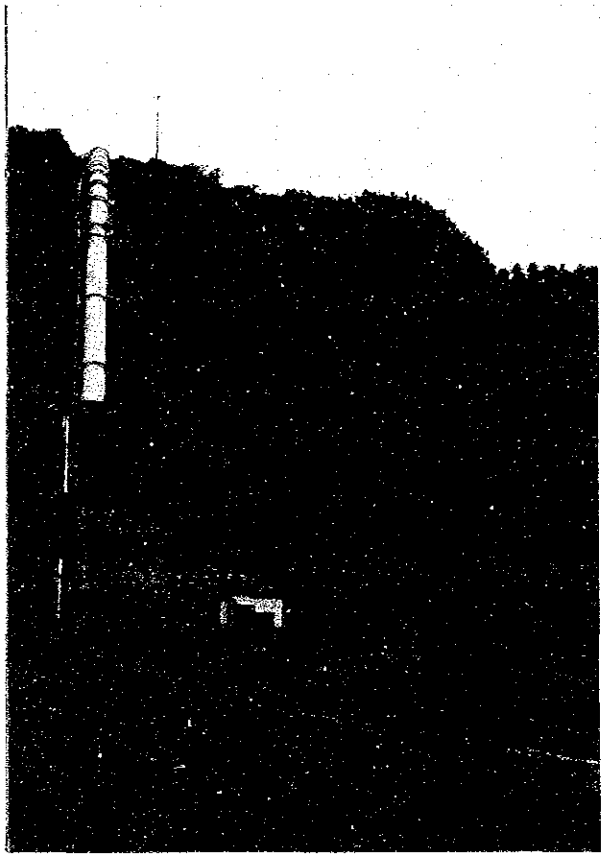
NAPOCOR P M C (Power management center)

MERALCO L D C (Load dispatching center)

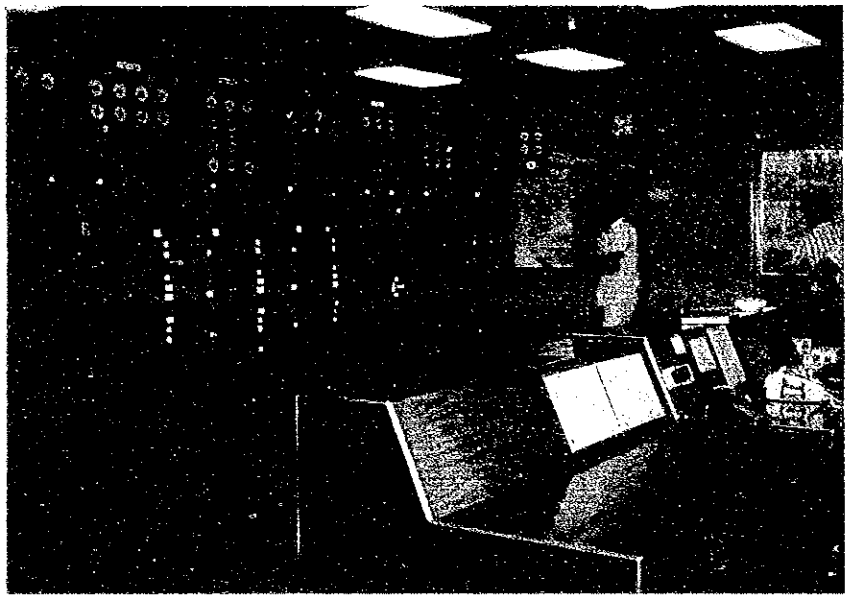
Magat Hydroelectric Power Plant

Angat Hydroelectric Power Plant

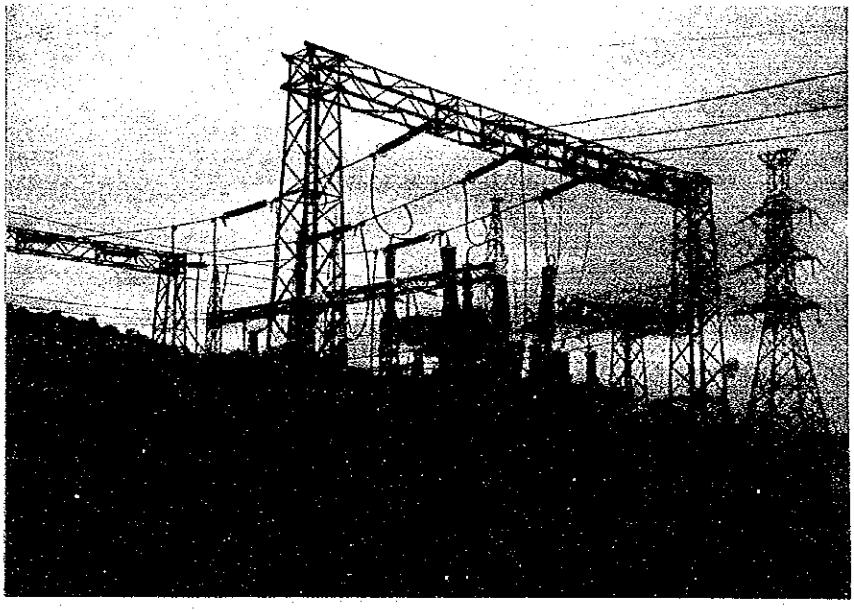
Mak-Ban Geothermal Power Plant



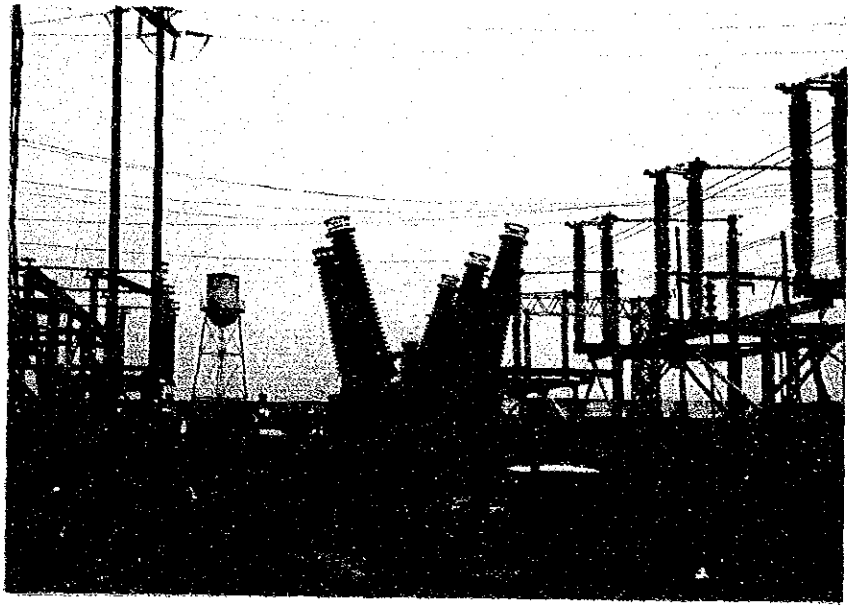
Kalayaan Hydroelectric Power Plant



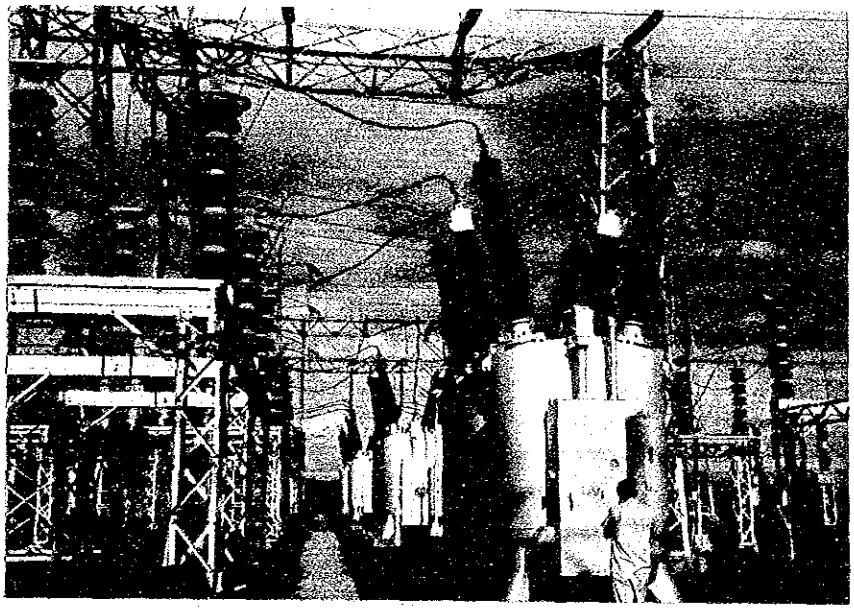
San Jose Substation Switch board



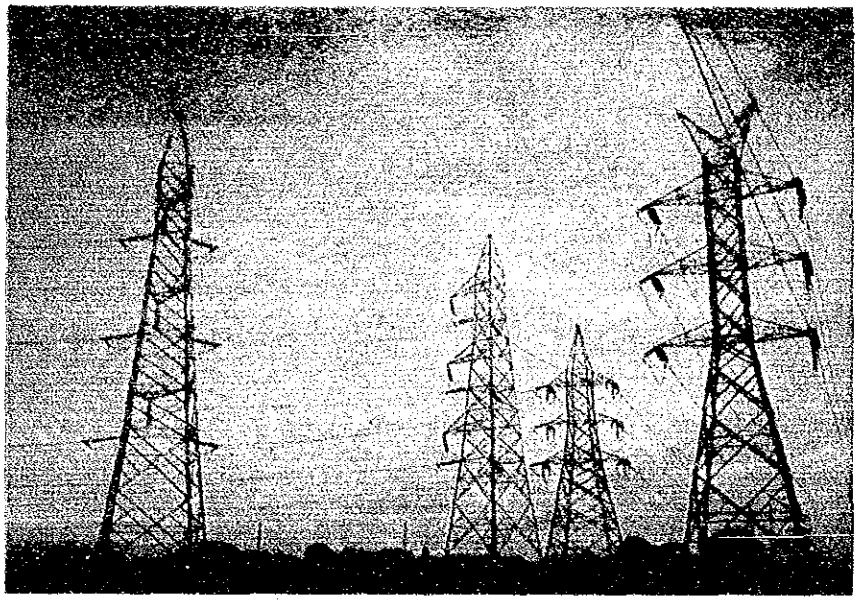
Bayombong Substation



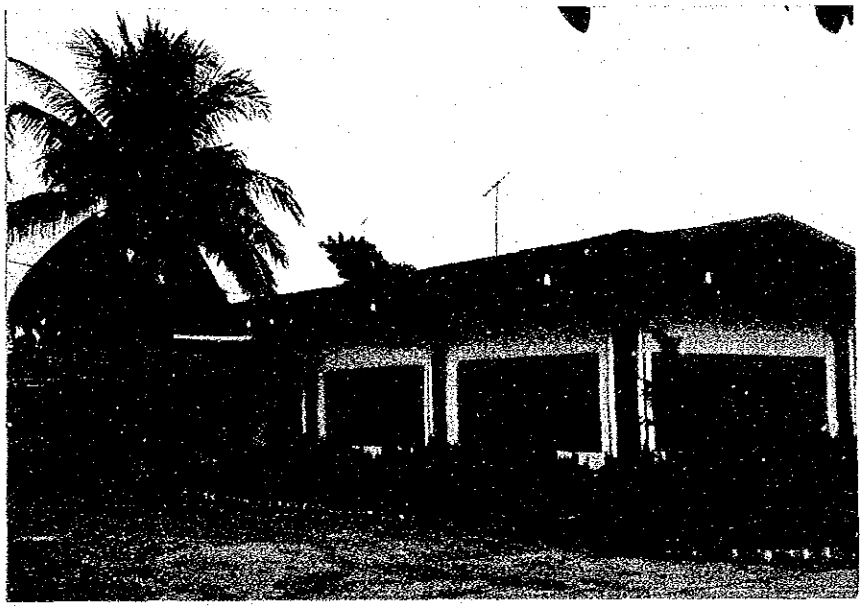
Balintawak Substation (MERALCO)
230 kV Yard Under Construction



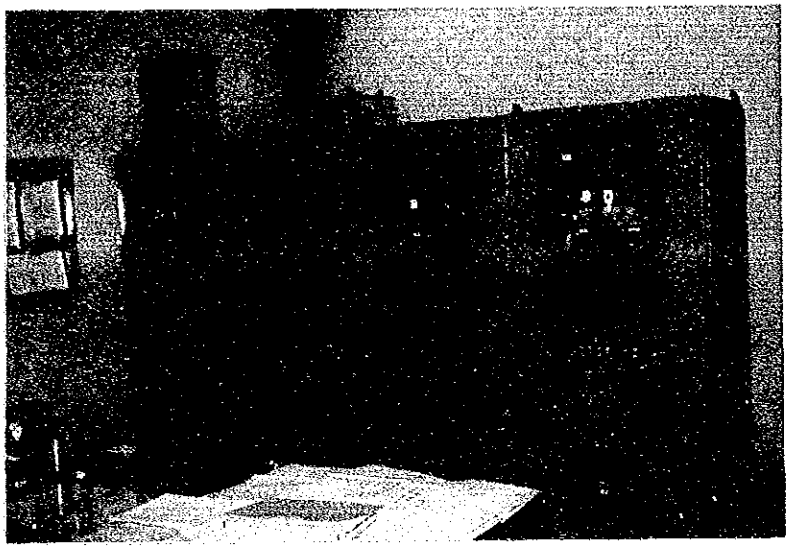
Mexico Substation
230 kV Oil Circuit Breaker



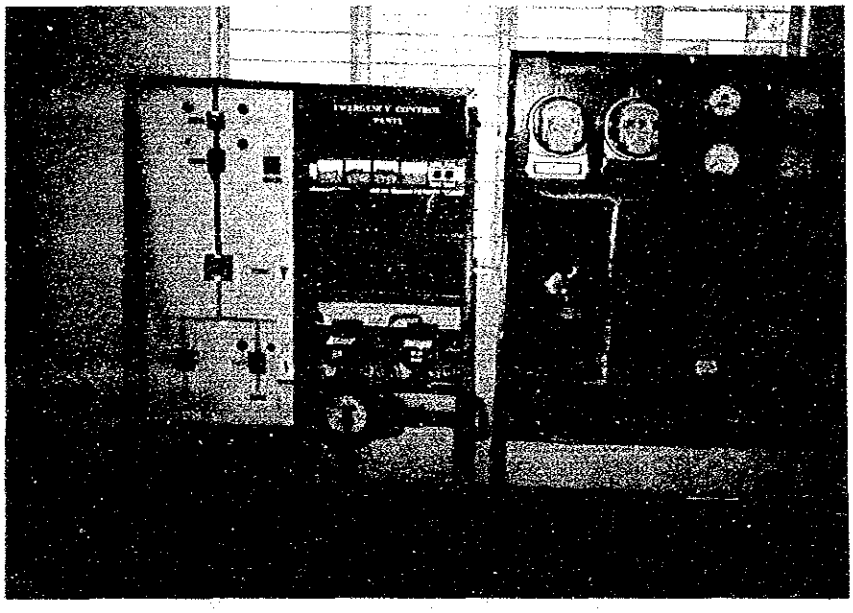
230 kV and 115 kV San Jose - Balintawak Line



Region Office of Southern Tagalog



BBC LZ Type Distance Relay



Training Mimic Panel

GLOSSARY

GLOSSARY

Unit of Measure	Unit	Symbol
Length	millimeter	mm
	centimeter	cm
	meter	m
	kilometer	km (10^3 m)
Area	square millimeter	mm^2
	square centimeter	cm^2
	square meter	m^2
	square kilometer	km^2 (10^6 m^2)
	Millenary circular mil	MCM (= 0.5067 mm^2)
Volume	cubic centimeter	cm^3
	cubic meter	m^3
Time	hour	h
	minute	min
	second	sec
Mass	gram	g
	kilogram	kg
Speed	meter per second	m/sec
Flow	cubic meter per second	m^3/sec

Unit of Measure	Unit	Symbol
Temperature	centigrade degree	$°C = \frac{5}{9}(°F - 32)$
	Fahrenheit degree	$°F = \frac{9}{5}°C + 32$
Pressure	kilogram per square centimeter	kg/cm^2
	millimeter of mercury	mmHg

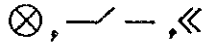
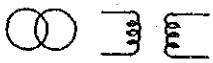
Electric Power	Unit	Symbol
Electric Energy	watt hour	Wh
	kilowatt hour	kWh (10^3 Wh)
	megawatt hour	MWh (10^6 Wh)
	gigawatt hour	GWh (10^9 Wh)
Electric Power	watt	W
	kilowatt	kW (10^3 W)
	megawatt	MW (10^6 W)
	gigawatt	GW (10^9 W)
Reactive Power	kilovar	kVar
	megavar	MVar
Apparent Power	kilovolt ampere	kVA
	megavolt ampere	MVA
	gigavolt ampere	GVA

Electric Power	Unit	Symbol
Voltage	volt	V
	kilovolt	kV
Current	ampere	A
	kilo ampere	kA
Frequency	herz	Hz
	kiloherz	kHz
	megaherz	MHz
	gigaherz	GHz
Inductance	microhenry	H
Rate	percentage	%

Currency	Unit	Symbol
	Yen	¥
	Philippine Peso	₱
	Million Peso	m₱
	US Dollars	US$

Exchange Rate 1 US$ = 240¥ = 14₱

Symbol

Line Trap (Blocking Coil)	
Circuit Breaker	
Disconnecting Switch	
Transformer	
Y Connection	
Delta Connection	
Coupling Capacitor	
Protective Relay	
Potential Transformer	
Current Transformer	
Lightning Arrester	
Power Line Carrier	
Line Tuning Unit	
Carrier Relaying Protection	
Automatic Exchange	
Rectifier	
Battery	

Abbreviation

IBRD	International Bank for Reconstruction and Development
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
MERALCO	Manila Electric company
NAPOCOR	National Power Corporation
NEA	National Electrification Administration
OECF	Overseas Economic Cooperation Fund in Japan

Economic Terms

C/A	Contract Agreement
CY	Calendar year
CIF	Cost, Insurance and Freight
E/L	Export Licence
FC	Foreign Currency
FOB	Free on Board
FY	Fiscal Year (from January to December in Philippines)
GDP	Gross Domestic Product
GNP	Gross national Product
IP	Implementation Program
IRR	internal Rate of Return
L/A	Loan Agreement
L/C	Letter of Credit
LC	Local Currency

Technical Terms

ACSR	Aluminium Cable Steel Reinforced Conductor
BC	Blocking Coil
BIL	Basic Impulse Insulation Level
ch	Channel (Telecommunication line)
CB	Circuit Breaker
cct	Circuit
CCPD	Coupling Capacitor Potential Device
DC	Direct Current
D/L	Distribution Line
DWT	Dead Weight Ton
EL	Elevation Level (meter)
EX	Automatic Exchange
FM	Frequency Modulation
GL	Ground Level
GT	Gross Ton
HAL	Hard-drawn Aluminum Conductor
HV	High Voltage
LV	Low Voltage
LT	Line Trap
LTC	Load Tap Changer
LTU	Line Tuning Unit
MCR	Maximum Continuous Rating
MV	Medium Voltage
OCB	Oil Circuit Breaker
OLTC	On Load Tap Changer
P/S	Power Station

SF_6	Sulfur Hexafluoride
S/S	Substation
SSB	Single Side Band
SVR	Step Voltage Regulator
PD	Condenser Type Potential Divider
PLC	Power Line Carrier
T/L	Transmission Line
Tr.	Transformer
UHV	Ultra High Voltage
VHF	Very High Frequency
WHM	Watt Hour Meter

Definition

Load Factor:

The ratio of the average load over a designated period to the peak load occurring in that period

Available Capacity:

The load carrying ability for the time interval and period specified when related to the characteristics of the load to be supplied. Available capacity of a station is determined by such factors as capability, operating power factor and portion of the load which the station is to supply.

Plant Efficiency:

The ratio of the energy delivered from the station to the energy received by it under specified conditions.

SUMMARY

CONTENTS OF SUMMARY

1. Background and Purpose of the Study

Following the completion of north and south interconnection of the Luzon Grid transmission system in 1983, the total blackout faults occurred on three occasions in 1983 and two occasions in 1984.

Recognizing the seriousness of the social and economic impacts of the total blackout fault, the Government of the Republic of the Philippines requested the Government of Japan to promptly undertake a study and to have the necessary measures to solve the problems of the power system.

The present study is in response to this request and is aimed to conduct a fact-finding survey on power demand, actual state and operation of power facilities and investigate the causes of total blackout faults in the Luzon Grid power system and then to analyze and evaluate the findings comprehensively to recommend the necessary measures for solution of the problem of total blackout faults.

2. Process of the Study

With the above-mentioned background, the Japan International Cooperation Agency (JICA) organized a study team and sent it to the Philippines. The study team conducted a field study during the period from September 18 to November 1, 1984. On returning to Japan, the study team reviewed and analyzed the data collected in the Philippines and summarized the results of its study in the present Feasibility Study Report for the Renovation Plan (Luzon Grid Transmission System).

The work schedule of the study team is as shown in Table-1.

Table 1 Work Schedule of Study Team (Actual)

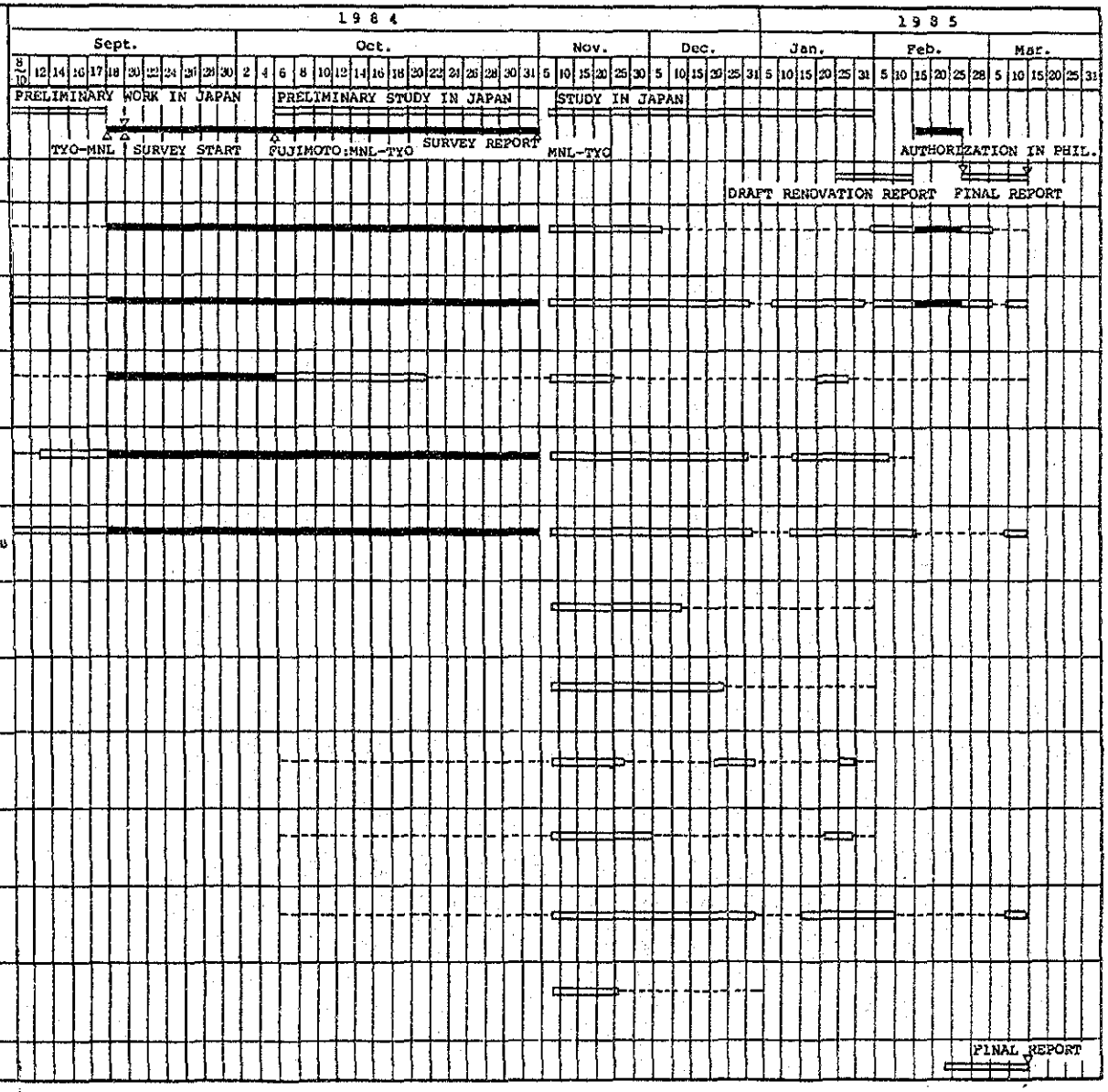
WORKS IN PHILIPPINES :
WORKS IN JAPAN :
CONCURRENT WORKS :

THE REPUBLIC OF THE PHILIPPINES

(1984) FEASIBILITY STUDY FOR THE PLANT RENOVATION PROJECT

(LUZON GRID TRANSMISSION SYSTEM)

	NAME	ASSIGNMENT
Field study in the Philippines and works in Japan	YUTAKA MATSUMOTO	Team leader, overall supervision, protective system and devices
	HIROYUKI YOSHIDA	Power supply demand forecast and system operation
	TATSUO FUJIMOTO	Business analysis
	KAZUO CHIJIWA	System operation
	TSUNEMASA FUKUDA	Power stations and substations
Works in Japan	TORU SHIBAYAMA	Transmission lines
	SADAYOSHI TAKAGISHI	Control and communication system
	YOSHIYASU JITSUFUCHI	System analysis
	YUTAKA YAMASHITA	Protective devices
	NOBUO MARUTA	Load dispatching facilities
	ZENGO NAKASHIMA	Substations



3. Organization and Itenerary of the Study Team

3-1. Organization

The organization of the study team is as follows.

Leader:	YUTAKA MATSUMOTO; WESTJEC	- Overall supervision; protective devices and systems
Member:	HIROYUKI YOSHIDA; WESTJEC	- Demand-supply planning and system operation
Member:	TATSUO FUJIMOTO; WESTJEC	- Business analysis
Member:	KAZUO CHIJIWA; WESTJEC	- System operation
Member:	TSUNEMASA FUKUDA; WESTJEC	- Power plant and substation facilities

3-2. Itinerary

The itinerary of the study team were as follows.

		Departure	Return
Y. MATSUMOTO:	(1st Time)	Sept. 18, 1984	Nov. 1, 1984
	(2nd Time)	Feb. 17, 1985	Feb. 23, 1985
H. YOSHIDA :	(1st Time)	Sept. 18, 1984	Nov. 1, 1984
	(2nd Time)	Feb. 17, 1985	Feb. 23, 1985
T. FUJIMOTO :		Sept. 18, 1984	Oct. 4, 1984
K. CHIJIWA :		Sept. 18, 1984	Nov. 1, 1984
T. FUKUDA :		Sept. 18, 1984	Nov. 1, 1984

3-3. Counterparts

The study team worked with the following counterparts of NAPOCOR and MERALCO.

NAPOCOR:

Sr. Vice-President	C.D. Del Rosario
Chairman of NPC Tech. Committee	J.U. Jovellanos
Chairman of Task-Force Director of System Operation Dept.	F.T. Delgado
Vice Chairman of Task-Force	M.R.B. Pascual
	C.C. Claudio
	F.C. Leynes
	M.C. Baile

MERALCO:

Assistant Vice-President and Head Technical Planning Dept.	V.C. Flordeliza
Assistant Vice-President and Head Operation Dept.	O.G. Valenzuela

4. Summary of Study Results

4-1. General Situation of Republic of the Philippines

(Chapter 1 of the Text)

The Republic of the Philippines comprises more than 7,000 islands of various sizes with a total area of 300,000 km^2 and a population of 53 million (in 1984). Luzon island is 100,000 km^2 in area (33%) and has a population of 29 million (55%). The Philippines is politically divided into 12 regions and Metro Manila special district, but is generally regarded to consist of three areas of Luzon, Mindanao and Visayas comprising a number of islands

located between Luzon and Mindanao.

The growth rate of real GDP in the 1980s was 6.2% but decreased in early 1980s and is expected to show a negative growth rate in 1984. Recently, the consumer price index has increased at a very high rate of nearly 50%, and unemployment is also at a high rate of 4.6% in 1984.

4-2. Power Situation in the Philippines (Chapter 2 of the Text)

The power industry of the Philippines is shared by NAPOCOR which manages power generation and transmission, MERALCO which manages power distribution, Electric Cooperatives (under NEA) and small scale public and private power distribution companies. The energized rate of the country is 53% at the end of 1983.

The actual and forecast demand of NAPOCOR are as shown below. The demand dropped sharply in 1984 owing to the economic recession but is expected to recover gradually thereafter. (Refer to Table 2)

	Area	1983	1984	1995	Average Annual Growth Rate (%)	
					1983-1984	1983-1995
Energy Sales (GWh)	Philippines	17,089	16,429	32,507	- 3.9	5.5
	Luzon	13,908	12,517	22,222	-10.1	4.0
	Luzon/ Philippines (%)	81	76	68	-	-
Peak Demand (MW)	Philippines	3,117	2,961	5,737	- 5.0	5.2
	Luzon	2,478	2,220	3,939	-10.4	3.9
	Luzon/ Philippines (%)	79	75	69	-	-

The power expansion programs in the past placed emphasis mainly on the development of hydro and geothermal power in line with the national policy to make effective use of domestic resources but the future plans contemplate the development of coal-fired and

nuclear power as shown below. The power expansion program for Luzon is shown Table 3 and Fig. 1.

(In MW)

Area	Year	Hydro	Oil-fired	Geo-thermal	Coal-fired	Nuclear	Total
Philippines		(31.3)	(52.0)	(15.7)	(1.0)		(100)
	1983	1,564	2,603	784	50		5,001
		(33.7)	(28.1)	(14.2)	(16.7)	(7.4)	(100)
	1995	2,832	2,364	1,192	1,405	620	8,413
	Increase	1,268	- 239	408	1,355	620	3,412
Luzon		(28.8)	(57.1)	(14.1)			(100)
	1983	1,126	2,230	550			3,906
		(27.9)	(32.9)	(13.2)	(15.4)	(10.6)	(100)
	1995	1,629	1,925	770	900	620	5,844
	Increase	503	- 305	220	900	620	1,938

The backbone transmission systems are 230 kV transmission lines in Luzon and 138 kV transmission lines in other areas. The total length of 230 kV transmission lines is more than 3,000 km at the end of 1983.

MERALCO is a private company which manages power distribution in and around Metro Manila. The secondary transmission system in Metro Manila is a 115 kV transmission network.

The power demand of MERALCO accounts for 61% of the total for the Philippines.

MERALCO has a total of 5,700 employees.

4-3. National Power Corporation (Chapter 3 of the Text)

The National Power Corporation (NAPOCOR) is a public corporation dedicated for the management of power generation and transmission systems of the Philippines, and the scope of its activities is determined by the National Power Committee. NAPOCOR was founded in 1936.

Table 2 Load & Demand Forecast Made in June 1984

		1983	1984	1985	1986	1987	1988	1989	1990	1995
Energy Sales (GWh)										
	Philippines	17089	16429	17624	19059	20396	21508	23054	24604	32507
	Luzon	13908	12517	12768	13278	13942	14779	15665	16605	22222
	Visayas	933	1246	1713	2123	2219	2315	2510	2577	2919
	Mindanao	2248	2666	3143	3658	4235	4414	4879	5422	7366
Demand (MW)										
	Philippines	3117	2961	3122	3362	3619	3837	4096	4356	5737
	Luzon	2478	2220	2263	2354	2471	2619	2776	2943	3939
	Visayas	229	303	349	397	413	434	460	471	529
	Mindanao	410	438	510	611	735	784	860	942	1269

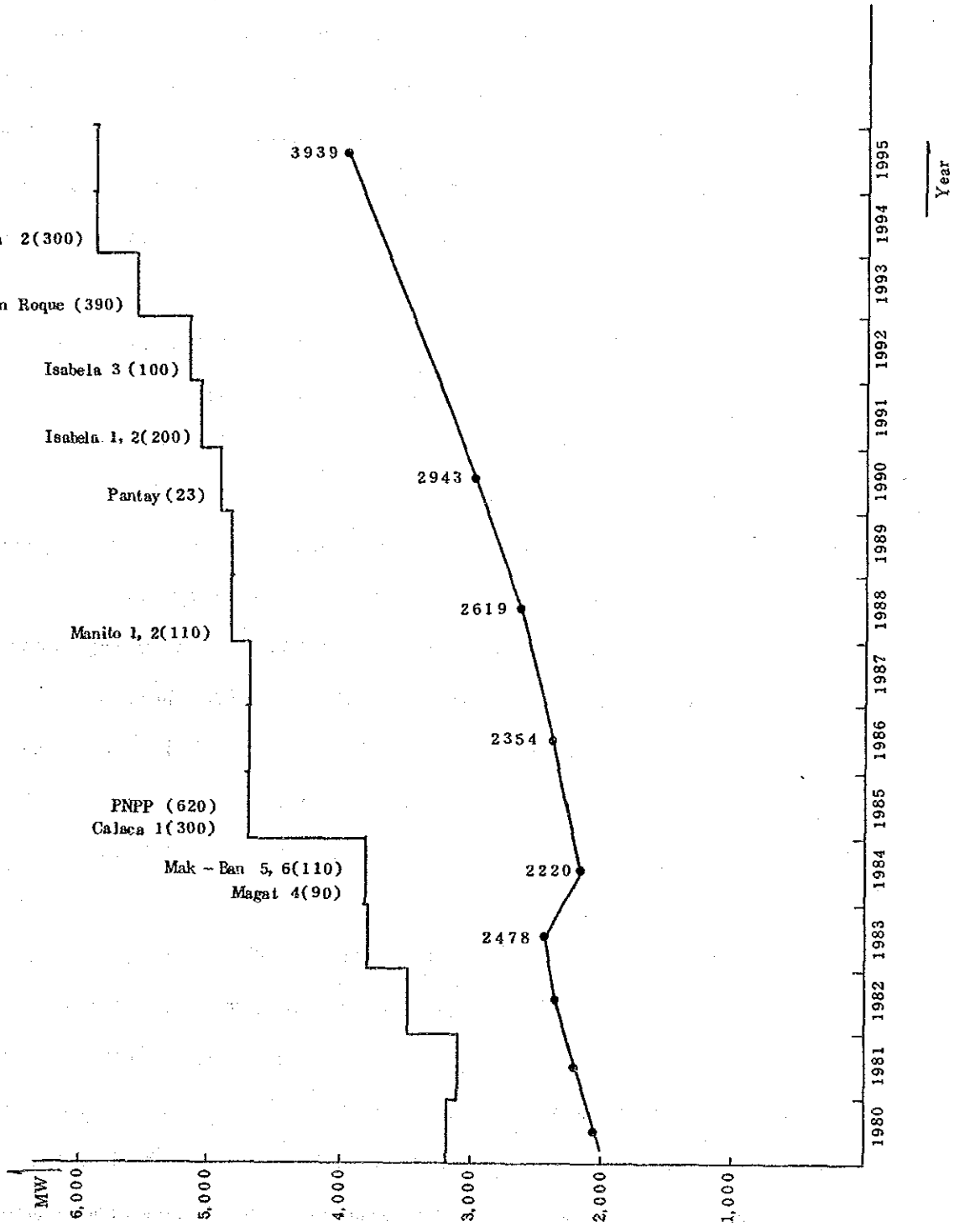
Note : 1983 Actual , 1984 ~ 1990, 1995 Estimates.

Table 3 Power Expantion Program

Unit : MW

Grid	Type	Plant	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Luzon	Hydro	Magat 4	90											
		Pantay							23					
		San Roque										390		
	Coalthermal	Calaca I		300										
		Isabela 1,2								200				
		Iaabela 3									100			
		Calaca II											300	
	Geothermal	Mak-Ban 5,6	110											
		Manito 1,2					110							
	Nuclear	PNPP		620										
	Oilthermal	Rockwell	△305											
		Additional	△105	920			110		23	200	100	390	300	
		Existing	3906											
		Total	3801	4721	4721	4721	4831	4831	4854	5054	5154	5544	5844	5844

Fig. 1 Peak Demand Forecast and Power Expansion Program



For organizational structure, NAPOCOR has under its president five departments - Finance & Administration, Engineering, Utility Operation of Luzon, Utility Operation of Visayas & Mindanao and PNPP (nuclear power plant) Construction Office. Its local organizations include Regional Centers, Area Offices and Technical Services. The total number of employees is 12,000, of which 52% belong to the utility operation departments and 34% to the engineering department.

The power rate of NAPOCOR is set close to the production cost in accordance with its non-profit making policy and was set at 0.5790 Peso/kWh (on the average) in 1983. However, the power rate varies greatly according to the area and the rate in 1983 was 0.6152 Peso/kWh in Luzon, 0.7235 Peso/kWh in Visayas and 0.2996 Peso/kWh in Mindanao. The power rate increased during the 1975-1983 period at an average annual rate of 24.2%. An average annual increase rate of 45.7% is planned for the 1983-1985 period.

For main management indexes of NAPOCOR for 1983, the ratio of net worth was 32.2%, profit ratio of sales 6.4%, the rate base profit ratio 8.2% and per employee productivity 1,470 MWh/employee.

4-4. Outline of Total Blackout Faults (Chapter 4 of the Text)

Interconnection of the 230 kV transmission lines between San Jose, Dolores and Malaya was completed in 1983. However, three total system blackouts occurred in series in 1983 since August and a prolonged system blackout occurred in March and September 1984.

Fig. 2 shows a power transmission network in and around Metro Manila. In each case of blackouts in 1983, a power of more than 600 MW was flowing from Malaya side to Dolores and San Jose

substations prior to the occurrence of blackout. The faults occurred in each of the Malaya-Kalayaan section, the Dolores-Malaya section and the San Jose-Dolores section. With the expansion of the fault-affected area, the luzon Grid transmission system was separated into two groups, the system south of Kalayaan and the system north of Malaya. The latter experienced a shortage of generating capacity amounting to 1,000 MW, while the former had an excess generating capacity of more than 1,000 MW, thereby causing a total system blackout.

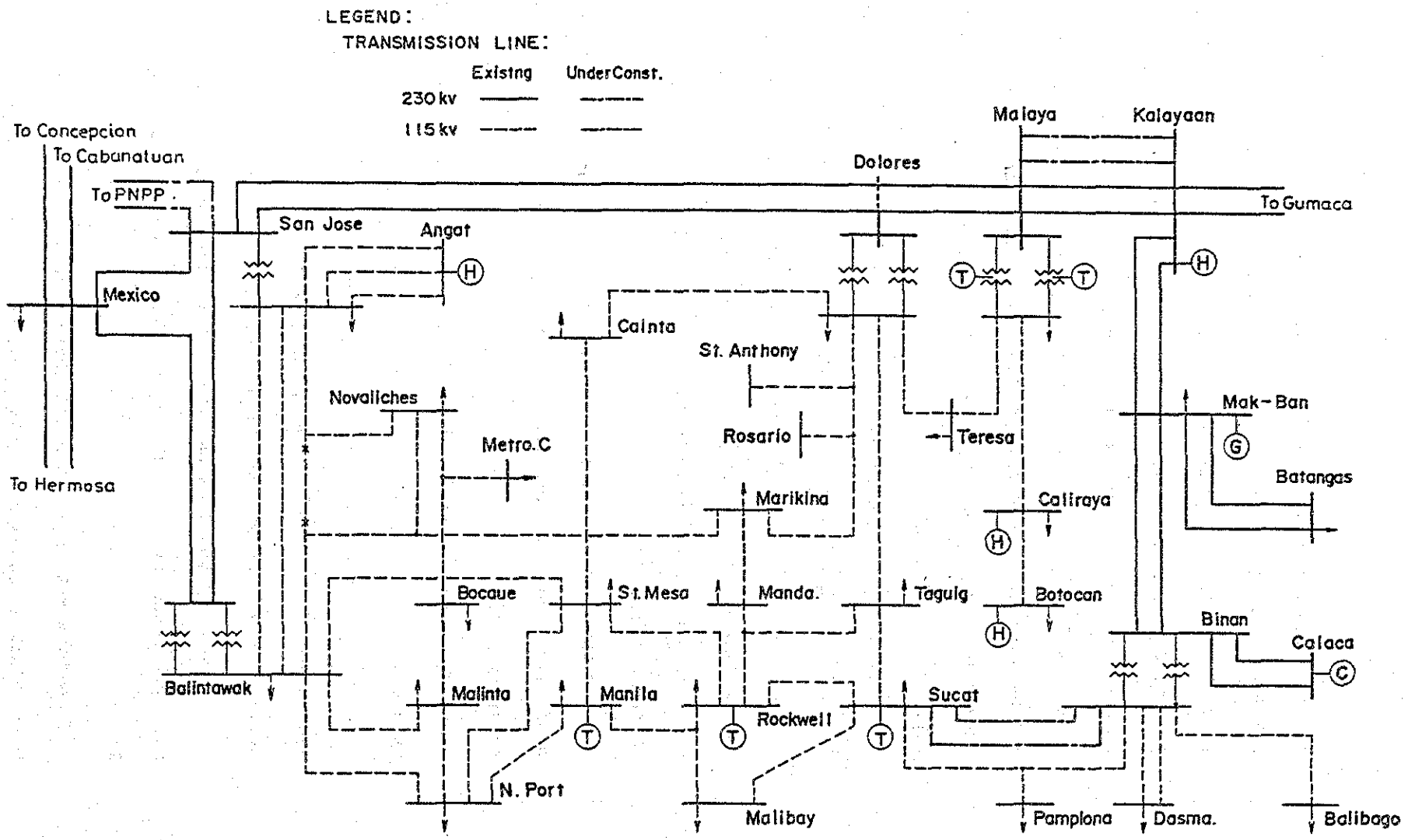
For the system blackout in March 1984, the root cause was a fault in the San Jose-Balintawak 230 kV line. Then the 115 kV line in the same section tripped due to overloads. This caused a shift of the greater portion of the load in Manila to Dolores substation, which eventually tripped due to overloads, thereby inducing a total system blackout.

In the case of blackout in September 1984, one unit of Malaya power plant was feeding the 115 kV transmission line to Dolores substation for trial operation of Calaca power plant. At that time, the power flow in the Kalayaan-Malaya section had already exceeded 500 MW. A fault occurred first in the Kalayaan-Malaya section, tripping two circuits. A power swing occurred in the system and when the power swing was almost over, Malaya power plant dropped out of the system, thereby causing a total system blackout.

In each of these cases, the system blackout occurred following the occurrence of a fault in the heavy power flow transmission lines.

NAPOCOR set up a Technical Investigation Committee for each of these blackout cases for working out corrective measures and

Fig. 2 Single Line Diagram of the Grid In and Arownd Metro Manila



actions have already been initiated for nine items of corrective measures.

4-5. Luzon Grid System (Chapter 5 of the Text)

a. The present backbone systems of the Luzon Grid are 230 kV ACSR 795 MCM 2-circuit transmission lines of the following routes (Refer to Fig. 3).

(1) North system extending from north hydro power plants and Bataan thermal power plant to San Jose substation.

(2) Metro Manila outer link system of the San Jose--Dolores--Malaya--Kalayaan--Mak-Ban--Binan lines.

(3) South system extending from Tiwi power plant to Kalayaan power plant

Of these routes, only the San Jose--Dolores--Malaya route is a four-conductor transmission line and others are single-conductor transmission lines.

Future plans are as follows.

1984: (1) Four-conductor two-circuit Malaya--Kalayaan line

(2) Two-conductor two-circuit Binan--Sucat line (115 kV operation at the initial stage)

1985: (1) Pi connection of two circuits at Dolores substation

(2) Two-conductor two-circuit Hermosa--San Jose line

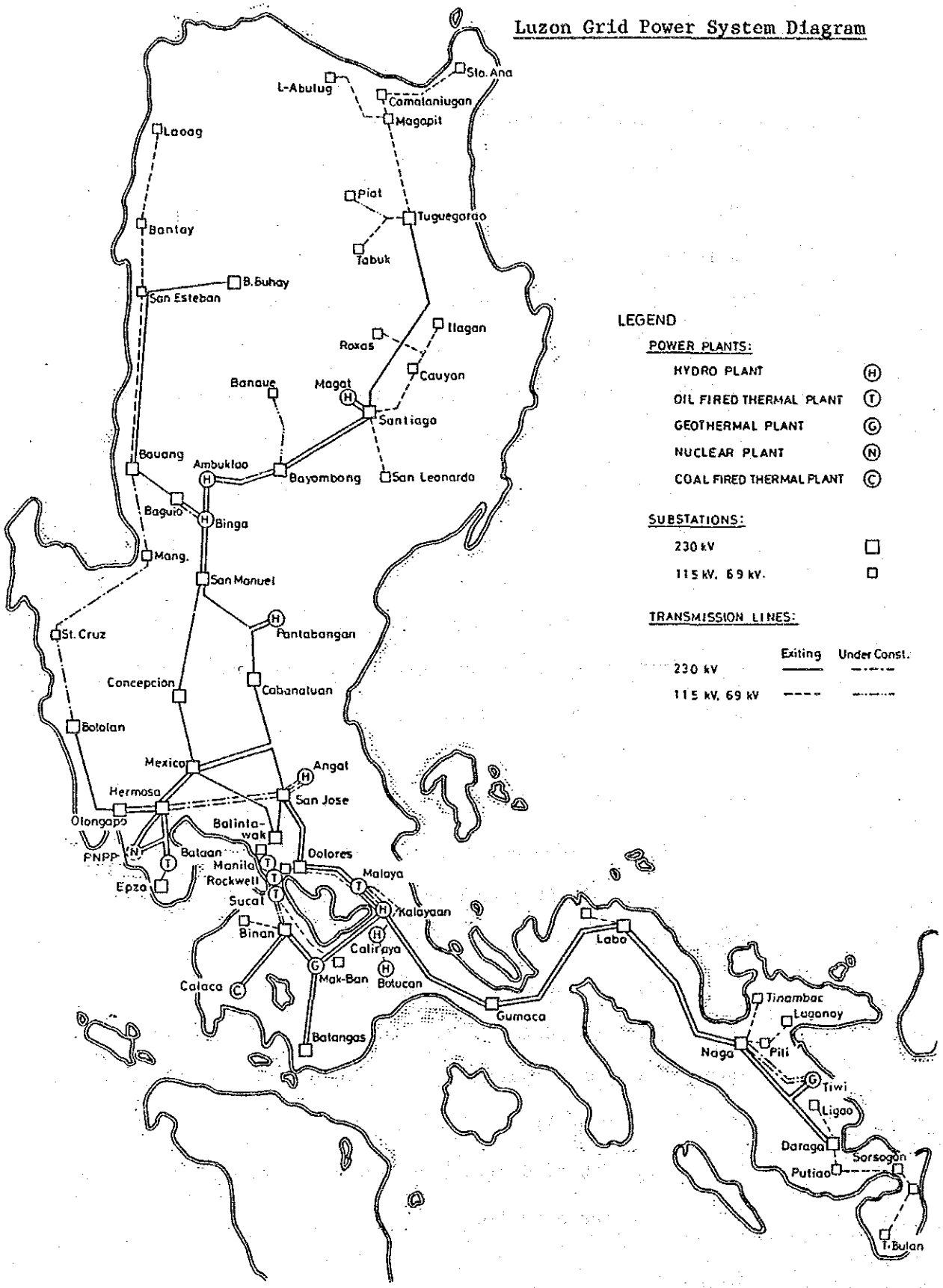
(3) Two-conductor two-circuit Tiwi--Naga line

1987: (1) 500 kV design four-conductor two-circuit Kalayaan--Naga line

(2) 500 kV design four-conductor two-ciucuit Kalayaan--San Jose line

Fig. 3

Luzon Grid Power System Diagram



b. The present communication system consists of microwave system and power line carrier communication system (PLC). The microwave system extends to Baguio substation in the north and Kalayaan power plant in the south, linking main power plants and substations. PLC is provided in each section of the 230 kV transmission lines.

c. The operation of the power system is directed by the Power Management Center (PMC) of NAPOCOR, but the data transmission system is not yet completed and is still in the stage of adjustment. System operation is provided in accordance with the system operation procedures (SOP) and also the emergency SOP.

d. Protective system is a combination of distance relay and PLC, which transmits a trip signal by under reach mode.

4-6. Study of Problems with the Luzon Grid and Remedial Measures (Chapter 6 of the Text)

The problems of the Luzon Grid System as revealed by the review and study of the past system blackouts and the analysis of future system composition, as well as the corrective measures, are summarized in the following.

a. Facilitation of Land Acquisition

b. Substantiation of Technical Training

c. Improvement of Maintenance Work

d. Problems of System Planning

e. Problems of System Operation

(1) Coordination in the operation of 115 kV system of MERALCO and 230 kV system of NAPOCOR

(2) Loop operation of 115 kV system of MERALCO

(3) Emergency system operating procedure

(4) Abnormal voltage rise on independent operation or test charging of long distance transmission lines

f. Problems of Protective Relays

g. Replacement of Obsolete Equipment

h. Improvement of Stability of North System

(1) Early construction of Bauang--Labrador--St. Cruz--Olongapo transmission line

(2) Adoption of transfer trip system for Magat power plant

(3) Pi connection of two circuits at Bayombong substation

i. Reinforcement of the San Jose--Balintawak transmission line

j. Expansion of microwave communication system

4-7. Computer Analysis of Power System and Problems to be Considered (Chapter 7 of the Text)

Analysis was made with computer of the Luzon Grid Transmission System (230 kV and 115 kV systems) with respect to system power flow, voltage and stability.

Calculations were made for the following and the results were reviewed.

a. Sixteen cases of operating conditions differentiated by season, PNPP on or off, day or night for study of system power flow and voltage.

b. Five cases of fault of main 230 kV transmission lines for study of system stability.

The main points revealed by analysis are as follows.

a) Power Flow and Voltage

(1) When there is a fault in one circuit of the San Jose--Balintawak 115 kV line, the power flow exceeds the capacity of the remaining one circuit.

(2) With the commissioning of PNPP, Magat hydro power plant and Calaca coal-fired power plant, the existing thermal power plants in Metro Manila will have to be stopped more frequently for the purpose of maintaining demand-supply balance. As a result, a reactive power of about 270 MVA will be required for a voltage regulation.

(3) With the increase of load in the Mak-Ban--Binan 230 kV line, there will be an increase of power flow year by year. This line needs to be expanded in the capacity.

b) System Stability

(1) The north hydro power plants become unstable in the event of a tripping of the San Manuel--Conception 230 kV line. Such measures as reinforcement of the 230 kV transmission line, transfer tripping of generating units of Magat power plant and adoption of high speed reclosing system should be considered.

(2) Detailed studies should be made in the future for solution of such problems as overcurrent in the unaffected transmission lines immediately after system fault and overvoltage of transmission lines during restoration effort following the system fault.

4-8. Renovation Plans (Chapter 8 of the Text)

a. Basic Idea for Renovation Plan

A power system is composed of generating power plants, thermal power plants, geo-thermal plants, hydro power plants, pumping up plants and nuclear power plants, and extra high voltage transmission lines and substations which link consumers and power plants, and organically operated as an union. As the load demand grows, the power system adopts a bigger unit size of generator, extra high voltage for transmission lines and substations, and long distance transmission lines year by year. Because the power system expands more complicated one, the establishment of higher control technics and a suitable protecting system becomes the urgent task for the system operation.

Not only the facilities in the power system, generators, transmission lines and substations, should be operated in the best condition each, but in addition, the power system should be operated as a whole system to serve consumers with a reasonable service level on voltage, frequency and reliability. The power system which should be met with the ever growing demand should be expanded with a suitable coordination between each facility and should be a flexible arrangement for its operation.

To eliminate a total blackout fault in the Luzon Grid system, it is necessary to execute the immediate corrective measures which are designed to renovate the existing system considering its future expansion plan. However, without the survey and study on the basic planning methods for long and

medium term plan and on the organization for the maintenance system, the works of immediate corrective measures could not fully be useful for the improvement of the stability of the system.

Therefore, the engineering services which support the study and survey for the planning methods on the operation and maintenance of system as the basic data for Phase 2, - medium term plan -, and for Phase 3, - long term plan 1 -, are one of the main works as well as the execution of the construction works during Phase 1, - immediate corrective measures -.

The renovation plan is divided in the following three Phases up to 2000, each plan should be executed to maintain the system in a reliable condition.

Phase 1. Immediate corrective measure (1985...1987)

The immediate corrective measures include the corrective measures to eliminate a total black-out fault in the power system up to 1987. In the plan, the study and survey for the renovation plan on the basis of medium and long term forecast also should be included.

Phase 2. Medium term plan (1988...1990)

The additional renovation plan for the improvement of reliability of the system should be executed in medium term plan from 1988 to 1990. and also, the study and survey for long term plan should be done in the plan.

Phase 3. Long term plan (1990...2000)

The plan should include the plan for construction and operation in order to fulfill the criteria for the power system operation which are shown in the following section and to maintain the high service level.

Specially, during Phase 1, the basic study for planning should be prepared with the assistance of a consultant and immediate corrective measures should be systematically designed considering future expansion vision for the establishment of stabilized system operation.

4-9. Immediate Corrective Measures (Chapter 9 of the Text)

Improvement of training system, implementation of urgent construction programs and provision and improvement of equipment and facilities as described below should be considered.

a. Improvement of Emergency System Operating Procedure

b. Establishment of the Training System for maintenance and Operation Engineers

c. Improvement of System Stability

   (1) Reinforcement of the San Jose--Balintawak transmission line

   (2) Pi connection of two circuits at Bayombong substation

d. Improvement and Expansion of Equipment and Protective Devices

   (1) Installation of Phase comparison Micro Carrier at 34 terminal stations in 17 sections for duplication of protective devices in main transmission lines

(2) Replacement of 64 existing distance relays with static distance relays

(3) Replacement of obsolete circuit breakers at Mexico and San Jose substations...15 units

(4) Adoption of transfer trip system for improvement of system stability

(5) Provision of recorders for analysis of the operation of protective devices

(6) Provision of a simulated transmission line for confirmation of the operation of protective devices

e. Voltage Improvement

(1) Installation of static condensers (SC) of 170 MVar at San Jose S/S, Dolores S/S, Hermosa s/s and Sucat P/P.

(2) Installation of shunt reactors of 50 MVar at Hermosa S/S

f. Expansion of Communication System

(1) Extension of microwave system to Magat power plant (two relay stations and one terminal station)

(2) Extension of microwave system to Tiwi power plant (four relay stations and one terminal station)

(3) Construction of four circuits of PLC

g. Provision of Maintenance Equipment

(1) Provision of vehicles for improvement of mobility of line gangs...225 units

(2) Provision of measuring and testing instruments for protective device and automatic control system

(3) Provision of control desks and system boards at main substations

h. Provision of New Training Facilities

(1) Provision of a steam power plant operation simulator

(2) Provision of a substation operation simulator

i. Engineering

An engineering consultant is to be retained for a long period of time for establishment of basic methodology and planning system.

4-10. Execution Program and Construction Cost

a. Items for Execution

The renovation program for Luzon Grid transmission system should be scheduled to be executed for the following items.

(1) Phase-1: Imediate Corrective Measures and Basic Study of Long Range and Medium Range Plan

Engineering works as mentioned above are itemized as follows.

	NAPOCOR & Consultant	Contractor(s)
Basic Plan, Basic Design	o	-
Contractor's Design Check, Construction Supervision Schedule Control and Other fundamental Engineering Functions		
Detailed Design of Equipment & Materials	-	o
Working Plan		
Draft of Operation & Maintenance Manual		

Consultant should assist the NAPOCOR engineers of operation and maintenance Engineering Division on duty.

(2) Phase-2 (Medium term plan)

Items should be executed from 1988 to 1990 after the execution of Phase-1, succeedingly.

However, the study for Phase-2 should start on the same time of Phase-1.

(3) Phase-3 (Long term plan)

Phase-3 should be executed considering the effects of Phase-1 and Phase-2, and the expansion program of power plants and transmission systems.

b. Methods for the Execution of the Program

For Phase-1, the package of works should be divided into three main items.

. Load dispatching facilities (including communication facility and training simulators)

. Substation facility and maintenance equipment

. Facilities for transmission system and line gang

c. Procurement Schedule

The renovation works should be executed with the following conditions.

. To employ a skilled consultant who has the sufficient experiences on the planning, design, maintenance and operation of the utility system.

. To make up the tender document and issue them to the bidders by three packages mentioned above, load dispatching facilities, substation facility and maintenance equipment, and facilities for transmission system and line gang.

. Procurement method should be a turn-key system, including the whole works for the construction, delivering materials and equipment, installation, test and training of operation.

. The organization to coordinate the execution of the works as a whole should be established and the responsibility of the execution should be clarified.

d. Schedule of Construction Work

The term of construction work is 26 months as shown in Chapter 10. Fig. 10-2-1.

e. Organization for the Execution

The organization for the Execution of the Project is as shown in Chapter 10, Fig. 10-1.

f. Construction Cost

The construction cost of the immediate corrective measures is summarized as fcllows.

	F.C.		L.C.	
	Million Dollar	Million Yen	Million Dollar	Million Peso
Power System	5.36	(1,324)	4.73	(85.4)
Equipment and Protective Devices	8.46	(2,091)	1.17	(21.1)
Voltage Improvement	3.24	(800)	0.56	(10.1)
Communication System	3.60	(890)	0.70	(12.6)
Maintenance Tools	3.04	(750)	0	(0)
Training Devices	4.45	(1,100)	0.33	(5.9)
TOTAL	28.15	(6,955)	7.49	(135.1)

Including the contingency of foreign currency 15% and local currency 20%, total cost amounts 32.37 million $ (7,998

million ¥) as foreign currency portion and 9.0 million $ (162.1 million ₱) as local currency portion.

4-11. Financial and Economical Evaluation

(Chapter 11 of the Text)

For expenses for the immediate corrective measures, the interest rates of 4.0% and 11% was considered for foreign currency portion and local currency portion, respectively. The construction cost was considered to be repaid in 44 years by the straight line method, and the operating expense was considered to be 3.0% of the construction cost according to Electric Company of Japan.

For gains to be derived from the immediate corrective measures, recovery of power loss due to total blackout faults and a savings of fuel cost of oil-fired power plants of the 115 kV system through voltage improvement were considered.

For fuel cost, three cases of increase at annual rates of 1.1%, 2.0% and 3.0% were considered. since the present oil price is $29/barrel, the prices of oil in each of the three cases in the year 2,000 is calculated at $34.17, $39.03 and $45.18 per barrel, respectively.

As a result of computation on the basis of the condition mentioned above, the Financial Internal Rate of Return (FIRR) is determined to be 7.6%, 12.0% and 14.4% for oil price increases at rates of 1.1%, 2.0% and 3.0%, respectively, indicating that the project for immediate corrective measures is economically feasible.

5. Conclusion and Recommendations

The conclusions and recommendations based on the result of the study for the Renovation Plan of the Luzon Grid Transmission System are outlined in the following.

while the rated generating capacity of power plants in the Philippines is 3,871 MW, comprising 1,121 MW of hydro power and 2,750 MW of thermal power (including geothermal), the present available capacity is 3,340 MW. As for load distribution, Metro Manila accounts for about 61% of the total load in the Philippines. Of the main power plants in Metro Manila, Malaya thermal power plant (650 MW) and Sucat thermal power plant (850 MW) with a combined rated capacity of 1,500 MW can generate only 1,160 MW, a decrease of about 30% from the rated capacity, and have frequently caused a system blackout in the past.

As for transmission system, an extremely large power flow was experienced by main transmission lines at the time of the total system blackout of 1983 as in the case of the Kalayaan--Malaya line (530 MW), Malaya--Dolores line (620 MW) and San Jose--Balintawak line (270 MW), which became a source of system instability in the event of a fault in one circuit of transmission line.

Besides, the fact that the static stability was nearing the limit in the Malaya P/P--Kalayaan P/P--Gumaca S/S--Labo S/S--Naga S/S--Tiwi P/P 230 kV line and that the Malaya P/P--Dolores S/S 230 kV line and the Malaya P/P--San Jose S/S 230 kV line had frequently dropped out of the system because of power swing and incomplete relaying system or experienced frequent erroneous operation of relays was the root cause of the total system blackout of August 1983, September and March 1984.

For the power system in Luzon, a study was made of the above-mentioned thermal power plants (Malaya and Sucat) during the period from May to September 1982 under the Plant Renovation Program. The present study is for the Renovation Program for the Luzon Grid Transmission system conducted as part of the Plant Renovation Program.

However, the stable operation of the power system can only be expected from a combination of stable operation of power plants which can be secured through implementation of the following measures and the reliability of transmission system.

- Economic operation of hydro and thermal power plants
- Reduction in the number of shutdowns due to faults and securing the rated capacity of each power plant through proper and adequate maintenance
- Stopping of operation at midnight and restarting of the existing thermal power plants following the commissioning of large power plants
- Establishment of regular maintenance schedules for power plants
- Coordination of reservoir operation of hydro power plants and automatic frequency control (AFC)

As the load demand grows, the power system adopts a bigger unit size of generator, extra high voltage for transmission lines and substations, and long distance transmission lines year by year. Because the power system expands more complicated one, the establishment of higher control technics and a suitable protecting system becomes the urgent task for the system operation.

Not only the facilities in the power system, generators, transmission lines and substations, should be operated in the best condition each, but in addition, the power system should be operated as a whole

system to serve consumers with a reasonable service level on voltage, frequency and reliability. The power system which should be met with the ever growing demand should be expanded with a suitable coordination between each facility and should be a flexible arrangement for its operation.

To eliminate a total blackout fault in the Luzon Grid system, it is necessary to execute the immediate corrective measures which are designed to renovate the existing system considering its future expansion plan. However, without the survey and study on the basic planning methods for long and medium term plan and on the organization for the maintenance system, the works of immediate corrective measures could not fully be useful for the improvement of the stability of the system.

Therefore, the engineering services which support the study and survey for the planning methods on the operation and maintenance of system as the basic data.

It is recommended that the measures proposed for the Renovation Program (Luzon Grid Transmission System) on the basis of the study be implemented in three phases of long-term plan, medium-range plan and immediate corrective measures as summarized below.

a. Immediate Corrective Measures (Phase 1)

(1) Improvement of emergency system operating procedure

(2) Establishment of the training system for maintenance and operation engineers

(3) Improvement of system stability

Construction of San Jose--Balintawak 230 kV transmission line and Pi connection of two circuits at Bayombong substation.

(4) Improvement and expansion of substation facilities and protective devices

Duplication of protection system for important transmission lines, improvement of existing relays, replacement of obsolete CB and installation of additional fault recorders.

(5) Improvement of system voltage:

Installation of static condensers 170 MVA and shunt reactors 50 MVA

(6) Expansion of communication system:

Expansion of microwave system and extension of PLC to the new transmission lines

(7) Provision of maintenance equipment:

Provision of vehicles for improvement of mobility of line gangs and provision of other maintenance equipment

(8) Provision of training facilities:

Provision of training simulators for power plants and substation operation

The construction cost for the immediate corrective measures is estimated at $32.79 million (¥8,100 million) for foreign currency portion and $6.11 million (₱110 million) for local currency portion, for a total of $38.90 million (¥9,640 million).

The construction period is 26 months following the signing of loan agreement.

b. Medium-Range Plan (Phase 2)

(1) Allocation and preservation of optimum spinning reserve.

(2) Review and improvement of maintenance system

(3) Reinforcement of transmission lines in the Kalayaan--Binan section

(4) Solution of problems of abnormal voltage rise on trippings of long distance transmission lines.

(5) Loop system of main microwave circuits

c. Long-Range Plan (Phase 3)

(1) Studies should be made for establishment of methodology for the formulation of demand-supply programs and power expansion programs and for substantiation of date to be used for system planning.

(2) Studies should be made for the construction of a north backbone transmission line and for Metro Manila power supply measures as a basic framework of the future power system.

6. List of Collected Data

1. Review of the June 1982 Power Expansion Program and the June 1984 Power Expansion Program

2-1. Annual Report NAPOCOR 1979

2-2. Annual Report NAPOCOR 1980

2-3. Annual Report NAPOCOR 1981

2-4. Annual Report NAPOCOR 1982

2-5. Annual Report NAPOCOR 1983

3. Annual Report MERALCO 1983

4. SOP-1 System Blackout Operation

5. SOE-2 Metro Manila Blackout Operation

6. Allocation Schedule of Protecting Relay and Fault Recorders

7. Organization Chart

8. Training Program 1982

9-1. Log Sheet - Malaya Substation

9-2. Log Sheet - Dolores Substation

9-3. Log Sheet - Hermosa Substation

10-1. Communication System Map I

10-2. Communication System Map II

11-1. Monthly Operational Highlights 1980

11-2. Monthly Operational Highlights 1981

11-3. Monthly Operational Highlights 1982

11-4. Monthly Operational Highlights 1983

11-5. Monthly Operational Highlights 1984

12. Single Line Diagram 1 set

13. Load Forecast of NAPOCOR

14. Load Forecast of MERALCO

15. Maintenance System of MERALCO

16. Manual of RAZFE Relay (ASEA)

17. Progress Report of Construction (Luzon Area) July 1984

18.	Map	Manila	North Sheet	1/25,000
			South Sheet	1/25,000
19.	Map	TIWI and NAGA	5-Sheet	1/50,000
20.	Map	San Jose-Balinta	1-Sheet	1/50,000

CHAPTER 1

GENERAL SITUATION OF REPUBLIC OF THE PHILIPPINES

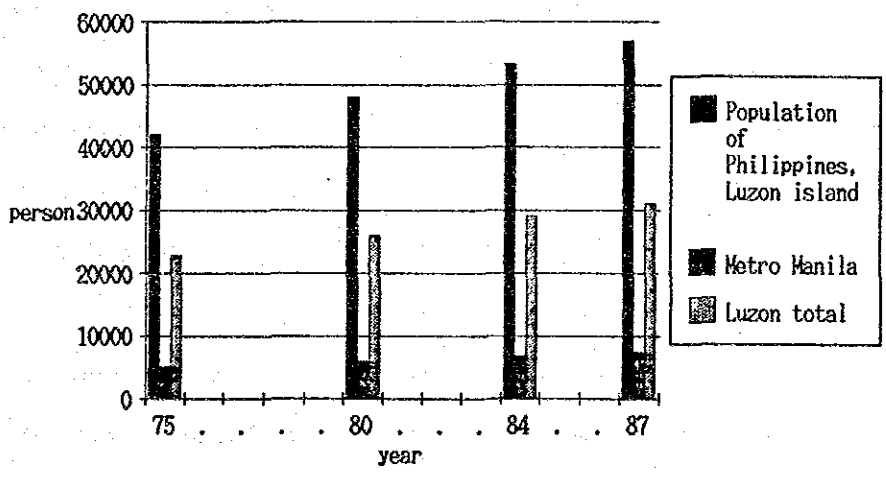
Chapter 1. General Situation of the Republic of the Philippines

1-1. Outline of the Philippines

The Republic of the Philippines consists of approximately 7,100 islands of various sizes, spread over an area extending 1,855 km from north to south and 1,108 km from east to west, and has a total land area of 299,765 square kilometers. The largest island is Luzon (104,686 km^2) lying in the north, followed by Mindanao (94,630 km^2) situated in the southernmost. Between the two islands, there are relatively large nine islands, including Samar (13,079 km^2), with a total land area of 85,451 km^2.

The population, which was 48,098,000 in the 1980 census, is estimated at 53,351,000 in 1984 as shown in Fig. 1-1 and Table 1-1, with an annual growth rate of 2.6 percent. The population of Luzon was 26,081,000 (54 percent of total population) in 1980 and is estimated at 29,078,000 (growth rate of 2.8%) in 1984.

Fig. 1-1 Population of Philippines, Luzon island



The island of Luzon is politically divided into one special district and 71 provinces, which are placed under administrative

control of 12 Regions and Metro Manila Area. The island of Luzon, together with the island of Masbate, is generically called "Luzon", while the island of Mindanao is referred to "Mindanao" and all other islands between these two "Visayas".

1-2. Basic Structures of Politics and Economy

In foreign diplomacy following the end of World War II, the Republic of the Philippines, while maintaining the constitutional republican form of government modeled after the American political system, has successively established diplomatic relations with such socialist countries as the Peoples Republic of China, Soviet Russia and Vietnam in an effort to break from her diplomacy strongly inclined toward the USA and is strengthening her collaboration with the Third World, especially the neighboring ASEAN nations.

In the domestic scene, the present government put the question of the new constitution to a national prebiscite in October 1976 and obtained an overwhelming support of 90.3 percent. The ruling party won an overwhelming victory in succession in the provisional national assembly election of 1978, national local election of 1980 and national assembly election of 1984. On the strength of these achievements, the present government has gradually normalized the political situation, thereby paving the way to long-term political power.

While the society of the Republic of the Philippines is composed mainly of Christians, there are a large number of Moslems inhabiting in the western half of Mindanao.

Since around 1970, these minority Moslems have been intensifying their activities as evidenced by the frequently reported armed

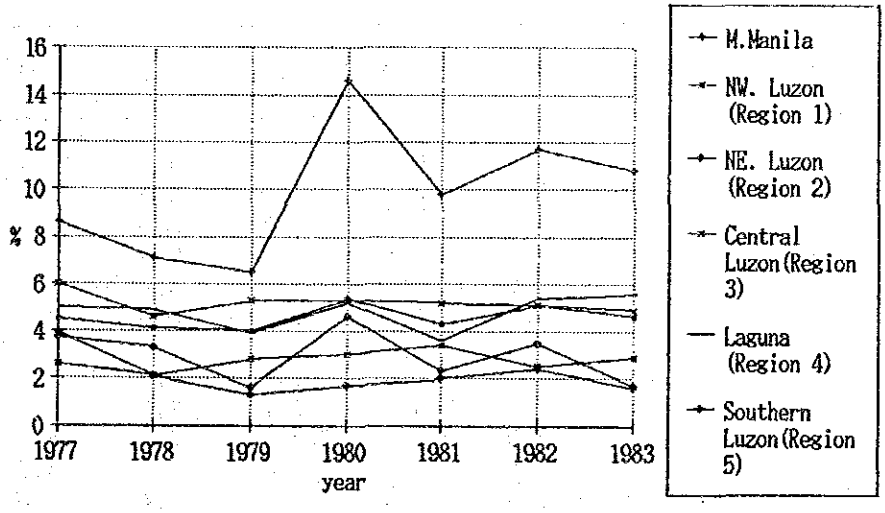
crashes with government troops. While the complicated social problems are a major obstacle to the economic development of the country, the government is striving for national unification through positive development of economically strained Moslem districts.

The economic system of the Philippines is that of private system modeled after the American economic system. However, the role of the government in the national economy has become increasing importance in recent years through successive implementation of powerful infrastructure improvement programs.

To characterize the economic environment of the Philippines, the "economy based on excess labor" is often pointed out.

In the Philippines, the unemployment ratio is constantly at high levels, which was 4.0 percent in 1979, 4.9 percent in 1981 and 4.6 percent in 1982 (943,000 persons) becoming a major source of social unrest.

Fig. 1-2 Ratio of Unemployee



Changes in the unemployment ratio by region and year are shown in Fig. 1-2 and Table 1-2.

Table 1-1 Population (1,000 Persons)

	1975	1980	1984	1987
All Philippines	42,071	48,098	53,351	56,985
M. Manila	4,970	5,926	6,739	7,316
Region 1	3,269	3,541	3,826	4,030
Region 2	1,933	2,215	2,459	2,630
Region 3	4,210	4,803	5,325	5,691
Region 4	5,214	6,119	6,894	7,437
Region 5	3,194	3,477	3,833	4,075
Luzon Total	22,790	26,081	29,078	31,179

Table 1-2 Ratio of Unemployed 15 Years Old and Over

	1977 (%)	1978 (%)	1979 (%)	1980 (%)	1981 (%)	1982 (%)	1983 (%)
Philippines	4.5	4.1	4.0	5.4	4.9	5.1	4.6
M. Manila	8.6	7.1	6.5	14.6	9.8	11.7	10.8
Region 1	2.6	2.1	2.8	3.0	3.4	2.5	2.9
Region 2	3.7	3.3	1.6	4.6	2.3	3.5	1.7
Region 3	6.0	4.6	5.3	5.3	5.2	5.1	4.9
Region 4	5.0	4.9	3.9	5.2	3.6	5.4	5.6
Region 5 (upper Luzon Area)	3.9	2.1	1.3	1.7	2.0	2.4	1.6
Region 6	5.1	3.7	5.0	2.4	2.9	3.3	3.1
Region 7	3.3	2.3	3.2	2.7	2.2	2.3	3.3
Region 8	4.1	4.6	4.0	10.5	7.8	5.1	2.6
Region 9	2.3	3.6	5.7	4.8	0.5	4.8	4.7
Region 10	3.0	3.6	3.8	5.1	11.4	5.6	4.5
Region 11	2.5	5.9	5.0	3.5	5.6	6.5	7.3
Region 12	0.5	1.6	2.4	2.6	1.8	3.3	1.7

The ratio of unemployed in the Philippines reached the peak of 5.4 percent in 1980 but gradually dropped thereafter with the ratio in 1983 being 4.6 percent. By region, Metro Manila is highest at 10.8 percent, while the ratio in Regions 3 and 4, neighboring area of Metro Manila, is 4.9 percent and 5.6 percent, respectively. The ratio in Region 11 of Mindanao is high at 7.3 percent but the ratio in other regions is 4 percent or less. The unemployed in Metro Manila and in the neighboring regions number 543,000 accounting for 57.6 percent of the total number of unemployed.

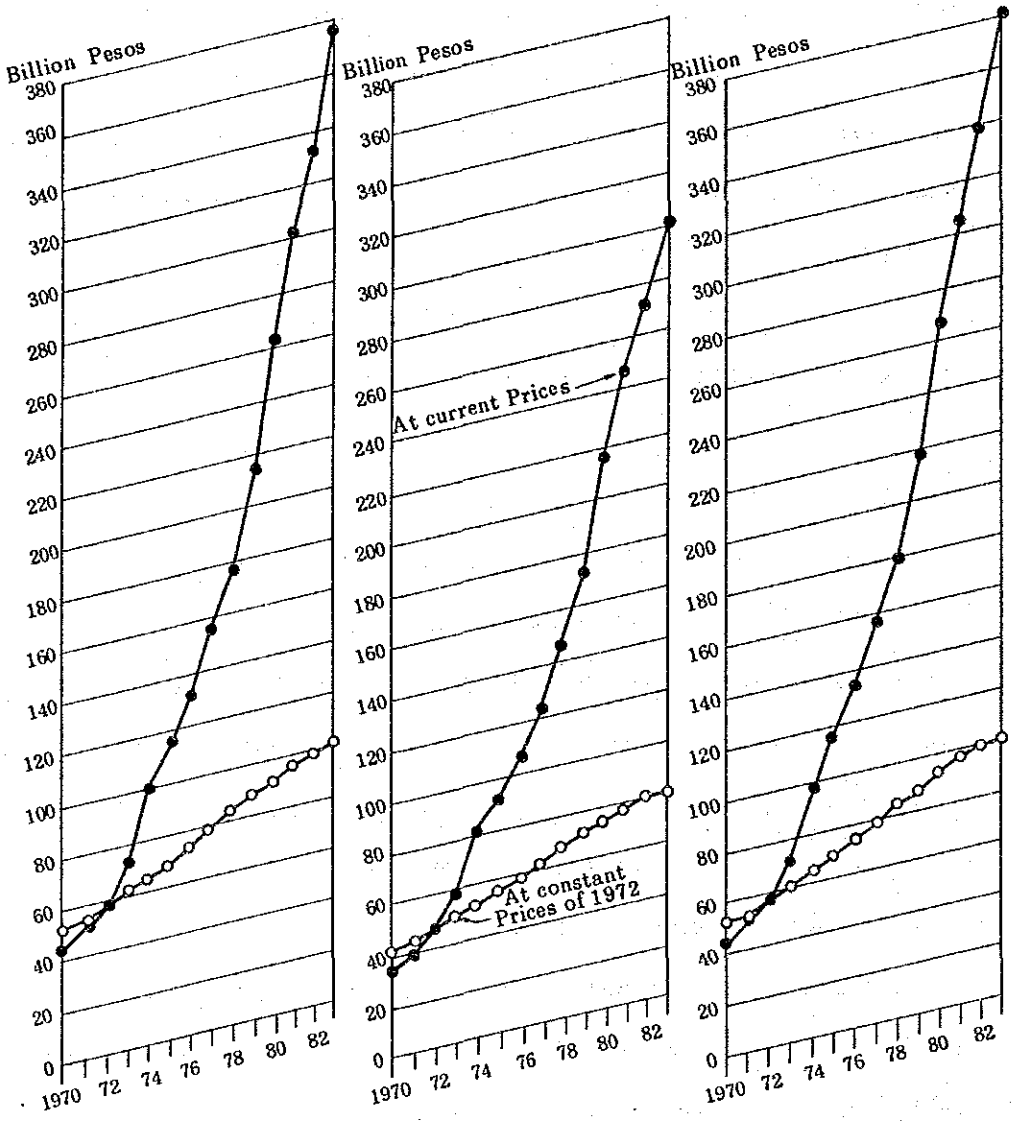
The energy problem of the country will be discussed later in the section dealing with Five Year Energy Program.

1-3. Changes of Main Economic Indicators

Secular changes of GNP, National Income and GDP are shown in Fig. 1-3. The GDP in 1982 amounted to 380,820 million Pesos. While the nominal growth rate is high for each year, the real growth, which amounted to about 5 billion Pesos per year (growth rate of 6.2%) in 1970s, declined in 1982 and 1983. The GDP is expected to show a negative growth rate in 1984 as indicated by main economic indicators in Table 1-3.

Results of export and import in recent years by item are shown in Fig. 1-4 and Fig. 1-5 (Tables 1-4 and 1-5), respectively. In 1981, the top three export items were coconut products, mineral products and sugar products in that order but changed to coconut products, mineral products and forest products in that order in 1982. Moreover, while the export of each of top three items earned more than 600 million Dollars in 1981, only the coconut products earned more than 600 million Dollars in 1983. In particular, the

Fig. 1-3 Gross National Product, National Income and Gross Domestic Product: 1970 to 1983



Gross National Product

National Income

Gross Domestic Product

Table 1-3 Main Economic Indicators

	1982	1983	1984	
GDP (Billion Pesos)	340.36	380.82		-
Real Economic Growth (%)	3.0	1.4	(Forecast)	-5.5
Price Increase (%)	10.2	10.0	(Jan - Mar)	36.5
Industrial Production Index (1981 = 100) (Jan - Feb)	104.9	110.3	(Jan - Feb)	134.2
Exports (Million Dollars)	5,021	5,005	(Jan - Mar)	1,197
Imports (Million Dollars)	7,667	7,487	(Jan - Mar)	1,480
Money Supply (Million Pesos)	23,520	32,519	(End of Mar)	30,189
Receipts and Payments of Treasury Funds (Million Pesos)	-14,414	-6,143	(End of Feb)	-1,401
Foreign Exchange Reserves (Million Dollars)	2,543	786		894
Outstanding Foreign Debts (Million Dollars)	24,631	24,845	(End of Mar)	25,152
Dead Service Ratio (%)	19.3	25.0		-

(Source: Central Bank of the Philippines, IFS)

export of sugar products in 1983 dropped sharply to the level of 54 percent of that in 1981 amounting to only 320 million Dollars.

The top three import items during the period of 1981 to 1983 remained to be petroleum products, processed food and machinery with import in 1983 amounting to 2,130 million Dollars, 1,170 million Dollars and 900 million Dollars, respectively.

Fig. 1-4 Main Items in Export

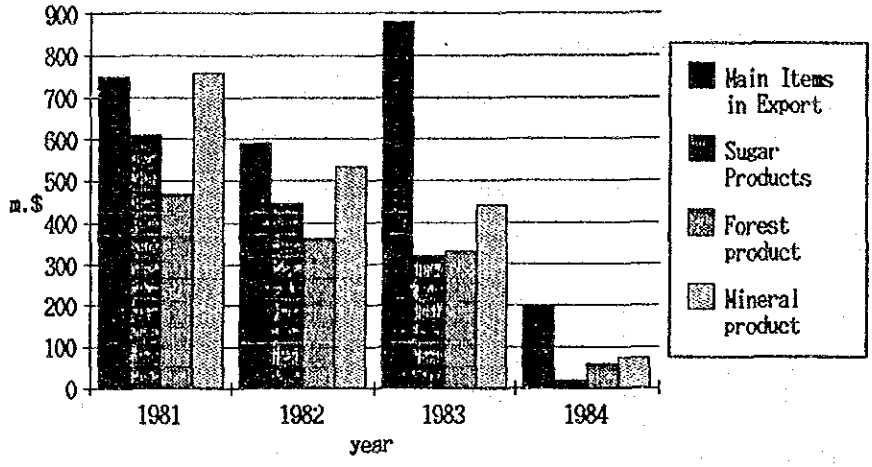
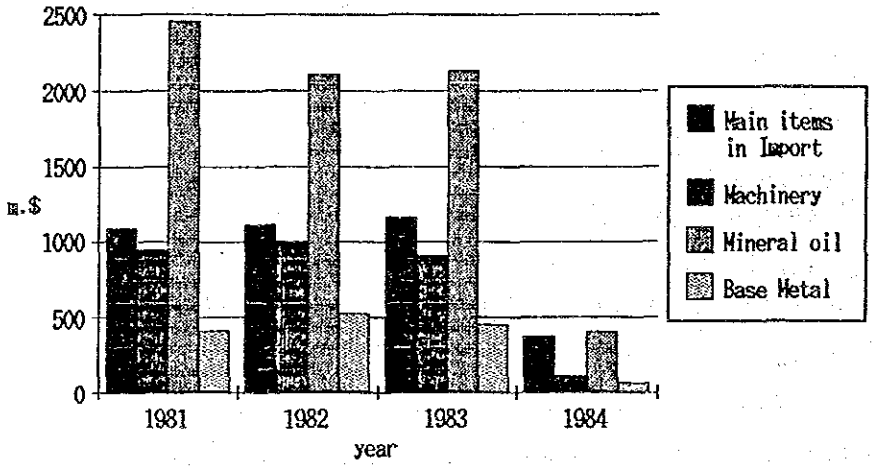


Fig. 1-5 Main Items in Import



The trade continued to expand since 1979 with exports amounting to 5,720 million Dollars and imports amounting to 7,950 million Dollar in 1971 but showed a decline thereafter, with exports amounting to 4,930 million Dollars and imports amounting to 7,400 million dollars in 1982.

Changes of consumer price index are shown in Fig. 1-6 and Table 1-6.

Table 1-4. Export

Unit : m. $

	1981	1982	1983	1984 Jan.～Mar.
1. Coconut product	750	590	680	198
2. Sugar product	609	445	321	18
3. Forest product	469	362	331	58
4. Mineral product	758	532	440	73
a. Copper	429	312	249	25
b. Gold	215	169	154	26
c. Others	114	51	37	12
5. Fruts & Vegetabl	378	374	327	99
a. Pineapple	101	107	102	26
b. Banna	124	146	105	28
c. Others	153	121	120	45
6. Abaca products	25	26	25	7
7. Tabaco	50	49	35	4
8. Fuel & lubricant	42	33	115	26
9. Chemicals	107	96	87	22
10. Textiles	69	56	25	7
11. Miscell. & other	2455	2449	2586	650
12. Re-export	10	9	33	21
TOTAL	5722	5021	5005	1183

Table 1-5. Import

Unit : m. $

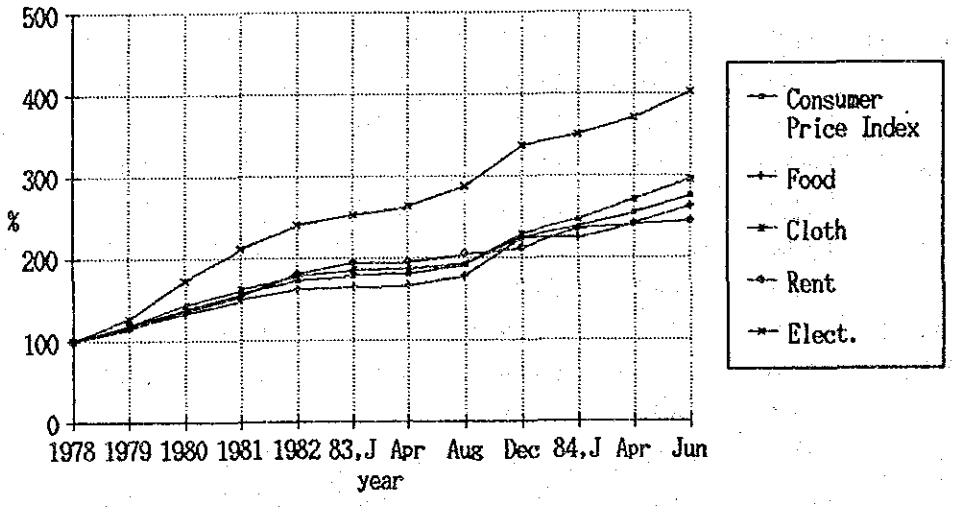
	1981	1982	1983	1984 Jan.~ Mar.
1. Consumer Good	1619.7	1710.3	1681.8	460.7
a. Cereal	230	241.9	248.5	50.4
b. Manufact. other	1088	1110.2	1167	374.2
c. Others	301.7	358.2	266.3	36.1
2. Capital goods	1919.6	1785.7	1760.1	296.1
a. Machinery	945.1	988.4	901.9	118.1
b. Elect. Mach.	387	384.7	404.6	107.1
c. Others.	587.5	412.6	453.6	70.9
3. Raw Haterials	4406.4	4170.9	4044.7	714.1
a. Minerals(oil)	2458.1	2104.7	2132.3	405.3
b. Chemical	298	259.3	266.6	44.6
c. Other materils	243	256.7	219	36.8
d. Explosives	213.8	295.2	258	31.7
e. Bace Metal	408.1	528.3	451.8	64.5
f. Others	785.4	726.7	717	131.2
Grand Total	7945.7	7666.9	7486.6	1470.9

Table 1-6 Consumer Price Index (1978 = 100)

	All Items	Food & Tabaco	Cloth	Housing	Fuel & Elect.	Service	Miscel-laneous
1978	100	100	100	100	100	100	100
1979	117.5	115.6	117.9	118.8	127.6	121.1	119.1
1980	138.9	132.9	144.2	137.4	173.8	152.1	139.8
1981	157.1	149.8	162.0	154.7	211.5	171.2	153.3
1982	173.2	162.5	178.2	180.5	240.0	192.9	165.9
1983	190.5	176.5	194.5	200.3	281.6	216.8	180.6
Jan.	178.7	165.1	185.2	194.3	252.8	201.4	172.2
Feb.	179.6	165.6	186.9	194.5	256.4	203.0	173.3
Mar.	180.0	165.6	186.3	194.6	261.6	203.9	173.7
Apr.	180.9	166.9	186.6	194.7	262.6	204.2	174.3
May	182.2	166.7	187.1	194.8	264.4	204.6	175.0
June	184.4	171.3	188.4	195.0	269.6	207.1	175.7
Jul.	188.8	174.8	190.4	203.9	282.8	211.8	176.9
Aug.	192.2	177.8	192.9	204.4	2888	220.6	178.6
SePt	193.0	178.3	194.8	204.6	290.2	221.5	179.8
Oct.	195.4	181.0	197.8	204.8	293.8	223.8	182.3
Nov.	207.2	192.5	209.7	207.6	320.3	240.2	192.3
Dec.	223.9	210.6	228.7	210.4	336.9	259.2	212.6
1984							
Jan.	238.2	223.6	245.9	235.7	350.7	269.0	225.3
Feb.	245.4	231.5	255.4	237.5	362.5	271.7	234.4
Mar.	250.8	237.1	264.0	238.8	369.2	274.5	243.7
Apr.	254.6	241.0	270.8	239.5	371.8	277.4	249.9
May	258.9	246.0	276.6	240.2	376.3	278.9	256.0
June	275.2	261.9	295.3	243.3	402.9	303.7	272.7
June 84/83 (%)	149.24	152.89	156.74	124.77	149.44	146.64	155.21

The growth rates of price index in 1982 and 1983 were 10.2 percent and 10.0 percent, respectively over the previous years but the price increase since December 1983 was so drastic that the growth rate of price index in June 1984 was 49.2 percent over the same period of last year. (see: Fig. 1-6) By item, the price increase of clothing is highest at 56.7 percent, and that of rent is lowest at 24.8 percent.

Fig. 1-6 Consumer Price Index

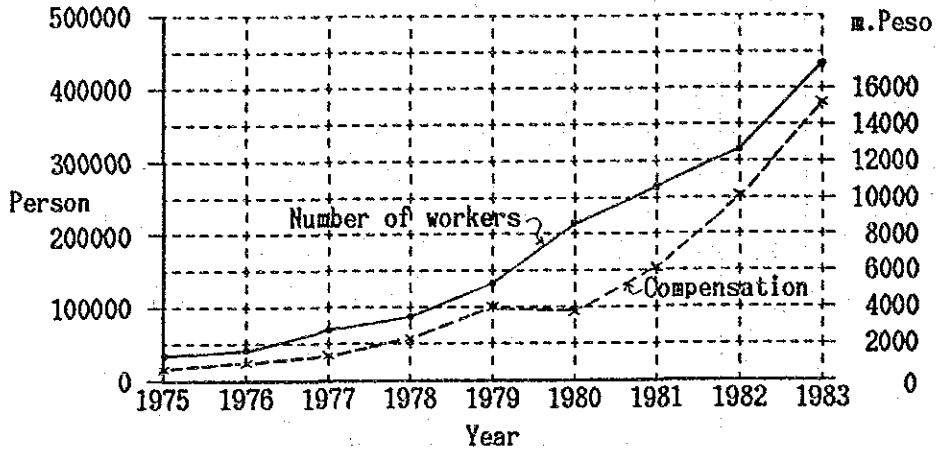


Lastly, changes in overseas contract workers are shown in Fig. 1-7 and Table 1-7. The number of overseas contract workers in 1975 was 36,000 with seamens accounting for 23,000 surpassing the number of land workers. From 1977, however, the number of land workers was increasing steadily. In 1983, the total number of overseas contract worker reached 434,000 comprising 380,000 land workers and 54,000 seamen. The amount of foreign currencies earned by these overseas contract workers holds a large share in the acquisition of foreign currencies and accounted for 20 percent of total export in 1983.

Table 1-7. Over seas Contract Workers

	Total (person)	Difference (person)	Land labor (person)	Difference (person)	Seamen (person)	Difference (person)	Compensat. (m.peso)	Export (m.peso)	Comp./Exp. (%)
1975	36035		12501		23534		737	21272	3.5
1976	47885	11800	19221	6720	28614	5080	824	23248	3.5
1977	70375	22540	36676	17455	33699	5085	1341	29306	4.6
1978	88241	17866	50961	14285	37280	3581	2243	31557	7.1
1979	137337	49096	92519	41558	44818	7538	4018	41461	9.7
1980	214590	77253	157394	64875	57196	12378	3837	54181	7.1
1981	266243	51653	210936	53542	55307	−1889	6049	57806	10.5
1982	314284	48041	250115	39179	64169	8862	10344	56150	18.4
1983	434207	119923	380263	130148	53944	−10225	14595	73883	19.8

Fig. 1-7 Number and Compensation of Overseas Contract Worker



1-4. Analysis of Recent Economic Trends

Because of the export structure depending heavily on the traditional primary products which are easily subjected to international price fluctuations and the high degree of dependence on the import of petroleum products, the economic foundation of the Philippines is extremely weak and the balance of international payments is now in deficit due to the increased payment of interest for foreign debts which have grown rapidly with the accelerated industrialization of the country. (See Table 1-8)

(Note) Share of Petroleum Products in Total Import

	1981		1982		1983	
	Amount (m.$)	Ratio (%)	Amount (m.$)	Ratio (%)	Amount (m.$)	Ratio (%)
Total of Imports	7,946	100	7,667	100	7,487	100
Petroleum Products	2,458	30.9	2,105	27.5	2,132	28.5

Furthermore, uncertainties about the economic outlook, prompted by the shortage of imported raw materials due to the depleting

Table 1-8 Balance of Payment (In million U.S. Dollars)

Item	1981	1982	1983	1984/1-3	1983/1-3
I. Current transactions					
A. Merchandise trade	(2,224)	(2,646)	(2,482)	(283)	(684)
Exports	5,722	5,021	5,005	1,197	1,166
Imports	7,946	7,667	7,487	1,480	1,850
B. Non-merchandise trade	(541)	(961)	(634)	(253)	(174)
Inflow	2,664	2,983	3,067	631	767
Outflow	3,205	3,944	3,701	884	941
G. Transfer	472	486	399	60	124
Inflow	485	498	407	60	127
Outflow	13	12	8	—	3
Current net inflow total	(2,293)	(3,121)	(2,717)	(476)	(734)
II. Non-monetary capital					
D. Long-term capital	1,332	1,548	1,427	79	302
Inflow	2,072	2,533	2,194	217	567
Outflow	740	985	767	138	265
E. Direct investments	407	17	4	22	17
Inflow	480	194	147	29	54
Outflow	73	177	143	7	37
F. Short-term capital	(433)※	(308)	(1,361)	166	178
Inflow	—	—			
Outflow	—	—			
Errors and omission	—	—			
Non-monetary capital total	1,306	1,257	70	267	497
G. Monetion of gold	400	277	183	54	100
H. Allocation of SDRs	27				
III. Overall surplus (deficit)	(560)	(1,587)	(2,464)	(155)	(137)

※ Includes arrors and omissions.
Source : Central Bank of the philippines

foreign currency reserves and the sharp price increase following the devaluation of the Peso against US Dollars, have made the procurement of new funds or refunding extremely difficult.

For this reason, the Philippine government made a request to private banks on October 17, 1983 for postponement of payment of borrowings for 90 days and thereafter made a request for extension of the period on three occasions in January, April and July 1984 making the postponement effective until October 9, 1984. As a result, the real growth rate of GDP in 1983 was 1.4 percent, the lowest in ASEAN nations, with the balance of payments showing the worst result in the history of the country.

(Note) Growth Rate of GDP, ASEAN Nations (Source: IMF)

	Singapore	Malaysia	Indonesia	Thailand	Philippines
1983	7.9%	5.6%	3.1%	5.8%	1.4%

The relief loan of IMF was not materialized even at the beginning of 1984. The economy of the country has deteriorated further, with the number of factories curtailing production and suspending operations increasing rapidly, the rate of price increase during the period of January to March 1984 jumping to 36.5 percent and the number of unemployed sharply increasing to 1.5 million (Source: Overseas Information Control Office, Bank of Tokyo) affected by the squeeze on budgetary outlays of the government. The real growth rate of GDP in 1984 is estimated at minus 5.5 percent (published by NEDA, July 1984).

Even when the relief loan (615 million Dollar SDR standby

credit) of IMF is materialized, input of new funds for economic reconstruction will be possible only in 1985 and the extremely difficult economic condition is expected to exist for sometime.

1-5 Long-Term Economic Planning

a. Ten-year Economic Development Program

The New Ten-year Economic Development Program (1978 - 1987), replacing the Five-Year Economic Development Program (1973 - 1977) revised in 1973, allocates the first five years for the improvement of economic efficiency and the last five years for structural changes of the economy. Table 1-9 shows main economic indicators under the program.

According to the program, a real growth rate of 7.7 percent per annum is envisazed for the first five years and the growth of 8 percent is contemplated for the following 1983 - 1987 period. Toward this objective, the government has made positive capital investments for infrastructure, including investments in public utilities and has vigorously promoted the 11 major industrial projects through introduction of large amounts of foreign capital in an effort to overcome economic difficulties of the country. However, the procurement of foreign capitals has become increasingly difficult owing to the world wide tendency toward high interest rate following the second oil crisis, coupled with increasingly cautious attitude of advanced countries in lending money to developing countries in the face of financial difficulties of developing countries due to swelling cumulative external debts as evidenced by the financial crisis of the Mexican government.

Table 1-9 Actual Results and Projection of Five-Year Plan

	1978		1979		1980		1981		1982	
	Pro-jec-tion	Actu-al	Pro-jec-tion	Actu-al	Pro-jec-tion	Esti-mated Actu-al	Pro-jec-tion	Re-vised Esti-mate	Pro-jec-tion	Re-vised Esti-mate
GNP (Real)	7.0	6.3	7.5	5.8	7.5	5.5	8.0	5.8	8.0	6.3
GNP (Nominal)	14.5	14.1	15.0	22.7	15.0	24.5	15.5	18.5	15.6	16.9
Per Capita GNP (Real)	3.9	3.7	4.4	3.3	4.4	3.1	5.0	3.5	5.0	4.0
Per Capita GNP (Nominal)	11.3	11.4	11.7	19.9	11.7	21.7	12.3	15.9	12.3	14.4
Personal Consumption Expenditure	4.9	4.6	6.2	5.0	6.2	4.2	7.0	4.4	7.2	4.8
Government Expenditure	20.4	3.3	8.0	3.4	8.4	4.0	8.2	4.2	8.3	4.5
Gross Domestic Capital Investment	6.0	6.3	8.0	7.4	8.1	4.2	8.3	8.0	8.4	10.4
Exports (Nominal)	17.9	8.7	18.1	34.3	18.4	30.0	18.7	20.0	18.7	
Exports (Real)	10.0	1.3	9.0	7.4	9.0	11.3	9.2	10.0	9.3	10.0
Imports (Nominal)	14.5	10.9	15.5	29.8	16.1	29.0	16.6	20.0	16.6	
Imports (Real)	4.0	12.5	8.0	10.3	8.0	5.2	8.1	5.9	8.3	6.0
Investment/Saving Disparity (Ratio to GNP)	4.9	5.6	4.5	5.4	4.1	6.0	3.7	6.1	3.0	5.2
Rate of Unemployment	4.0	5.2	4.0	4.7	4.0	4.0	4.0	4.0	4.0	4.0
Agricultural Production (including Fishery and Forestry)	5.0	4.8	5.0	4.4	5.0	5.2	5.3	5.2	5.3	5.2
Industrial Production	8.9	6.6	9.5	6.7	9.7	5.9	10.2	6.5	10.7	7.2
Mining	7.5	3.9	8.5	17.6	8.5	13.0	9.5	12.3	9.5	12.3
Manufacturing	8.1	6.8	8.5	5.4	8.8	5.1	9.3	5.7	10.0	6.5
Construction	11.5	6.9	12.0	7.0	12.0	5.6	12.5	6.4	12.5	7.2
Electricity (including Gas and Water)	10.0	5.2	10.5	13.4	10.5	11.2	11.0	11.3	11.5	11.5
Services	7.3	5.8	7.9	5.7	7.6	5.3	8.0	5.6	7.5	6.2
Transport (including Communication)	9.0	5.6	9.4	5.0	9.4	3.6	9.4	4.8	9.4	5.6
Commerce	7.2	6.4	7.7	6.3	7.6	5.8	7.9	5.9	7.8	6.6
Other Services	7.1	5.0	7.7	5.1	7.1	5.3	7.8	5.4	6.6	5.7

(Note) As of the beginning of 1981 Source: NEDA

For this reason, construction is under way for only two projects, copper refinery project and phosphate plant project out of the 11 projects. As a result, the attainment is far from the projection in most industrial fields at this stage when the first five years of the program have already elapsed.

(Note) Eleven major industrial projects contemplated

(1) Copper refining plant
(2) Phosphate plant
(3) Aluminum refining plant
(4) Integrated steel plant
(5) Alcogas plant
(6) Heavy machinery manufacturing plant
(7) Paper and pulp plant
(8) Petrechemical plant
(9) Diesel engine manufacturing plant
(10) Cement plant
(11) Rationalization of coconut industry

b. Infrastructure Investment Program (1978 - 1987)

Under this program, the ratio of government investments for infrastructures to the GNP is low at 4 to 6 percent as compared with the ratio of about 17 percent of private investments for plant and equipment as shown in Table 1-10. However, the growth rate of government investments is considerably high at 14 percent as compared with the growth rate of 9 percent by private sectors.

This high growth rate is the result of positive government

Table 1-10 GNP, Population and Per Capita GNP

	1978	1979	1980	1981	1982	1987
GNP (Million Pesos at Prices of 1972)	83,250	89,494	96,206	103,902	112,214	164,879
GNP (Million Pesos at Current Prices)	174,076	200,198	230,317	266,081	307,578	633,795
Population (1,000 person)	46,350	47,719	49,137	50,557	52,026	59,903
Per Capita GNP (In Peso at Prices of 1972)	1,796	1,875	1,958	2,055	2,157	2,752
Per Capita GNP (In Peso at Current Prices)	3,756	4,195	4,687	5,263	5,912	10,580
Personal Consumption Expenditure (% of GNP)	65.3	64.7	64.1	63.9	63.0	61.4
Government Expenditure (")	10.8	11.0	11.2	11.4	11.6	12.7
Gross Domestic Capital Investment (")	26.5	26.6	26.7	26.7	27.0	28.0
Fixed Capital Investment (")	21.4	21.8	22.2	22.5	23.0	25.0
Government (")	4.1	4.3	4.5	4.8	5.2	6.1
Private (")	17.3	17.5	17.7	17.7	17.8	18.9
Exports (")	17.8	18.2	18.7	19.3	20.1	22.1
Imports (")	19.3	19.7	20.2	21.0	22.0	24.0
Agriculture, Fishery and Forestry (")	30.2	29.5	28.8	28.2	27.5	24.3
Manufacturing (")	29.2	29.7	30.3	31.0	31.8	36.9
Services (")	40.6	40.8	40.9	40.8	40.7	38.8
Employed and Unemployed						
Employed (1,000 person)	15,922	16,521	17,138	17,720	18,830	21,595
Unemployed (")	768	740	713	687	662	530
Rate of Unemployment (%)	4.8	4.5	4.2	3.9	3.6	2.5
Balance of International Payment						
Outflow						
(Million Dollars)	6,375	7,333	8,534	9,840	11,275	22,049
Imports	4,580	5,290	6,142	7,162	8,351	17,692
Medium and Long-Term Loans	498	584	776	890	1,035	1,262
Inflow (Million Dollars)	6,443	7,498	8,722	10,050	11,555	22,399
Imports	3,572	4,219	4,995	5,929	7,038	16,795
Medium and Long-Term Loans	1,300	1,483	1,550	1,562	1,591	1,500
Surplus	68	165	188	210	280	350

investments for infrastructure centering on electric power, irrigation and steel plant projects. (See Table 1-11) The priorities of government measures are given to the attainment of self-sufficiency in food, diversification of crop types and promotion of agrarian reform in the field of agriculture, and to the promotion of labor-intensive industries and small/medium scale industries, increased use of domestic raw materials and promotion of export-oriented industries and industrial decentralization. In the field of international trade, the growth of exports at an average annual rate of 19 percent is projected for the next five years through expansion and diversification of market for export of industrial products.

c. Five-Year Energy Development Program (1980 - 1985)

The hardest blow to the Philippine economy in the prolonged recession originating from the second oil crisis was a heavy fall of the market across the board for such primary products as coconut, sugar, lumber and mineral products, which are Philippines' main export items, in the face of a sharp increase of payment for petroleum imported. In particular, the price of sugar in 1982 fell to one third of that in 1980. As a result, a balance of payments deficit has increased sharply while the economic growth rate has dropped drastically since 1979.

In the Philippines, the energy revolution has made rapid progress because of a relatively high rate of motorization under the influence of American rule for some time and also due to weakness of the coal industry. The country depended on the

Table 1-11 Infrastructire Investment Plan (1978 - 1987)

(Million Pesos at Current Prices)	1978	1982	1987	1978 --82 (%)	Average Growth Rate (%) 1978 --82	1982 --87	1978 --87
Construction	3,100	5,442	13,187	21	14.1	17.1	15.9
Road	1,946	3,061	8,646	13	11.3	20.8	16.1
Others	1,154	2,381	4,541	8	18.1	12.9	15.5
Water Resources	3,681	6,556	11,698	24	14.4	11.6	13.0
Irrigation	2,019	3,475	5,111	12	13.6	7.7	10.7
Water Supply	1,168	2,299	4,110	9	16.9	11.6	14.3
Flood Control	494	782	2,477	3	11.5	23.1	17.3
Power Generation and Electrification	5,956	8,994	18,107	36	10.3	14.0	12.2
Generation	5,310	8,235	16,992	33	11.0	14.5	12.8
Rural Electrification	546	759	1,115	3	8.2	7.7	8.0
Communication	298	450	2,041	2	10.3	30.2	20.2
Social Infrastructure	1,356	3,698	8,916	14	25.1	17.6	21.4
Others	663	354	1,659	3	15.7	30.9	7.6
Total	14,954	25,494	55,608	100	13.3	15.6	14.5

import of petroleum for 95 percent of her primary energy requirement in 1973. Such being the case, the Philippine government has been making an all out effort for development of her own oil resources and substitute energy resources following a series of oil crises.

However, the country was still dependent on import of petroleum for 84 percent of her energy requirement in 1981. Under such a situation, the government worked out a five-year energy development program, with emphasis placed on the development of coal and geothermal resources as an immediate question, in order to increase the share of domestic energy resources in the total commercial energy requirement to the level of 49 percent by 1985 as shown in Table 1-12.

Under the program, the growth of coal production from 300,000 metric tons attained in 1980 to 2.31 million metric tons in 1985 is contemplated to cover 13.4 percent of the total energy requirement of the country.

d. New Five-year Economic Development Program (1983 - 1987)

During the first five years (1978 - 1982) of the Ten-Year Economic Development Program, the Philippines achieved various economic and social developments. Examples of such accomplishments are as follows.

(1) Exports increased at an average annual rate of 34.3 percent and the growth was particularly remarkable in non-traditional fields.

(2) Dependence on import of petroleum dropped from 90 percent in 1978 to 84 percent in 1981.

Table 1-12 Five Year Energy Plan

A. Energy Consumption Structure of the Philippines (1980--1985)

(Million Barrels in Oil Equivalent)	1980		1981		1985	
	Qty	(%)	Qty	(%)	Qty	(%)
Electric Power						
Hydroelectric	6.62	7.21	7.26	7.42	17.08	12.78
Geothermal	3.84	4.19	5.34	5.46	16.34	12.22
Coal-fired	0.42	0.46	1.15	1.18	8.38	6.27
Oil-fired	19.39	21.13	19.50	19.93	7.02	5.25
Nuclear	-	-	-	-	2.81	2.10
Substitute Energy	-	-	0.09	0.09	1.37	1.02
Sub-total	30.27	32.99	33.34	34.08	53.00	39.64
Non-Electric Energy						
Petroleum	60.92	66.39	63.16	64.55	66.44	49.70
Coal	0.52	0.57	1.17	1.20	9.55	7.14
Substitute Energy	0.05	0.05	0.17	0.17	4.71	3.52
Sub-total	61.49	67.01	64.50	65.92	80.70	60.36
Total of Commercial Energy	91.76	100.00	97.84	100.00	133.70	100.00
Share of Petroleum	80.31	87.52	82.66	84.50	73.46	54.94
Domestic Energy	16.51	17.99	22.48	22.97	65.37	48.89

Source: Ministry of Energy

B. Projection of Main Energy Production (1980--1985)

	Petroleum (Million Barrels)		Coal (1,000 tons)		Capacity of Geothermal Power (MW)
	Production	Demand	Production	Demand	
1980	5.05	80.31	300	285	1,200
1981	7.30	82.60	780	701	1,700
1982	9.10	82.80	1,380	1,976	2,320
1983	10.95	82.00	1,710	3,146	2,870
1984	14.60	82.70	1,950	3,241	3,330
1985	18.25	76.70	2,310	5,434	3,480

(3) Agricultural production increased continuously and the rate of self-sufficiency in food also increased.

(4) There was remarkable progress in the field of transportation, irrigation, power generation and electrification.

Accomplishments in social developments are as follows.

(1) Agrarian reform benefited 982,395 farmers by 1981.

(2) Regional disparity in living condition was considerably narrowed.

Under the prolonged world recession, however, the real economic growth of the Philippines in 1981 and 1982 remained at low rates of 3.8 percent and 4.1 percent (estimate), respectively, (at prices of 1972) as shown in Table 1-13, falling far below the average annual growth rate of 7.7 percent attained in the first five years, prompting the government to announce a new five-year economic development program in May 1982.

Under the new program, the growth of economy at an average annual rate of 6.5 percent in real term (at prices of 1972) is projected and the growth of GNP to 136.7 billion Pesos in 1987 and the increase of national income per capital from 2,026 Pesos in 1983 to 2,399 Pesos in 1987 are contemplated on the assumption of the population of 56,980,000 in 1987 at the population growth rate of 2.2 percent per annum during the period of the program.

As a vanguard of economic growth during the period, the growth of the manufacturing industry under the Industrial Reorganization Plan is projected and an average annual growth of 7.6 percent is estimated. For the mining industry, a growth

Table 1-13 Gross National Product (Five Year Development Plan, 1983-1987)

Item	Constant level (billion pesos)					Average annual real growth rates			Current level (billion pesos)				
	Actual		Estimate	Projections		Actual	Estimate	Projections	Actual		Estimate	Projections	
	1980	1981	1982	1983	1987	1980-81	1981-82	1983-87	1980	1981	1982	1983	1987
Personal consumption expenditures	59.3	61.6	64.2	67.5	84.1	4.0	4.2	5.6	178.0	205.6	239.9	277.7	492.5
Government consumption expenditures	8.4	8.7	8.7	8.9	10.7	4.1	−0.5	4.3	21.4	24.6	27.1	30.6	51.0
Gross domestic capital formation	26.6	27.2	27.5	28.6	38.8	2.3	1.1	7.1	81.2	93.3	105.1	117.7	223.9
Fixed capital formation	22.7	23.5	24.1	25.1	34.3	3.5	2.3	7.3	68.0	79.3	90.5	101.9	197.1
Construction	11.1	12.0	12.3	12.6	17.2	8.3	2.2	6.9	37.4	46.0	52.3	58.9	114.2
Government	4.9	5.2	4.9	4.9	6.0	7.9	−6.2	4.2	16.3	20.0	20.9	23.0	40.2
Private	6.3	6.8	7.4	7.7	11.1	8.6	8.6	8.6	21.0	26.0	31.4	35.9	74.0
Durable equipment	11.6	11.5	11.8	12.4	17.2	−1.0	2.5	7.8	30.6	33.3	38.2	43.0	82.9
Increase in stocks	3.9	3.7	3.4	3.5	4.5	−5.0	−6.8	5.5	13.2	14.0	14.6	15.9	26.9
Exports of goods and nonfactor services	18.1	18.4	19.4	20.9	29.4	1.6	5.0	8.7	54.2	58.5	68.2	80.2	159.1
Imports of goods and nonfactor services	19.4	18.9	19.5	20.6	26.6	−2.9	3.4	6.4	68.9	74.0	85.3	96.2	176.4
GROSS NATIONAL PRODUCT	92.6	96.1	100.0	105.2	136.7	3.8	4.1	6.5	265.0	305.5	352.7	408.2	749.2
Agriculture, fishery and forestry	23.7	24.6	25.5	26.6	32.3	3.6	3.8	4.9					
Industry	33.5	35.1	36.6	38.6	52.8	4.7	4.3	7.6					
Mining and quarrying	2.2	2.3	2.3	2.5	3.3	1.7	3.0	6.8					
Manufacturing	23.2	24.0	25.0	26.3	35.9	3.4	4.2	7.6					
Construction	7.1	7.8	8.1	8.6	11.8	9.7	3.8	7.8					
Electricity, gas and water	0.9	1.0	1.1	1.2	1.8	7.8	13.1	9.7					
Services	35.5	36.6	38.1	40.1	51.2	3.0	4.3	6.1					
Transportation, communication and storage	4.8	5.0	5.3	5.7	7.5	4.4	5.9	7.1					
Commerce	19.3	19.7	20.4	21.4	27.5	1.8	3.8	6.1					
Other Services	11.3	11.8	12.4	13.0	16.3	4.3	4.6	5.7					
GROSS DOMESTIC PRODUCT	92.7	96.2	100.2	105.3	136.3	3.8	4.2	6.3					

rate of 6.8 percent is projected. The growth rate of power generation, which is expected to attain the highest growth rate in the manufacturing industry, is estimated at 9.7 percent in anticipation of accelerated development of energy.

The growth rate of the construction industry is estimated at 7.8 percent, which is lower than the rate attained in the past three years. The growth of agricultural production is estimated at 4.9 percent, which is almost the same as the present level. The growth of the service industry is estimated at a rather high rate of 6.1 percent.

As evident from the foregoing analysis of general economic situation, the important and urgent question of the Philippine economy is to solve the problem of excess labor-oriented economy or the problem of unemployed and underemployment and the energy problem. While the impact of the present world economic recession has had a tremendous impact on the Philippine economy, its earliest recovery is strongly hoped for. Suter economic recovery is largely dependent on the prompt materialization of IMF relief loans and the concerted effort of the government and private sectors for the successful implementation of the new five-year economic development program.

CHAPTER 2

POWER SITUATION IN THE PHILIPPINES

Chapter 2. Power Situation in the Philippines

2-1. Status of Energization

The power industry of the Philippines is composed of two sectors, the generation and transmission sector and the distribution sector, managed by separate organizations. The biggest one of power distribution sectors is shared of Manila Electric Co. (MERALCO), a private power distribution company in Metro Manila, local public and private power distribution companies and the cooperatives (118 in number at the end of 1983) which are local organizations responsible for the promotion of rural electrification under the guidance of the National Electrification Administration (NEA).

The National Power Corporation (NAPOCOR) supplies power directly to large local consumers and sells power at wholesale prices to MERALCO, public and private power distribution companies and the cooperatives.

The energization ratio of the Philippines at the end of 1983 was 53 percent with the number of households energized reaching 4,230,000 as shown in Table 2-1. The figure represents an increase of 265,000 households over the previous year. The energization ratio in Metro Manila is as high as 93 percent. In other regions, the ratio is relatively high at 77 percent in Region III, 60 percent in Region IV, both near Metro Manila and 63 percent in Region I in northeastern Luzon, but is lowest at 23 percent in Region VIII including Leyte and Samar.

Table 2-1 Status of Energization (As of December 31, 1983)

Region	Municipalities		Barangays		House Connection			Cooperatives			MERALCO			Others		
	Coverage	Energized	Coverage	Energizod	Potentiol	Actual	%	Potential	Actual	%	Potential	Actual	%	Potential	Actual	%
I	165	150	3622	2848	583000	369820	63	515000	334277	65				68000	35543	52
II	107	90	2408	1145	369000	130180	35	369000	130180	35						
III	122	122	2252	1888	827000	639607	77	581000	431323	74	92000	84596	92	154000	123688	80
IV—A	17	17	—	—	1223000	1139836	93				1223000	1139836	93			
IV—B	194	179	3182	1760	996000	600222	60	545000	268798	49	363000	272657	75	88000	58767	67
V	108	96	3296	1885	551000	228546	41	551000	228546	41						
VI	129	129	3834	1665	750000	234247	31	712000	212919	30				38000	21328	56
VII	131	125	2541	1274	589000	227688	39	435000	112963	26				154000	114725	74
VIII	133	102	3916	1136	456000	104632	23	456000	104632	23						
IX	83	62	2099	637	381000	90140	24	381000	90140	24						
X	107	102	2030	1281	426000	188955	44	395000	169982	43				31000	18973	61
XI	85	72	1368	507	536000	178046	33	437000	124273	28				99000	53773	54
XII	100	89	3198	1114	358000	97958	27	327000	75504	23				31000	22454	72
Total	1481	1335	33746	17140	8045000	4229877	53	5704000	2283537	40	1678000	1497089	89	663000	449251	66

2-2. Energy Sales by Region

Changes in energy sales and system peak by region for the period from 1977 to 1983 are shown in Fig. 2-1 and Fig. 2-2. The total energy sales in the Philippines in 1983 increased to 17.09 billion kWh from 10.73 billion kWh in 1977 at an annual growth rate of 8.1 percent. By area, Luzon accounted for 13.9 billion kWh or 81.4 percent of total energy sales in 1983, of which 10.4 billion kWh or 61.3 percent of the total was sold by MERALCO servicing Metro Manila. The sales in Mindanao amounted to 2,250 million kwh accounting for 13.2 percent, while that in Visayas was 930 million kwh or 5.4 percent.

The peak power in the Philippines attained in 1983 was 3,117 MW, comprizing 2,478 MW in Luzon, 410 MW in Mindanao and 229 MW in Visayas, with Luzon accounting for the largest share. However, the trend of leveling off in the growth of energy sales has become apparent since the beginning of 1984 owing to the recession experienced toward the end of 1983.

Shown in Table 2-2 is a comparison of energy sales in Luzon, which accounts for the greatest portion of energy sales in the Philippines, in a six-month period between 1983 and 1984. According to the table, the energy sales in Metro Manila in the six-month period of 1984 decreased by 380 million kWh (7.25%) from the same period of previous year, with the total sales in Luzon decreasing by 5.14 percent.

In 1984, the peak power in Luzon in June, the month when the maximum peak power is normally experienced, was 2,374 MW, a decrease of 145 MW (5.8%) from 2,519 MW in 1983. The maximum peak power in Metro Manila in June, 1984 was 1,677 MW, a decrease of 278

Fig. 2-1 Energy Sales (Total)

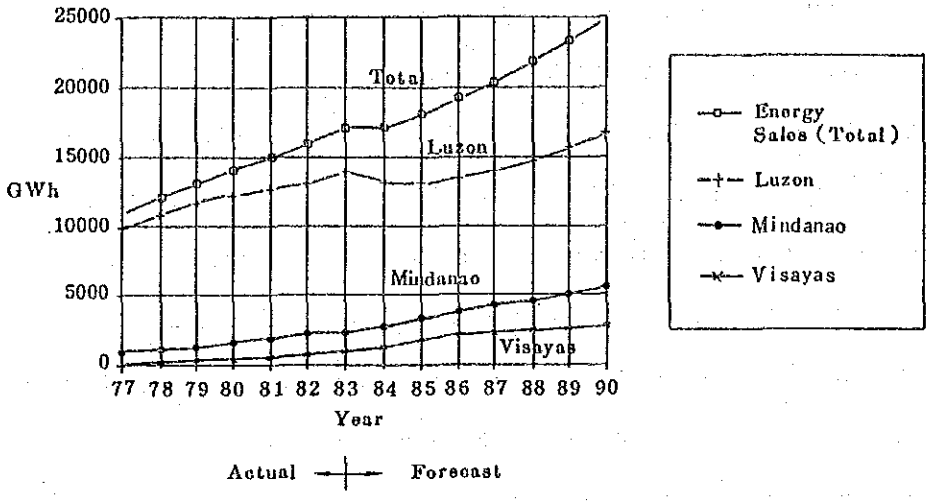
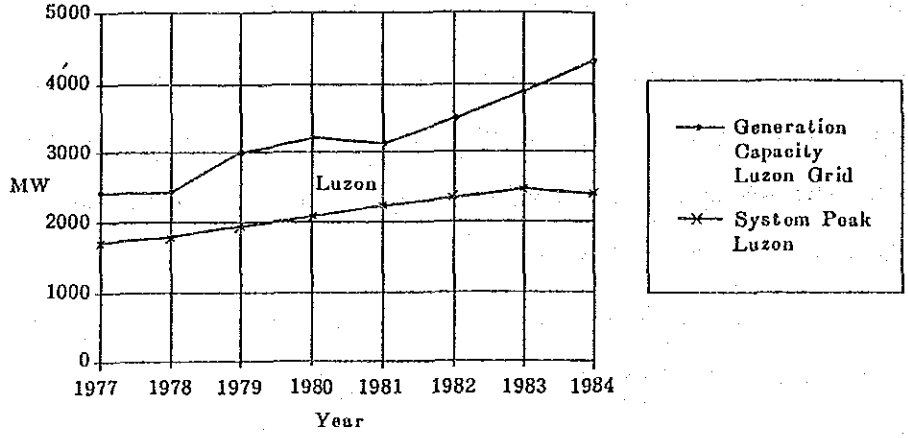


Fig. 2-2 Generation Capacity & System Peak

: Luzon Grid



: Visayas & Mindanao Grid

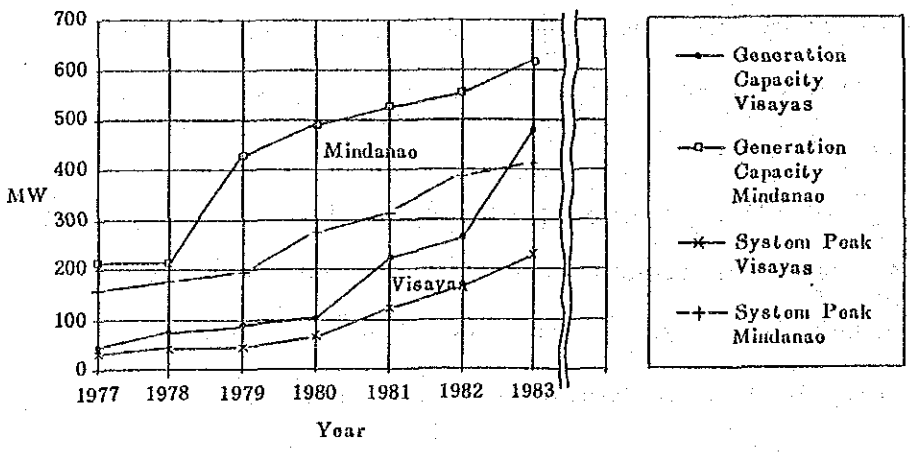


Table 2-2 Comparative Energy Sales (Luzon Grid)

Unit : MWh

	1983			1984			Percent Increase		
	Provincial	MERALCO	Total	Provincial	MERALCO	Total	Provincial	MERALCO	Total
Jan.	280.874	781,364	1,062,238	279,097	746,642	1,025,739	△ 0.63	△ 4.44	△ 3.44
Feb.	282,430	855,973	1,138,403	289,806	815,415	1,105,221	2.61	△ 4.74	△ 2.91
Mar.	262,591	826,177	1,088,768	271,901	773,564	1,045,465	3.54	△ 6.37	△ 3.96
Apr.	298,475	900,570	1,199,045	300,542	867,684	1,168,226	0.69	△ 3.65	△ 2.57
May.	288,676	920,833	1,209,509	301,759	829,903	1,131,662	4.53	△ 9.87	△ 6.44
Jun.	305.606	988,634	1,294,240	298,421	858,123	1,156,544	△ 2.35	△ 13.20	△ 10.64
Total	1,718,652	5,273,551	6,992,203	1,741,526	4,891,331	6,632,857	1.33	△ 7.25	△ 5.14

MW (14.2%) from the same period of the previous year.

2-3. Power Demand and Peak Load Forecast

In June 1984, NAPOCOR announced a new forecast of power demand and peak load demand in view of the stagnant Philippine economy and slackened growth of demand for the first half of 1984. The outline of the forecast is shown in Table 2-3.

The power demand in the Philippines in 1984 is forecast to be below the level of 1983 but is estimated to increase steadily thereafter at an average annual growth rate of 4.7 percent during the 1984 - 1988 period and at a higher annual rate of 6.1 percent during the 1989 - 1995 period following the anticipated growth of the Philippine economy, with the average annual growth rate through the 1984 - 1995 period being 5.5 percent.

Total peak load in the Philippines is forecast at 3,117 MW in 1982, 3,827 MW in 1988, 4,356 MW in 1990 and 5,737 MW in 1995. An annual growth rate of 4.2 percent is the forecast for the five years from 1984 to 1988, while a growth rate of 5.9 percent is the forecast for the last seven years, with the average annual growth through the 12-year period being 5.2 percent.

By area, a low growth rate of 1.1 percent is forecast for Luzon for the first five years owing to the recession but a higher growth rate of 6.0 percent is estimated for the last seven years, with the average annual growth through the 12-year period being 3.9 percent.

For Visayas and Mindanao, however, a high growth rate of about 13 percent is forecast for both area for the first five years and growth rates of 2.9 percent and 7.1 percent, respectively, for the last seven years in anticipation of the expansion of generating

Table 2-3 Load & Demand Forecast in June 1984

		1983	1984	1985	1986	1987	1988	1989	1990	1995
Energy Sales (GWh)										
	Philippines	17089	16429	17624	19059	20396	21508	23054	24604	32507
	Luzon	13908	12517	12768	13278	13942	14779	15665	16605	22222
	Visayas	933	1246	1713	2123	2219	2315	2510	2577	2919
	Mindanao	2248	2666	3143	3658	4235	4414	4879	5422	7366
Demand (MW)										
	Philippines	3117	2961	3122	3362	3619	3837	4096	4356	5737
	Luzon	2478	2220	2263	2354	2471	2619	2776	2943	3939
	Visayas	229	303	349	397	413	434	460	471	529
	Mindanao	410	438	510	611	735	784	860	942	1269

Note : 1983 Actual , 1984 ~ 1990, 1995 Estimates.