The price of FM current comparison relaying system is higher than that of other systems. Since it has four channels of signal circuit, it is suitable for multiple terminal circuit of more than three terminals.

For normal two-terminal circuit section, the sample value phase comparison relaying system requiring only one signal circuit will be used.

b. Backbone Line Protective Relay Improvement Plan

(1) Sample value phase comparison relaying system will be employed for the 230 kV Mexico-Kalayaan line and others shown as follows for duplication of protective relays.

No. of sections: 17 sections, 34 terminal stations

Mexico-San Jose

Mexico-Balintawak

San Jose-Balintawak

San Jose-Balintawak.....New line No. 1

San Jose-Balintawak.....New line No. 2

San Jose-Hermosa.....Lines No. 1 and No. 2

San Jose-Dolores.....Lines No. 1 and No. 2

Dolores-Malaya.....Lines No. 1 and No. 2

Malaya-Kalayaan.....Old lines No. 1 and No. 2

Malaya-Kalayaan.....New lines No. 1 and No. 2

San Jose-Kalayaan.....Lines No. 1 and No. 2

(2) Replacement of Mechanical Distance Relays with Static Type

Mechanical distance relays at 64 terminal stations shown in Table 9-9-1 will be replaced with static distance relays.

Table 9-9-1 Schedule of Replacement of Old Electromechanical Relays by Static Relays

	Line	Number of Relays	Year
1.	Binga-La Trinidad 230 Lines 1 & 2	4	1987
2.	La Trinidad-Bauang 230 Lines 1 & 2	4	1987
3.	Hermosa-PNPP Lines 1, 2, 3, 4 & 5	10	1987
4.	Hermosa-Bataan 230	2	1987
5.	Bataan-PNPP 230	2	
6.	Binan-Calaca 230 Lines 1 & 2	4	1987
	Total for 1987.....	26	
7.	Magat-Santiago 230 Lines 1 & 2	4	1988
8.	Santiago-Ambuklao 230	2	1988
9.	Santiago-Ambuklao 230	2	1988
10.	Bayombong-Ambuklao 230	2	1988
11.	Ambuklao-Binga 230 Lines 1 & 2	4	1988
12.	San Jose-Balintawak 115 Lines 1 & 2	4	1988
13.	San Jose-Angat 115 Lines 1, 2 & 3	6	1988
14.	Gumaca-Labo 230 Lines 1 & 2	4	1988
15.	Labo-Naga 230 Lines 1 & 2	4	1988
16.	Naga-Tiwi 230 Lines	2	1988
17.	Naga-Daraga 230	2	1988
18.	Tiwi-Daraga 230	2	1988
	Total for 1988.....	38	

c. Employment of Transfer Trip System

In the system north of San Jose substation, there is a problem of over power flow in healthy transmission lines due to a fault in one transmission line as described below, and this problem will continue to exist until the completion of 500 kV system in the future.

(1) When the power generation by north hydro power plants increases while PNPP is in operation and when there is a tripping of 2 circuits of Hermosa-San Jose line, over power flow in the Hermosa-Mexico line, Mexico-Balintawak line and Mexico-San Jose line is unavoidable.

(2) When there is a tripping of Mexico-San Manuel line or San Manuel-Ambukulao line while north hydro power plants are operating at more than 80% of the capacity, a very large power flow in unaffected transmission lines is unavoidable.

The above conditions can be detected at San Jose and San Manuel substations. Since the tripping of the Ambukulao-Binga line can be detected by the power plants located within this section, output of Ambukulao power plant must be controlled accordingly. For other sections, whatever power stations detecting such a condition should utilize a microwave link to transmit a signal for transfer trip of output of Magat power plant.

d. Employment of High Speed Reclosing System

For improvement of system stability, three-phase (or single-phase) reclosing will be employed in the two parallel

circuits section upon confirmation of that the other healthy line is connected between both terminals in one-line-to ground fault.

e. Review of Separated System Operation

Separated systems, including the 115 kV system in Metro Manila, in the event of a major system failure should be considered with the expansion of the Luzon Grid including the 115 kV system in Metro Manila. Since the points of system separation are expected to change depending on whether it is dry season or wet season, switching points for system separation should be decided by the judgement of PMC.

f. Training on Maintenance of Protective Devices

A training institute, equipped with a simple simulator of transmission lines and various types of relays should be provided for training of maintenance personnel for confirmation of the operation of various types of relays and for the study of relay characteristics so that they can improve their skills and acquire the knowledge how to analyze abnormal operations of protective devices.

g. Provision for Recorders

Fault recorders and sequence recorders should be provided at power plants and substations of the Luzon Grid. With these recorders, the operating state of circuit breakers and protective relays can easily be monitored in the event of a system fault. Even for a complicated system fault, the operating state of protective relays can easily be monitored and accurate analysis of operating sequence can be made for taking prompt actions.

Schedule of stations to be provided with sequential event recorders (23 sets) and schedule of stations to be provided with fault recorders (10 sets) are shown in Tables 9-9-2 and 9-9-3, respectively.

Table 9-9-2 Schedule of Stations to be Provided with Sequential Event Recorders

Substation	
1. Santiago	7. Concepcion
2. Bayombong	8. Cabanatuan
3. La Trinidad	9. Dasmarinas
4. Labrador	10. Gumaca
5. Sta. Cruz	11. Labo
6. Olongapo	12. Daraga

Table 9-9-3 Schedule of Stations to be Provided with Fault Recorders

Allocation for four (4) SANGAMO CME Recorders to be initially procured.

Plants	Substations
1. Binga HE Plant.	1. Dolores
2. PNPP	2. Malaya
3. Sucat Thermal Power Plant.	3. Binan
4. Mak-Ban Geothermal Power Plant.	
5. Tiwi Geothermal Power Plant.	

h. Provision for Fault Locator

The fault locator which locates the point of a fault is scheduled to be installed on Siemens static distance relay 7SL24 in the section where this relay is provided. The fault locators are also scheduled to be installed in four sections together with the installation of ASEA's RAZFE static relays.

For the sections where there are no fault locators at present or where there is no plan for installation, 12 sets of fault locators should be added as follows.

Table 9-9-4 Schedule of Stations to be Provided with Fault Locators

1st Stage		2nd Stage	
Mexico	1 set	Hermosa	1 set
Hermosa	1 set	Labo	1 set
Kalayaan	1 set	Makban	1 set
Naga	1 set	Ambuklao	1 set
Daraga	1 set	Santiago	1 set
Binan	1 set		
Santiago	1 set		
Subtotal	7 sets	Subtotal	5 sets

Total 12 sets

i. Measures for High Resistance Ground Faults

High resistance ground faults are very difficult to detect. However, a high resistance ground faults does not require high speed trip of the line like a short-circuit fault. In the event of a high resistance ground fault, therefore, it is important to determine the location of the fault from a total system point of view and take appropriate measures.

For this purpose, ground directional relays will be provided at various locations to transmit signals indicating their operating state to the load dispatching office, where signals from various points will be displayed for monitoring the state of relay operation.

The ground directional relays will be provided in the Mexico-Kalayaan section and data are to be transmitted to the load dispatching office by microwave system for processing by the SCADA system for display.

Table 9-9-5 Stations to be Provided with Ground Directional Relays

Mexico Substation	6 pcs
Balintawak Substation	4 pcs
San Jose Substation	10 pcs
Dolores Substation	4 pcs
Malaya Substation	6 pcs
Kalayaan Substation	12 pcs
Total	42 pcs

9-10. Communication Facilities

The following microwave communication systems should be provided for load dispatching operation and transmission of protective relay signals.

a. Microwave System for Load Dispatching Operation

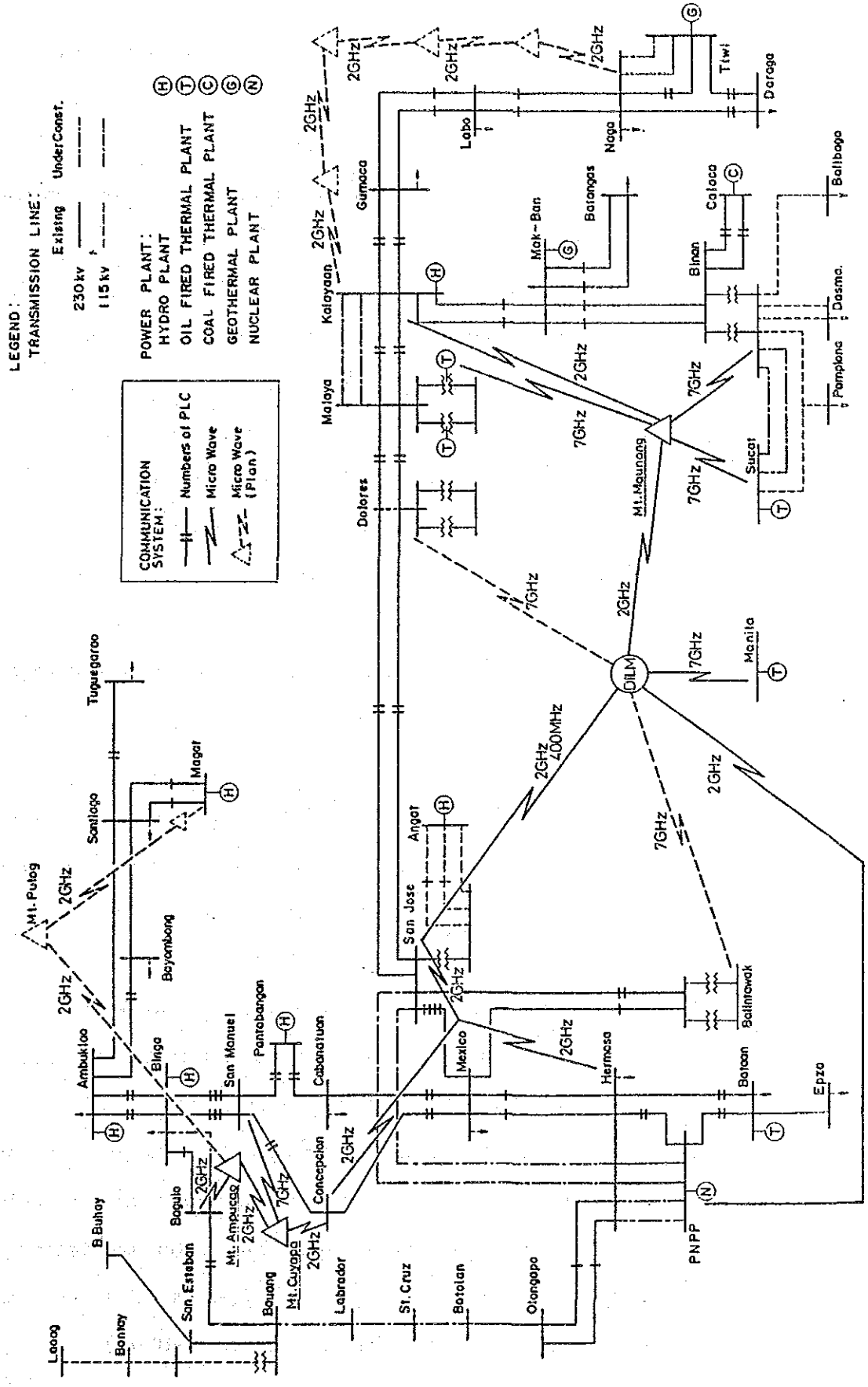
A microwave link for load dispatching operation will be provided up to Magat power plant as described below (see Fig. 9-10-1. Microwave Communication Diagram).

2 GHz microwave circuit will be extended from the existing Mt. Apucao relay station, via new Mt. Pulog relay station and Santiago substation, to Magat relay station near Magat power plant. Cable line will be used between Magat relay station and the power plant.

b. Protective Relay signal Transmission

(1) The protective relaying system of 230 kV outer link transmission lines from Mexico substation in the north of Metro manila to Kalayaan substation in the south should be duplicated. More specifically, a dual relaying system comprising the existing distance relay or new static distance relay and the phase comparison (sample value) relay should be provided. A microwave communication system should be used for the transmission of phase comparison relay signals, while power line carrier telephone line will be used for the transmission of static distance relay signals. This duplicated both the relaying system and signal transmission line, thereby greatly improving the reliability of protection system. At Dolores and

Fig. 9-10-1 Communication System Diagram



Balintawak substations, which lack microwave communication links with DILM in the present power system, 7 GHz microwave links should be provided.

At Mexico, San Jose, Malaya and Kalayaan, where a microwave communication line is already provided, an additional signal terminal station should be provided.

(2) The new Naga-Kalayaan 500 kV transmission line will be provided with current-operated relays utilizing the microwave communication link to ensure the complete system protection. The 2 GHz trunk microwave link will be provided for a distance of 300 km between Kalayaan power plant and Naga substation with four relay stations constructed between the two points. This microwave link can also be used as a communication system for load dispatching operation of Tiwi and Manito geothermal power plants in the south.

c. Construction of a New Power Line Carrier Communication System

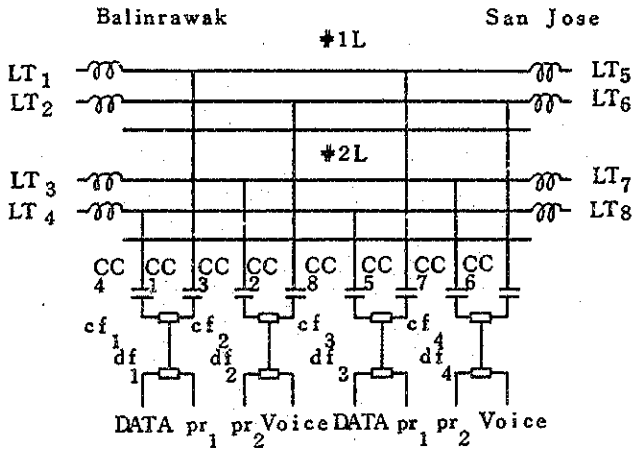
With the change of part of 230 kV transmission system (route), a new power line carrier communication system must be provided.

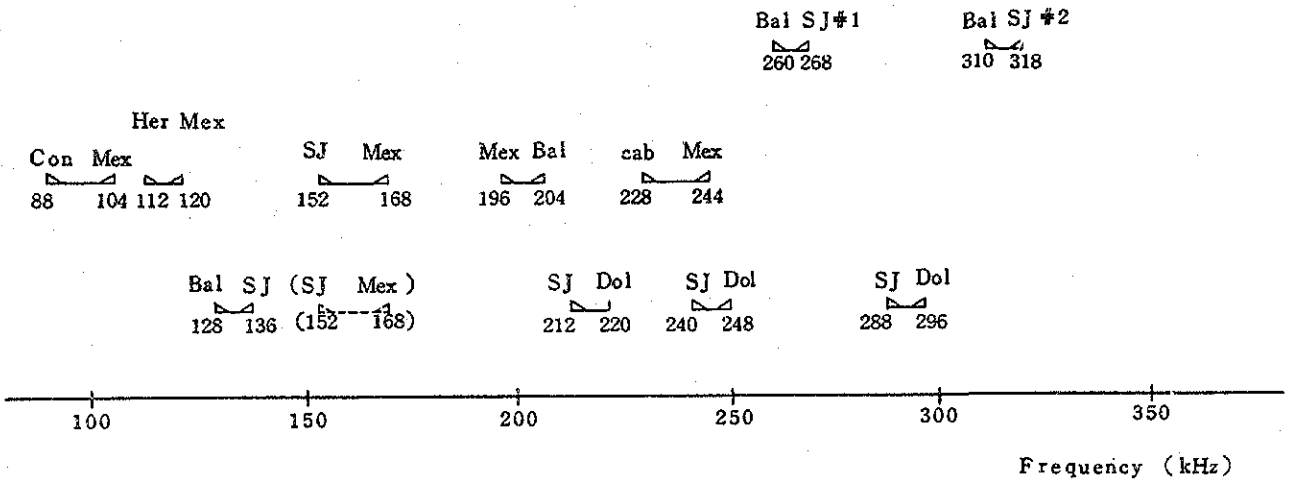
(1) With PI connection of two circuits at Bayombong substation, two power line carrier terminals should be provided at the station (Two-phase metal circuit system).

(2) With the construction of two-circuit 230 kV San Jose-Balintawak line, two power line carrier terminals should be provided at each of San Jose substation and Balintawak substation. (The system is different line two-phase metal circuit system as shown in Fig. 9-10-2.)

Fig. 9-10-2

PLC Layout





d. Main Equipment

Microwave systems for north and south Luzon are shown in Fig. 9-10-3 and Fig. 9-10-4, respectively. Main facilities for microwave communication are as shown in Table 9-10-1. Main facilities include five houses, eight 20 t antenna steel towers, two 40 t steel towers, twenty 4 mφ parabolic antennas, twenty-two radio sets, thirty-nine modules and six DC power units.

As blocking coils and coupling condenser of power line carrier are included in the estimated construction cost of substations, filters and communication equipment for six terminal stations are to be provided.

9-11. Improvement of Mobility of Line Gangs

At present, the line gangs are distributed to 44 locations in the area of North Luzon branch office and 18 locations in the area of South Luzon branch office. Each line gang is composed of 8 to 9 linemen and is charged with the maintenance of 230 kV line down to 69 kV line. Transmission line length and the number of line gangs are shown in the following Table 9-11.

Table 9-11 T/L Length and Line Gangs

		No. of line gang	No. of line men	Transmission Line			
				230 kV T/L (km)	115 kV T/L (km)	69 kV T/L (km)	Total (km)
North	No.	44	325	1924	476	1603	4003
	km/man			5.92	1.46	4.93	12.32
South	No.	18	151	1595	146	935	2676
	km/man			10.56	0.97	6.19	17.72
Total	No.	62	476	3519	622	2538	6679
	km/man			7.39	1.31	5.33	14.03

Fig. 9-10-3 Micro System for South Luzon

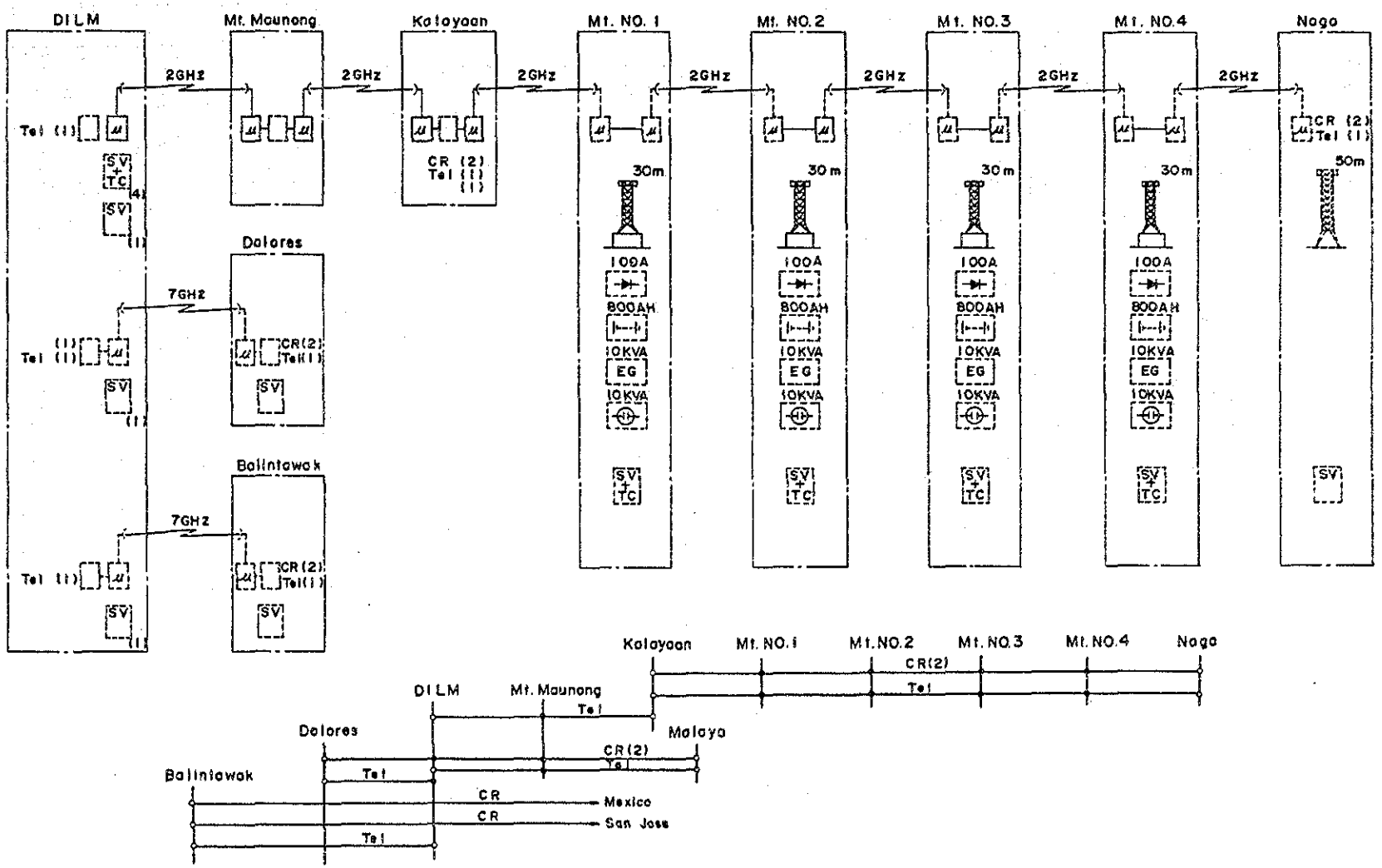


Fig. 9-10-4 Micro System for North Luzon

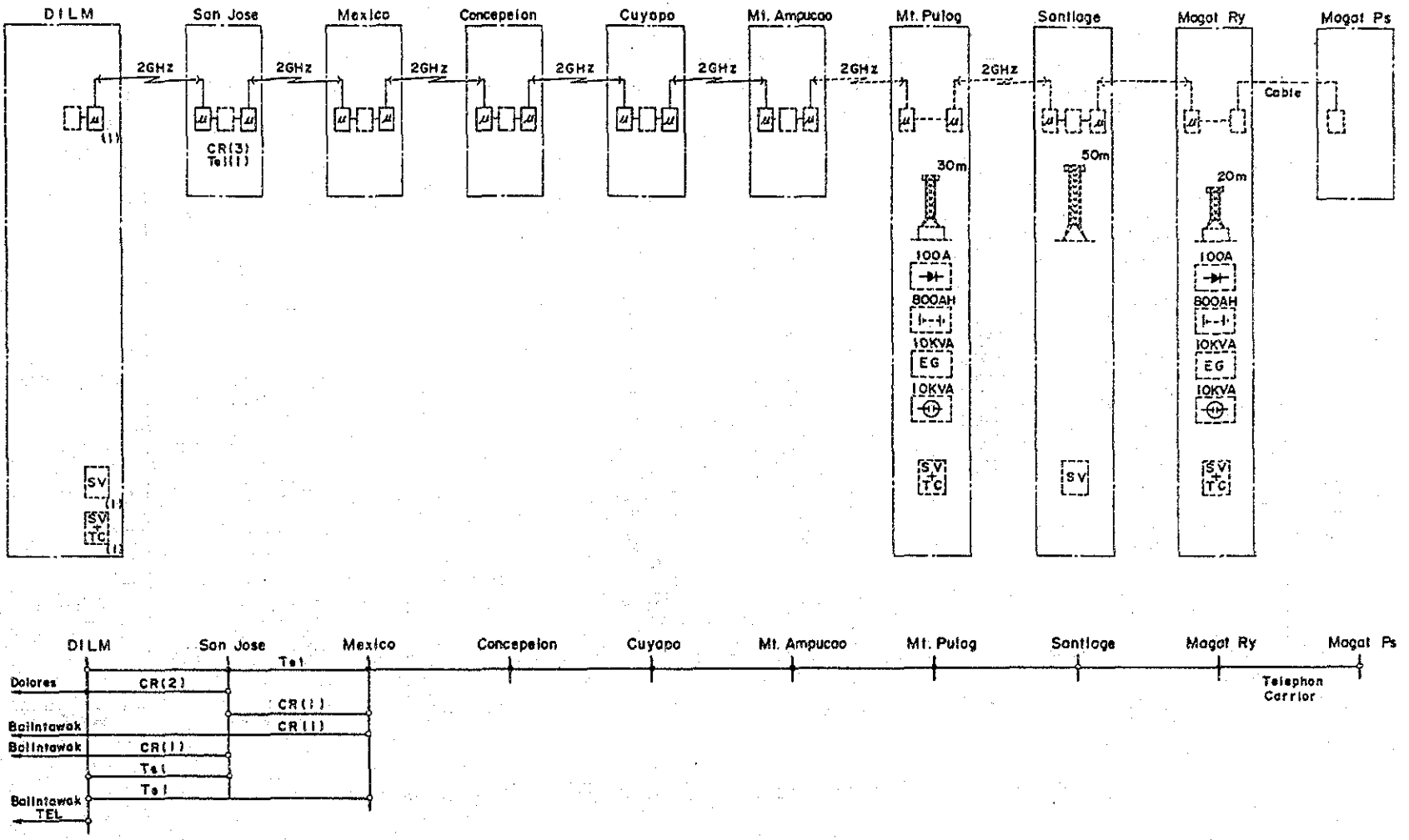


Table 9-10-1 Facilities for Micro-Wave Communication

	DILM	S. Jose	Mexio	Mt. Quyapo	Mt. Ampucao	Mt. Pulog
House	–	–	–	–	–	1
Steel tower	–	–	–	–	–	1
Antena	2	–	–	–	1	2
Radio set	–	–	–	–	1	2
Module	7	2	1	1	1	2
Power source	–	–	–	–	–	1

	Santiago	Magat R.	Magat P.	Dolores	Balint	Malaya
House	–	1	–	–	–	–
Steel tower	1	1	–	1	1	–
Antena	2	1	–	1	1	–
Radio set	2	1	–	1	1	–
Module	2	2	1	1	1	1
Power source	–	1	–	–	–	–

	Mt. Maunong	Kalayaan	Mt. #1	Mt. #2	Mt. #3	Mt. #4	Naga
House	–	–	1	1	1	1	–
Steel tower	–	–	1	1	1	1	1
Antena	–	1	2	2	2	2	1
Radio set	–	1	2	2	2	2	1
Module	5	3	2	2	2	2	1
Power source	–	–	1	1	1	1	–

The length of transmission line per lineman is 14.03 km on the average, of which 230 kV line is 7.39 km accounting for more than 52%. Moreover, most of the 230 kV lines run through mountain areas. At present, each line gang is provided with one maintenance truck. Besides, one heavy duty maintenance truck is provided for every three or four gangs. When the terrain of their area of responsibility and the importance of the maintenance of 230 kV transmission lines are taken into account, the mobility of each line gang should be improved with the provision of additional maintenance trucks and land cruisers. The total requirement is as follows.

Maintenance truck	65 units
4-wheel drive maintenance car	130 units
Special vehicles	30 units
Total	225 units

9-12. Education and Training Facilities

With the increasing tendency toward the use of large size, automated, extra high voltage and sophisticated power equipment, it becomes more difficult to expect operation stability of the power system and improvement of operators' skills only through on-the-Job training of operators. For this reason, training of operators with the following simulators of power plants and substations is considered essential.

a. Steam Power Plant Operation Simulator

This simulator can be used for operation of both coal-based and oil-based thermal power plants and simulates the

functions of 300 MW class steam and turbine systems.

b. Power System Simulator

This simulator simulates a power system composed of 2 substations and 2 power plants.

Each power plant and substation of the simulator is equipped with four bays and 12 CB circuits and can simulates the operation of most of present NAPOCOR power plants and substations.

9-13. Others

In some of the existing 230 kV substations, switchboard simulates the station bus bars. With the anticipated expansion of power system in the future, it is increasingly important for the main 230 kV substations to operate with due consideration given to their relations with the total power system. Each of the following substations and power plant will be provided with a system board and a load dispatching table.

Mexico substation

Hermosa substation

San Jose substation

Dolores substation

Malaya substation

Kalayaan power plant

Total 6 locations

CHAPTER 10

REVISED SCHEDULE OF THE PROJECT AND CONSTRUCTION COST

Chapter 10. Execution Schedule of the Project and Construction Cost

10-1. Items for Execution

NAPOCOR has been endeavouring to restore a higher supply reliability as an utility by engaging in the rehabilitation project of thermal plants around Metro Manila, the construction work for the reinforcement of the transmission line, the substitution of obsolete facilities and the rearrangement of unrational configuration of the system as he has been executing the expansion programs since 1980. But the total black-out faults had occurred in 1983 and 1984 and they urged to review the existing renovation plans.

The reviewed plant renovation program is divided in two stages.

1. Plant Renovation Program-1:

   Rehabilitation Plan for Main Thermal Power Plants in Luzon Grid

2. Plant Renovation Program-2:

   Renovation Plan for Luzon Grid System

The former has been executing some part of the program because the recovery of the capacity of main thermal power plants is urgent for the supply in Luzon Grid.

Plant Renovation Plan 2nd Stage should be executed dividing in 3 phases previously mentioned in Chapter 8.

Table 10-1 Phase-1: Execution Schedule of Immediately Corrective Measures from 1985 to 1987

	Item No. In Chap. 9	Engineering Works	Procurement of Equip. & Materials	Construction Works
(1) Review of System Operation Methods	9-3-b-(2)-2)	o	-	-
(2) Study of Training of Actual Works for Operators & Maintenance Crew	9-1, 9-12	o	-	-
(3) Improvement of System Stability				
Construction of New 230 kV Lines between San Jose & Balintawak 2 cct PI at Bayombong and Others	9-3-1-(1), 9-4, 9-5, 9-6	o	o	o
(4) Renovation of Facilities of SS & Protecting Relay				
Dual Protecting System for Main T/L Replacement of Obsolete C.B. Installation of Static Z Relay Installation of Recording Equipment	9-3-c, 9-5, 9-7, 9-9-a, b, c, g, h	o	o	o
(5) Improvement of System Voltage				
Static Condenser 170 MVA (Hermosa 50, San Jose 50, Dolores 50, Sucat 20) Shunt Reactor 50 MVA at Hermosa	9-3-a-(2), (3), 9-8	o	o	o
(6) Expansion of Communication System				
Expansion of Micro-Wave Communication System & PLV for New Constructed Transmission System	9-10	o	o	o
(7) Arrangement for Maintenance Materials & Equipment				
Vehicles for Line Gang and Arrangement of Materials and Equipment for Maintenance	9-11	o	o	-
(8) Installation of Training Simulators				
Simulators for Thermal Plant & SS Operators	9-3-b-(2)-1) 9-12	o	o	o

Phase 1: Immediate Corrective Measures

The construction work should be executed in each item as shown in Table 10-1.

Furthremore, the study of the software for power system operation, the improvement of operating methods for system facilities and training for emploee, is an important portion of the work for Phase 1 as well as the expansion and improvement of system facilities.

The study and planning for executin of the software is specially needed the assistance of the consultant.

Engineering works as mentioned in Table 10-1 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.

Phase-2:

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.

	Engineering Works	Procurement of Eqt. & Materials	Construction Works
(1) Reinforcement for System Stability Improvement Review of SCADA System Relocation of Shunt Reactors	o		
(2) Improvement of System Voltage Recommendable Voltage Control System	o	(Note: Planning should be done in the works of Phase 1.)	
(3) Study for Reasonable Reserve Capacity	o		
(4) Study for the Organization of Maintenance	o		
(5) Study for the Reinforcement of Main Transmission Lines Main Transmission Lines Kalayaan...Bin'an	o		
(6) Extension of Micro-Wave Communication System Loop System	o		

Phase-3:

Phase-3 should be executed considering the effects of Phase-1 and Phase-2, and the study of the expansion plan of power plants and transmission system.

10-2. Method for the Execution of the Program

Phase-1:

The packages of works should be divided three main items.

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

. Substation facility and maintenance equipment

. Facilities for transmission system and line gang

Following the awarding of contracts, a work execution system should be established and an overall work execution program should be worked out for each of the groups of facilities as basic works for implementation of the plan.

a. Load Dispatching Facilities

The work of communication system, installation of training simulators and the preparation of operation and maintenance manuals by the contractor should be carried out separately from the construction work. However, the work of PLC and modernization work of load dispatching facilities should be carried out in parallel with the work of substation facilities.

b. Substation Facilities and Maintenance Equipment

Works to be executed include PI connection and installation of additional circuit breakers at Bayombong s/s, drawing-in facilities for two circuits of the Balintawak line and replacement of circuit breakers at San Jose s/s, replacement of circuit breakers at Mexico s/s, installation of static condensers and shunt reactors, and replacement and additional installation of protective relays and measuring instruments at

Hermosa, San Jose and other substations.

While the equipment and materials for these works will be ordered simultaneously, the works should be carried out individually for each substation as different works are required for different substations.

However, the installation and replacement of measuring instrument and protective relays should be commenced for each group of substations according to the progress of construction work of the related substations and should be carried out while making the necessary adjustments and conducting the required tests.

c. Facilities of Transmission System and Maintenance Equipment for Line Gangs

Works to be executed include the construction of the San Jose-Balintawak 230 kV two-circuit line and procurement of vehicles and maintenance equipment for line gangs.

Construction of transmission lines, which normally takes a longer time to complete than other works because of the difficulty in acquiring the right of way, may be the key to the overall work progress for the immediate plan of Phase-1.

Since the installation, adjustment and testing must wait for the completion of the construction work of transmission lines, the work schedule for transmission lines must be worked out with due consideration to the overall work progress.

Construction of the new 230 kV transmission line (between San Jose and Balintawak) is to be carried out while operating the existing three circuits of 115 kV transmission line. Upon completion of the 230 kV line, two circuits of the existing

115 kV line are scheduled to be abolished and one remaining circuit is to be maintained. However, the acquisition of the right of way along the route of entrance cable to Balintawak s/s seems to be very difficult, special designs or work methods, including the selection of a temporary route for the 115 kV line or grade separation of the 115 kV line from the proposed 230 kV line, will have to be considered.

d. Installation of Training Simulators and Other Training Facilities

Training simulators and other training facilities, required under the training program worked out with the assistance of the consultant, should be provided (during the execution of the works of the Renovation plan) for on-the-Job training of maintenance crews and operators.

10-3. Procurement Schedule

After obtaining the required fund for the execution of urgent works of Phase-1 (the immediate plan), construction works, review of the system operation and training should be commenced immediately.

the works of Phase-1 (the immediate plan) involves a number of items for improvement as mentioned previously, and the establishment of an optimum maintenance system is also essential for maintenance of supply reliability following the completion of the improvement work.

For the execution of the works of Phase-1 (the immediate plan), the following will be required.

- Employment of an engineering consultant well experienced in the planning, design, operation and maintenance of public utility facilities.
- Purchase specifications should be prepared with the assistance of the consultant and orders should be placed in three packages of the load dispatching facilities (including communication system and training simulators), the substation facilities and maintenance equipment and the transmission facilities (including maintenance equipment for line gangs).
- The contract system should be a turn-key system by which the contractor is responsible for supply, installation and test of equipment and materials and training.
- In addition, a package contract by which the responsibilities for all the works can be unified should also be considered.

The engineering services of the consultant to NAPOCOR are outlined in the following.

(1) Review of the Renovation Program and determination of the method of program implementation

(2) Study of emergency operating procedure.

(3) Planning and execution of on-the-Job training of maintenance crews and operators

(4) Assistance in the preparation of tender documents

(5) Assistance in tendering and contracting

(6) Review of contractors' specifications and drawing and assistance in approving thereof

(7) Presence at contractors' factory tests of main equipment

(8) Construction supervision

(9) Planning of required tests and presence at site tests

(10) Preparation of work completion reports and assistance in the establishment of operation and maintenance regulations.

(11) Assistance in the operation and maintenance of facilities upon completion

(12) Working out the medium-term (Phase-2) and long-term (Phase-3) renovation plans

10-4. Schedule of Construction Work

The schedule of construction work for Phase 1 is shown in Table 10-1-1--2.

The works for the immediate correction measures should be completed within 26 months after the loan contract.

The main schedule are as follows.

Loan Agreement		0 month
Consultant Contract	2 months	
Advertisement of Bid	4 months	
Bid Close		6 months
Evaluation		8 months
Contract		9 months
Start of Construction Work		11 months
Delivery of Equipment	17 months	
Completion		26 months

Consulting work for long and medium range planning for the

renovation should be served two years after the Consultant Contract signed. The extension of the consulting work will be revised on the end of the term considering the actual progress.

The outlines of the construction schedule for Phase 2 and Phase 3 are shown in Table 10-2-2. The basic idea of them should be studied and planned in the work of Phase 1.

The schedule of Engineering Services is shown in Table 10-3.

10-5. Organization for the Execution

The organization for the execution of works for Phase 1 is shown in Fig. 10-1.

10-6. Construction Cost

The construction cost for the immediate plan, including the reinforcement of power system, improvement of facilities and protective devices, voltage improvement, expansion of communication system, provision of maintenance equipment and training facilities, is as shown in Table 10-4 and is summarized as follows.

	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)

The construction cost amounts to 30.04 million dollars in foreign currency portion and 5.27 million dollars in local currency portion (as shown in the above table). With a contingency of 9.7%, the foreign currency portion amounts to 32.79 million dollars and the local currency portion 6.11 million dollars.

Disbursement of the investment according to the construciton schedule shown in Chapter 10 is as follows.

First year :	Advance payment of 30% on contract and engineering fee	$12.41 million
Second year:	Payment of 60% for equipment on shipment and engineering fee	$24.82 million
Third year :	Payment of the remaining 10% of construction cost and engineering fee	$ 4.14 million

Table 10-2-1 Schedule of Renovation Plan

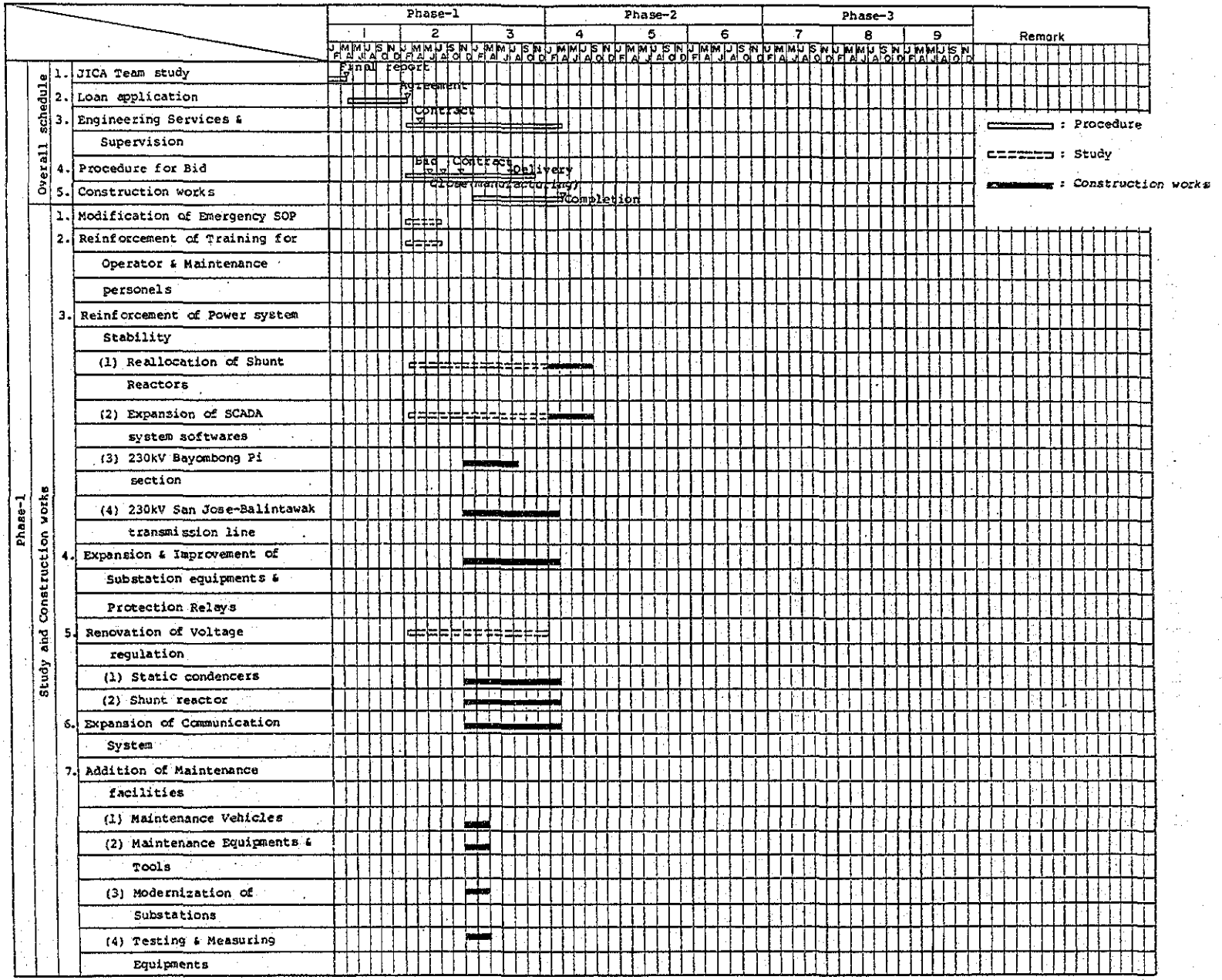


Table 10-2-2 Schedule of Renovation Plan

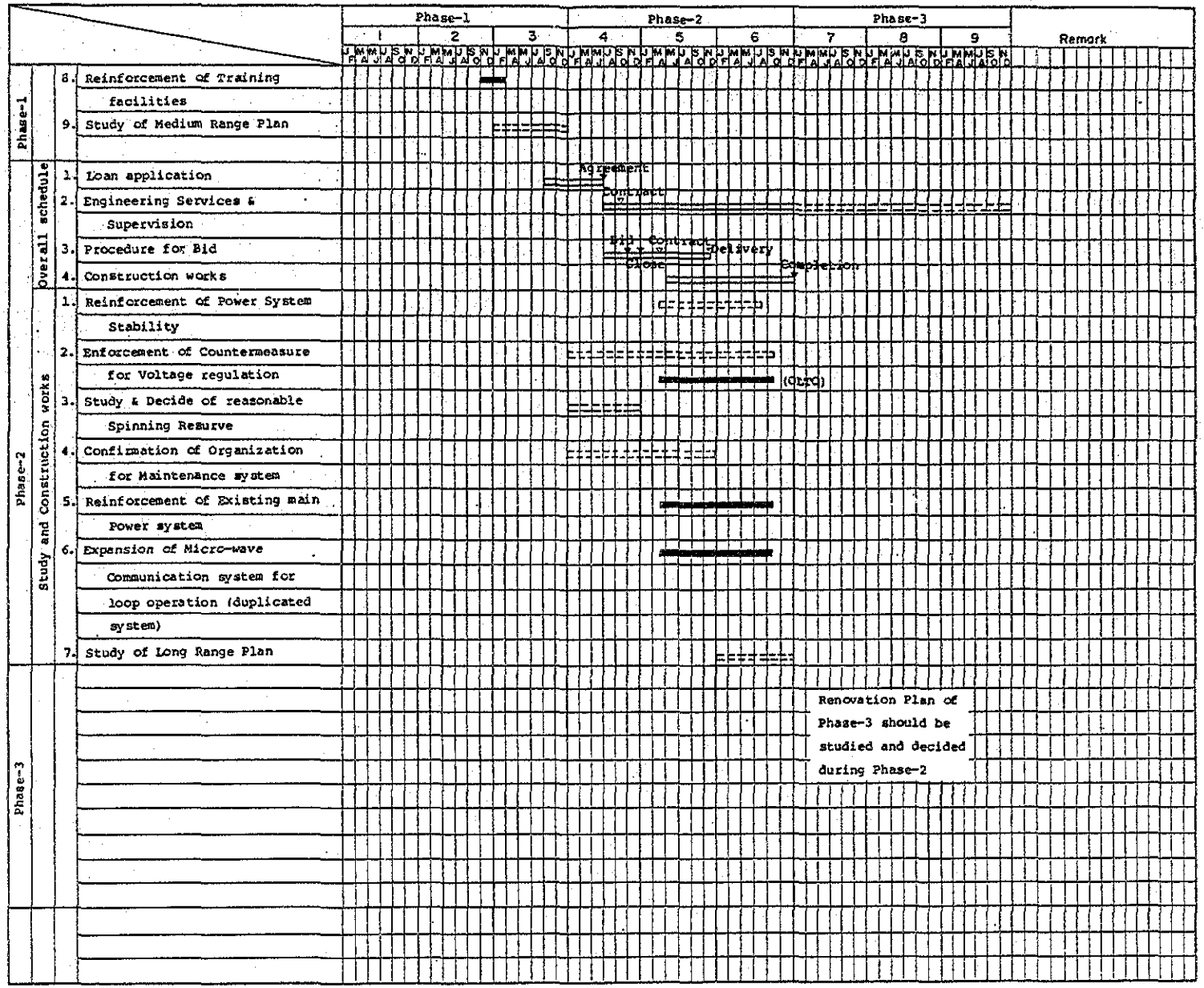
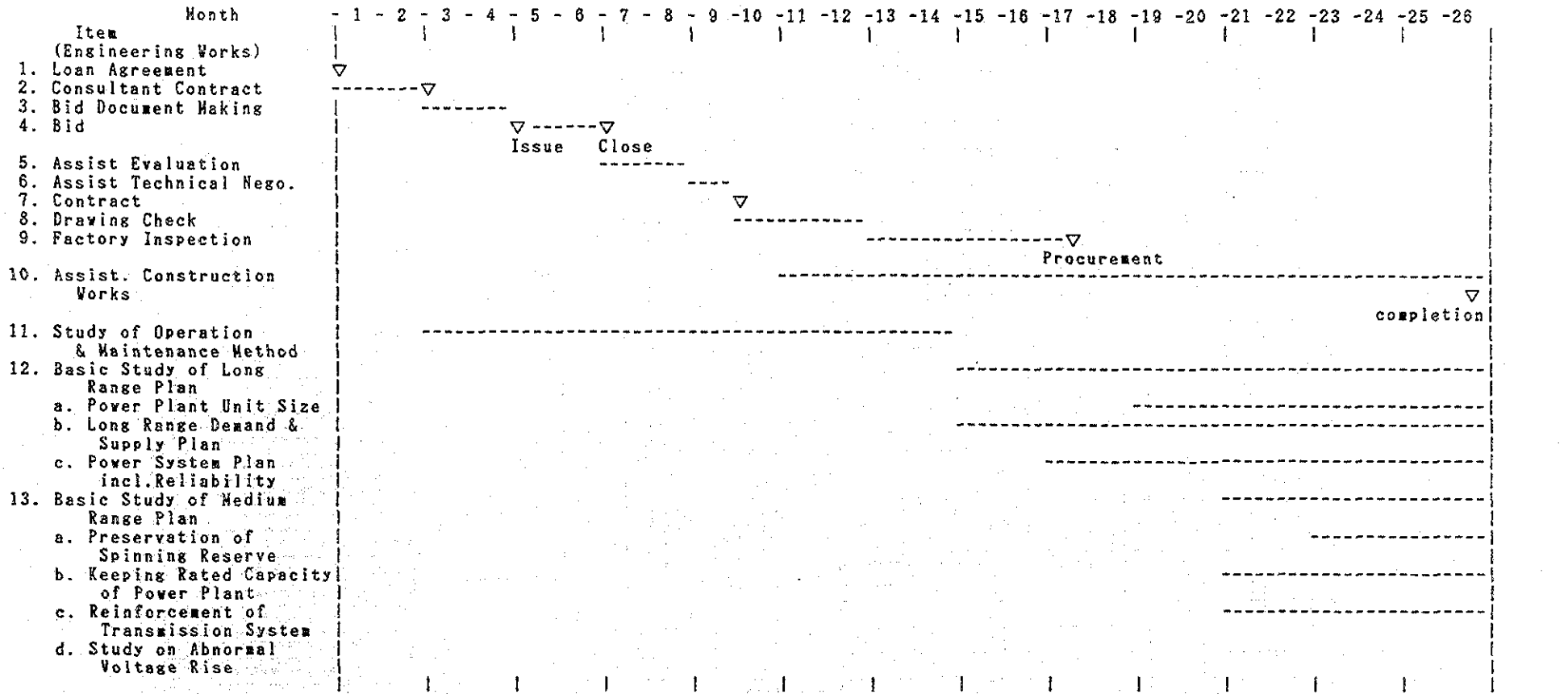
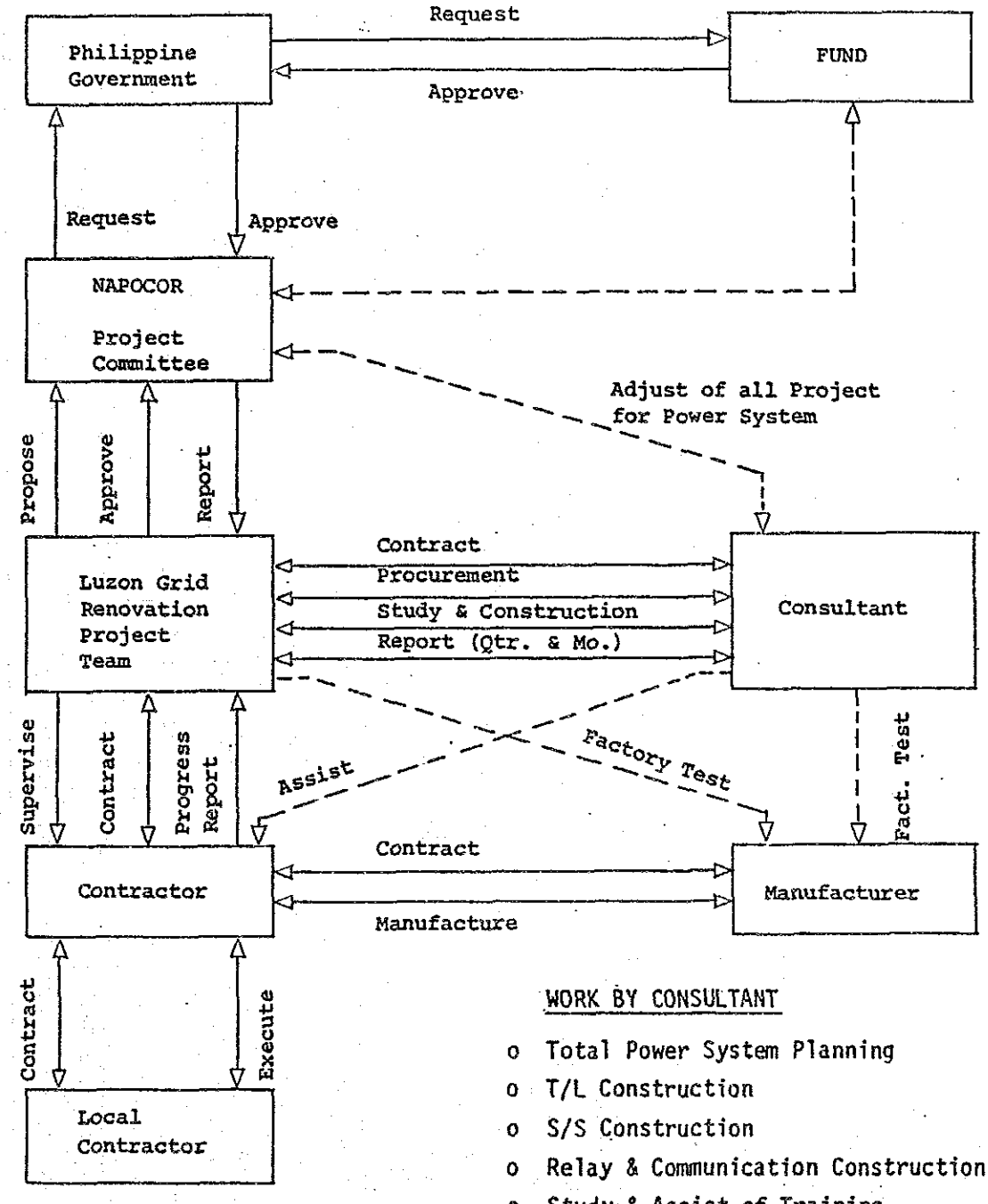


Table 10-3 Engineering Service Schedule



(Manning Schedule)	- 1	- 2	- 3	- 4	- 5	- 6	- 7	- 8	- 9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-21	-22	-23	-24	-25	-26	Total
Engineer A (M-M)			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	24
Engineer B (M-M)			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	24
Engineer C (M-M)			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	24
Engineer D (M-M)			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	24
Total (M-M)			8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	96
Home Office (------)			8	2	2	5	2	4	4	2	3	4	2	8	46												
MHL Office (======)			0	6	6	3	6	4	4	6	5	4	6	0	50												

Fig. 10-1 Organization for the Excution of Luzon Grid Renovation Project



WORK BY CONSULTANT

- o Total Power System Planning
- o T/L Construction
- o S/S Construction
- o Relay & Communication Construction
- o Study & Assist of Training
- o Study of System Operation & Maintenance Organization

Table 10-4 Construction Cost of Phase 1

No.	item	F. C.		L. C.			Total		Remarks
		m.$	m.Y	m.$	m.P	m.Y	m.$	m.Y	
1	Bayombong S/S 2cct Pi connection	0.86	212	0.30	5.40	74.0	1.16	286.0	Stability for Magat P/S
2	San Jose-Balintawak 230kV T/L	4.50	1112	4.44	80.00	1098.0	8.94	2209.0	Load increase in Manila
3	Obsolate C.B Replacement	3.73	921	1.00	18.00	247.0	4.73	1168.0	Mexico & San Jose S/S
4	Phase Comparison Relay	1.82	450	0.06	1.08	14.0	1.88	464.0	Renovation of Relay System
5	Static Z Ry. for Replacement	1.74	430	0.06	1.08	14.0	1.80	444.0	-Ditto-
6	Sequence & Fault Recorder	1.01	250	0.04	0.72	11.2	1.05	261.2	Analysis of Relay Operation
7	S.C(170MVar) & Sh.R(50MVar)	3.24	800	0.56	10.08	140.0	3.80	940.0	Voltage Improvement
8	Extention of Micro Communication	3.60	890	0.70	12.60	173.0	4.30	1063.0	For Magat, Naga, Calaca & Mak-Ban
9	Vehicles for Line Gang	2.43	600	0.00	0.00	0.0	2.43	600.0	Mobilization of Line Gang
10	Instrument for Maintenance	0.61	150	0.00	0.00	0.0	0.61	150.0	Renovation for Maintenance
11	Dispatching Desk for 6 S/S	0.16	40	0.01	0.18	2.8	0.17	42.8	Improvement Operation
12	Training Simulator for P/S & S/S	4.45	1100	0.33	5.94	84.0	4.79	1184.0	Improvement of System Operation
	Subtotal	28.15	6955	7.50	135.08	1858.0	35.66	8812.0	
	Contingency(incl. Engineering Fee)	4.22	1043	1.50	27.02	370.0	5.72	1413.0	F.C.=15% L.C.=20%
	Grand Total	32.37	7998	9.00	162.10	2228.0	41.38	10225.0	

CHAPTER 11

FINANCIAL AND ECONOMICAL EVALUATION

Chapter 11. Financial and Economical Evaluation

11-1. Financial Evaluation

The completion of the immediate corrective measures brings forth the restoration of sales energy caused by a total blackout fault and the save of additional fuel cost which is necessary to keep the system voltage in a standard condition with the additional operation of thermal power plants.

Because the merits for NAPOCOR are able to be measured their amounts, they are used as the merit of the project in the financial evaluation.

Cost:

a) Depreciation of the total investment for the plan

b) Payable interest for the investment

c) General cost and operating cost for the new facilities

Benefit:

d) Energy recovered as a result of elimination of total blackout

e) Savings of fuel cost of thermal power plants in Metro Manila as a result of expansion of power facilities and improvement of system voltage

The amount of benefit shown above was considered as a unit price of benefit per KWh on the basis of unit production cost, average unit sales price and fuel cost of thermal power plants obtained from the analysis of financial statements of NAPOCOR.

Of the cost, the operating and maintenance expenses under item c) were determined with reference to the recent record of NAPOCOR.

The recovery of sales energy with the elimination of total blackout and the saving of fuel cost with the voltage regulating facilities and the reinforced transmission system are only two items as the benefit of the plan in the financial evaluation.

Also, the recovery of transmission loss, which was very small in absolute value, was disregarded in the economic appraisal.

11-2. Assumptions used for Calculation

The following assumptions were used for calculation in the economic appraisal.

a. Increase of Power Rate and Production Cost

The consumer price index in the Philippines has been increasing at an average annual rate of more than 20% since 1983 as shown in Table 1-6 in Chapter 1. Since the prediction of the future increase rate of consumer price index was extremely difficult, NAPOCOR's long-term forecast of power rate up to 1995 was used as a trend of future power rates and the increase of production cost was considered to follow the same trend as that of the power rate forecast. The power rate after 1995 was assumed to increase at an annual rate of 6.6%, which is about one half of the average annual increase rate of 13.2% forecast for the period up to 1995.

Long-Term Forecast of Power Rates

(in Peso)

	Philippine Average Rate		Philippine Average Rate
1984	0.8288	1990	1.7706
1985	1.2251	1991	2.0506
1986	1.3347	1992	2.2755
1987	1.3638	1993	2.5859
1988	1.4132	1994	2.9543
1989	1.5829	1995	3.2308
	Annual Increase Rate		13.2%

The forecast of the oil price is down by NAPOCOR as shown in Table 11-1.

Table 11-1 Estimation of Oil Price

Unit: $/Barrel

Year	NPC act. & Estimate	#1 Estimate 1.1%	#2 Estimate 2%	#3 Estimate 3%
1979	29.45			
1980	30.63			
1981	31.85			
1982	31.85			
1983	31.85			
1984	31.85			
1985	29.00	29.00	29.00	29.00
1986	29.00	29.32	29.58	29.87
1987	29.00	29.64	30.17	30.77
1988	29.00	29.97	30.78	31.69
1989	29.00	30.30	31.39	32.64
1990	29.00	30.63	32.02	33.62
1991	31.90	30.97	32.66	34.63
1992	31.90	31.31	33.31	35.67
1993	31.90	31.65	33.98	36.74
1994	31.90	32.00	34.66	37.84
1995	31.90	32.35	35.35	38.97
1996	31.90	32.71	36.06	40.14
1997	31.90	33.07	36.78	41.35
1998	31.90	33.43	37.51	42.59
1999	31.90	33.80	38.26	43.87
2000	31.90	34.17	39.03	45.18
2001	35.09	34.55	39.81	46.54
2002	35.09	34.93	40.61	47.93
2003	35.09	35.31	41.42	49.37
2004	35.09	35.70	42.45	50.85
2005	35.09	36.09	43.09	52.38
Growth ratio/Year	1.1%/Year	1.1%/Year	2%/Year	3%/Year

As for fuel cost, NAPOCOR's long-term forecast of fuel cost is as shown in Table 11-1. The table shows a gradual increase of the price of petroleum from $29/barrel in 1985 to $31.9/barrel in 1991 and $35.09/barrel in the year 2001. Assuming that the price of petroleum increases annually at an equal rate, the average annual increase rate up to the year

2001 is calculated at 1.1% as shown under #1 column of the Table. In general, the price of petroleum in the year 2000 is often estimated at $40 to $50 per barrel. Then, calculation was made for financial appraisal for three cases - #1 case in which the unit price of petroleum is assumed by NAPOCOR to increase at an equal annual rate of 1.1%, #2 case in which the annual increase rate is estimated at 2% and #3 case in which the annual increase rate of 3% is assumed.

Incidentally, the price of petroleum in the year 2000 is estimated at $34.17/barrel in #1 case, $39.03/barrel in #2 case and $45.18/barrel in #3 case. (As shown in the following Table)

b. Exchange Rate Applied

For calculation, the following exchange rate of October 1, 1984 was applied.

$1.00 = ¥247

$1.00 = ₱18.002

For conversion of Peso to Japanese Yen, the exchange rate of ₱1.00 = ¥13.721 or ₱1.00 = ¥14 was applied.

c. Computation Period

According to the financial standards of NAPOCOR, the rate of depreciation applied to the power facilities varies depending on the location as shown in Table 11-2. In North Luzon, the rate of depreciation is set at 4.19% for thermal power plants, 2.02% for hydro power plants and 2.25% for transmission system. In South Luzon, the rate applied is 3.4% for hydro power plants and 2.36% for transmission system.

In Luzon, the average rate of depreciation applied to

transmission system is 2.3%. Accordingly, a service life of 43.4 years or about 44 years was considered for the transmission system.

Table 11-2 Depreciation and Depletion of NAPOCOR

Functional Account	Home Office	NLRC	SLRC	MMRC	VRC	MRC
Steam Production Plant	-	4.19%	-	3.91%	5.00%	-
Geothermal Plant	-	-	5.00%	-	5.00	-
Hydraulic Production Plant	-	2.02	3.40	-	2.09	2.07%
Other Production Plant (Diesel)	-	4.00	5.00	-	5.00	4.54
Transmission Plant	-	2.25	2.36	2.26	2.39	2.23
Distribution Plant	-	4.00	4.00	-	4.00	4.00
General Plant	4.94%	6.20	7.98	4.98	8.09	4.48

The term of the depreciation for the plan is assumed 44 years in the study, but the evaluation is calculated through twenty years after the completion of the plan.

Also, the payable of the interest for the investment of the plan is calculated through twenty years after the completion of the plan.

11-3. Cost

a. Depreciation for the Installed Facilities

The investment is assumed to disburse by three times divided as mentioned Chapter 10. The study is calculated

under the following conditions.

Term of depreciation ... 44 Years

Period of calculation ... 20 Years after the completion

Unit: Million $

Year	1	2	3	4	...	10	...	20	...	23	Total
Total Invest. (F.C & L.C.)	12.41	24.82	4.14	-	...	-	...	-	...	-	41.37
Depreciation	-	-	-	0.94	...	0.94	...	0.94	...	0.94	18.8

b. Interest for the Investment of Facilities

The interest for the foreign currency portion is assumed 4 percent.

The prime rate for long term loan in USA is 10.5% and the interest for IBRD Loan is more than 11%. Other side, many of the import and export Banks in the world decide that 9.5% interest is as the guideline for the loan to the countries adopting a high interest in their country.

The interest for the local fund in the Philippines is more than that of the above bank's loan. However, the period of the project loan is a long time one, 11% of interest for the local loan is applied in the study.

According to these assumption, interest for the loan becomes as the following table assuming equal payment through the term.

Payment of Interest for the Investment

Year	Investment			Interest		
	Foreign Currency (m.$)	Local Currency (m.$)	Total (m.$)	Foreign Currency (m.$)	Local Currency (m.$)	Total (m.$)
1	9.71	2.7	12.41	0.388	0.297	0.685
2	19.42	5.4	24.82	1.165	0.891	1.056
3	3.24	0.9	4.14	1.295	0.99	2.285
4	-	-	-	1.015	0.776	1.791
.	.	.	.	.	.	.
.	.	.	.	.	.	.
10	-	-	-	1.015	0.776	1.791
.	.	.	.	.	.	.
.	.	.	.	.	.	.
20	-	-	-	1.015	0.776	1.791
.	.	.	.	.	.	.
.	.	.	.	.	.	.
23	-	-	-	1.015	0.776	1.791
Total	32.37	9.0	41.37	23.148	17.698	40.846

c. Operation Cost and General Cost

The amount of operating cost for transmission facilities in Luzon Grid has been increasing year by year, and its ratio to the asset of transmission system is shown in the following table.

It was 15% in 1983 4.5% in 1984. The total amount of operation cost in 1984 increased from that of 1983, but the ratio to the asset decreased because of the reevaluation of

the asset caused with price index escalation.

Year	1984	1983
Operation Cost of Luzon Transmission Facilities (A)	198 m₱	129 m₱
Amount of Assess for Luzon Transmission Facilities (B)	4,429 m₱	855.7 m₱
Factor for Operation Cost (A/B) x 100	4.5%	15%

The amount of asset for transmission facilities in "K" Power Co. in Japan, 10,000 MW peak demand, is 626.3 billion Yen in 1984. It is about 44 billion Peso with the exchange rate on October, 1984.

The peak demand of the Luzon Grid in 1984 was 2,300 MW, about 20% of that of "K" Co. If assume that the amount of asset is proportional to the peak demand, the amount of asset for transmission system becomes 8,940 m₱, in the Luzon Grid.

On the other side, the Luzon Grid has more than 3,000 km of 230 kV lines. The re-construction cost reaches more than 120 billion Yen (8,500 m₱) assuming that the construction cost of 230 kV line is 40 million ¥ (2.8 million ₱).

Considering these conditions, it is reasonable that the amount of asset for the Luzon transmission facilities might be 9,000 million ₱.

The factor for operation cost becomes 198/9.000 = 2.2% in

1984. From the conditions, the factor of operation cost to the amount of asset is assumed 3% in the study.

Using the factor, the operation cost for the transmission facilities in the plan is calculated as follows.

Year	Investment (A) m.$	Operation Cost (A) x 0.03 m.$
1	12.41	-
2	24.82	-
3	4.14	-
4	-	1.241
10	-	1.241
23	-	1.241
Total	41.37	24.82

The factor for the general cost for the investment is usually 0.5% in Electric Power Co. Using the factor, the general cost for the plan becomes 0.207 million ₱ every year after the completion of construction.

d. Total Cost

The summation of Interest, General Cost, Depreciation and Operation Cost for the investment becomes as following Table. Its total amount of cost through the period reaches 88.587 million $.

Year	Interest m.$	General Cost m.$	Depreciation m.$	Total m.$
1	0.685	-	-	0.685
2	2.056	-	-	2.056
3	2.285	-	-	2.285
4	1.791	0.207	1.241	4.178
5	1.791	0.270	1.241	4.178
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
23	1.791	0.207	1.241	4.178
Total	40.846	4.137	24.822	88.587

11-4. Merit of Immediate Plan

a. Elimination of Total System Blackout

Following the completion of north-south interconnection of the 230 kV transmission system of the Luzon Grid in 1983, a total system blackout occurred on three occasions in 1983 and two occasions in 1984. The time required for the restoration of the system in these blackout cases was 30 hours or more at the longest and 4 hours at the shortest.

Assuming that the total system blackout, occurring twice a year for a duration of 5 hours each time, is eliminated through the implementation of the immediate plan, the increase of energy sales as a result of elimination of one blackout case is estimated at (2,000 MW x 5 hrs x 2/3) = 6,600 MWh.

(The energy loss by the blackout of September 24, 1984 is estimated at 7,000 MWh.)

Without any measure against total system blackout, the energy loss caused by two blackouts per year is calculated at:

7,000 MWh x 2 = 14,000 MWh

The energy loss caused by system blackout is estimated to increase as shown below in proportion of the future growth rate of load shown in Table 2-3 in Chapter 2.

The increase of load and lost energy are assumed as follows.

Year	Energy Forecast	Growth Rate	Lost Energy by Blackout
1984	12,517 GWh	-	14,000 MWh
1985	12,768	2%	14,000
1987	13,942	4.5	15,300
1990	16,605	6.0	20,500
1995	22,222	6.0	24,400
2000	29,739	6.0	32,600

Note: Growth rate after 1996 is assumed as same as that of 1990...1995.

The unit merit price is assumed as follows.

Unit Price of Merit

= (Unit sales price - Unit production cost)

However, it was very difficult to determine the above price because of the devaluation of Peso in 1983 and 1984.

Considering the devaluation of Peso, unit costs were as shown in Table 11-3.

Actual Unit Costs in 1983 and 1984

Unit: Peso/kWh: $/kWh

Item	Currency	1983	1984
Power Rated per kWh	Peso (A1)	0.579	0.8288
	$ (A2)	0.0526	0.04604
Production Cost per kWh	Peso (B1)	0.4865	0.744
	$ (B2)	0.0442	0.04132
Unit Price of Merit	Peso ((A1) - (B1))	0.0925	0.0848
	$ ((A2) - (B2))	0.0084	0.00472

Note: Exchange Rate: 1$ = 11.0015 Peso on Sept. 1983
1$ = 18.002 Peso on Oct. 1984

Table 11-3 Production Cost by Region and by Type of Plant
Peso per kWh
January to September, 1984 and 1983

	1984		1983	
	Production Cost	Fuel, Steam & Coal Cost	Production Cost	Fuel, Steam & Coal Cost
TOTAL PHILIPPINES	.7005	.4539	.4738	.3448
Hydro	.2640	-	.2806	-
Oil-based	1.0150	.8004	.5761	.4878
Geothermal	.5074	.2195	.2068	.1065
Coal	.7949	.3811	.5265	.2090
Luzon	.7444	.5169	.4865	.3655
Hydro	.4523	-	.5295	-
Oil-based	.9654	.7901	.5596	.4870
Geothermal	.4293	.2069	.2810	.1353
Visayas	1.3135	.6088	.7022	.4287
Hydro	.3726	-	.5095	-
Oil-based	1.5329	.8871	.7483	.4943
Geothermal	1.2062	.3449	.6264	.2073
Coal	.7949	.3811	.5265	.2393
Mindanao	.2239	.0663	.2860	.1620
Hydro	.1074	-	.1080	-
Oil-based	1.6165	.8589	.6492	.4926

(From NAPOCOR Monthly Report)

The unit price of the merits decreased to ₱0.0848/kWh ($0.00472/kWh) in 1984 as compared with the previous year but is expected to recover with application of NAPOCOR's long-term power rate forecast. Accordingly, the unit price of the merits was also considered to change in direct proportion to the increase rate of power rate. The merits derived from the elimination of total system blackouts are calculated as follows.

Year	Restored Lost Energy (MWh)	Merit m. $
1987	15.3	0.11
1990	20.5	0.158
1995	24.4	0.39
2000	32.6	0.968

b. Merit of Voltage Improvement

With the commissioning of Magat hydro power plant, Calaca coal thermal power plant and PNPP nuclear power plant, the generating capacity of the power plants connected to the 230 kV transmission system will exceed 3,500 MW. In the average water flow year, the North Luzon hydro power plants can be operated at full capacity of 635 MW during daytime and evening peak hours throughout the year. Even when the regular maintenance is taken into account, the concurrent operation of North hydro power plants and the nuclear power plant will be possible for the period accounting for 60% of the year.

This means that the Manila and Sucat power plants connected to the 115 kV system in Metro Manila can be stopped and used as a spinning reserve during the evening peak hours for

more than five months in 1985 and for more than four months in 1990.

However, the voltage of the 115 kV substations in Metro Manila varies in the term of 2 to 3 kV depending on the operating condition of the power plants in Metro Manila, as discussed in Chapter 7. To maintain the required voltage under the present condition, the thermal power plants connected to the 115 kV system will have to be operated at an output of more than 100 MW.

The fuel cost of oil-fired power plants in Luzon in 1984 was ₱0.79/kWh (¥11.06/kWh) as shown in Table 11-4.

Assuming the operation of a 100 MW thermal power plant, which operates 10 hours a day during the peak hour, for an average 23 days per month and for an average four months a year, is stopped, the savings of energy generation is calculated at:

100 MW x 23 days x 10 hrs x 4 months = 92 GWh

The net fuel cost of oil-based thermal power plants in Luzon was ₱0.487($0.044)/kWh in 1983 and ₱0.79($0.044)/kWh in 1984. The purchase price of petroleum was $31.5/barrel as shown in Table 11-1.

For the increase of oil prices in the future, the following three cases were considered.

Case	Escalation Rate of Oil Price	Estimated oil Price in 2000	Remark
Case 1	1.1%/year	34.17 $/bar.	NAPOCOR's Forecast
Case 2	2.0%/year	39.03 $/bar.	
Case 3	3.0%/year	45.18 $/bar.	

The saving of fuel cost by cases is as follows.

Saving of Fuel Cost by Improving Voltage Regulation

Unit: m. $

Year	Saved Energy GWh	Saving Amount Case 1	Case 2	Case 3
1987	92	3.708	3.708	3.708
1990	92	3.832	3.935	4.052
1995	92	4.047	4.345	4.697
2000	92	4.275	4.797	5.445

c. Total of Merits

Total of Merits is shown in Table 11-4.

Table 11-4 Calculation of Benefit (Unit: m$)

Year	Save GWh from Black Out	Fuel Escalation 1.1 %		Fuel Escalation 2.0 %		Fuel Escalation 3.0 %	
		Save of fuel Cost	Total	Save of fuel Cost	Total	Save of fuel Cost	Total
1							
2							
3							
4	0.110	3.749	3.859	3.782	3.893	3.819	3.930
5	0.132	3.790	3.922	3.858	3.990	3.934	4.066
6	0.158	3.832	3.990	3.935	4.093	4.052	4.210
7	0.190	3.874	4.064	4.014	4.203	4.173	4.363
8	0.227	3.916	4.144	4.094	4.321	4.299	4.526
9	0.272	3.960	4.232	4.176	4.448	4.428	4.700
10	0.326	4.003	4.329	4.259	4.585	4.560	4.886
11	0.390	4.047	4.438	4.345	4.735	4.697	5.088
12	0.468	4.092	4.559	4.431	4.899	4.838	5.306
13	0.560	4.137	4.697	4.520	5.080	4.983	5.543
14	0.671	4.182	4.853	4.610	5.281	5.133	5.804
15	0.804	4.228	5.032	4.703	5.506	5.287	6.090
16	0.963	4.275	5.237	4.797	5.759	5.445	6.408
17	1.153	4.322	5.475	4.893	6.046	5.609	6.762
18	1.381	4.369	5.750	4.990	6.372	5.777	7.158
19	1.654	4.417	6.072	5.090	6.745	5.950	7.604
20	1.981	4.466	6.447	5.192	7.174	6.129	8.110
21	2.373	4.515	6.888	5.296	7.669	6.313	8.686
22	2.843	4.565	7.408	5.402	8.245	6.502	9.345
23	3.405	4.615	8.020	5.510	8.915	6.697	10.102
Total	20.062	83.353	103.415	91.897	111.959	102.524	122.684

11-5. FIRR

FIRR of the project is calculated and the results are shown in Fig. 11-7. From the figure, FIRR of each case becomes as follows.

Case	Escalation Rate Oil Price	FIRR	Remark
Case 1	1.1%	7.6%	NAPOCOR Forecast
Case 2	2.0%	12.0%	
Case 3	3.0%	14.4%	

The minimum value of FIRR is 7.6% in the case which the escalation rate of oil price is the lowest one.

From the result, the project is considered to be a profitable one.

11-6. Socio-Economic Evaluation

The reliability of the Luzon Grid system is expected to be greatly improved with the completion of the construction work in the project. Loss of producting materials and products in industrial factories and commercial shops, and decrease of sales chance in retail stores will be eliminated with the improvement of the system reliability.

The improvements on the economical aspects are expected to be a big amount with the plan.

Additionally, the reserve generators which are installed in factories, business-buildings and hotels would be operated in a total blackout fault. The operation would amount to a good deficit.

The undesirable socio-economic effects caused with the system disturbances and with the voltage drop at consumers, -the decrease of motor's efficiency and the discomfort with illuminations and televisions-, are also expected to be eliminated with the improvement of system stability and with the installation of phase modifiers.

Presently, the benefits derived from the renovation plan are very difficult to measure quantitatively.

Therefore, the socio-economic evaluation is only qualitative analysis of the effect as mentioned above, and is only supplementing the financial evaluation.

However, it might say that the previously mentioned effects have serious effects on the socio-economy of the country.

Table 11-5 Cost Calculation by Discount Rate

Unit : m $

Year	3 %	5 %	10 %	15 %	20 %	25 %
1	0.665	0.652	0.623	0.596	0.571	0.548
2	1.938	1.865	1.699	1.555	1.428	1.316
3	2.091	1.974	1.717	1.502	1.322	1.170
4	3.712	3.437	2.854	2.389	2.015	1.711
5	3.604	3.274	2.594	2.077	1.679	1.369
6	3.499	3.118	2.359	1.806	1.395	1.095
7	3.397	2.969	2.144	1.571	1.166	0.876
8	3.298	2.828	1.949	1.366	0.969	0.701
9	3.202	2.693	1.772	1.188	0.810	0.561
10	3.109	2.565	1.611	1.033	0.675	0.449
11	3.018	2.443	1.464	0.894	0.562	0.359
12	2.930	2.326	1.331	0.781	0.469	0.287
13	2.845	2.216	1.210	0.679	0.391	0.147
14	2.762	2.110	1.100	0.590	0.325	0.117
15	2.682	2.010	1.000	0.513	0.271	0.094
16	2.604	1.914	0.909	0.447	0.226	0.075
17	2.528	1.823	0.826	0.388	0.188	0.060
18	2.454	1.736	0.752	0.338	0.157	0.048
19	2.383	1.653	0.683	0.294	0.131	0.038
20	2.313	1.575	0.621	0.255	0.109	0.031
21	2.246	1.500	0.564	0.222	0.091	0.025
22	2.181	1.428	0.513	0.193	0.076	0.020
23	2.117	1.360	0.467	0.168	0.063	0.016
Total	61.579	49.468	30.762	20.844	15.090	11.113

Table 11-6 Calculation of Benefit by Discount Rate: Case 1

(Fuel Escalation 1.1%)

Unit : m $

Year	3 %	5 %	10 %	15 %	20 %	25 %
1						
2						
3						
4	3.429	3.175	2.636	2.207	1.861	1.581
5	3.383	3.073	2.435	1.950	1.576	1.285
6	3.342	2.977	2.252	1.725	1.333	1.046
7	3.304	2.888	2.085	1.527	1.134	0.852
8	3.271	2.804	1.933	1.355	0.981	0.695
9	3.243	2.728	1.795	1.203	0.820	0.568
10	3.221	2.658	1.669	1.070	0.699	0.465
11	3.206	2.595	1.555	0.950	0.597	0.381
12	3.198	2.539	1.453	0.852	0.512	0.313
13	3.199	2.491	1.361	0.763	0.439	0.165
14	3.208	2.451	1.278	0.686	0.378	0.136
15	3.230	2.420	1.205	0.618	0.327	0.113
16	3.264	2.399	1.140	0.560	0.283	0.094
17	3.312	2.389	1.083	0.509	0.247	0.079
18	3.378	2.389	1.034	0.465	0.216	0.066
19	3.463	2.403	0.993	0.427	0.190	0.056
20	3.570	2.430	0.958	0.394	0.168	0.048
21	3.703	2.472	0.931	0.366	0.149	0.041
22	3.866	2.532	0.910	0.342	0.134	0.035
23	4.064	2.611	0.896	0.322	0.121	0.030
Total	67.852	52.424	29.600	18.290	12.147	8.050

Table 11-7 Calculation of Benefit by Discount Rate: Case 2

(Fuel Escalation 2.0%)

Unit : m $

Year	3 %	5 %	10 %	15 %	20 %	25 %
1						
2						
3						
4	3.459	3.202	2.659	2.226	1.877	1.594
5	3.442	3.126	2.477	1.984	1.604	1.308
6	3.428	3.054	2.311	1.770	1.367	1.073
7	3.418	2.987	2.157	1.580	1.173	0.881
8	3.411	2.925	2.016	1.413	1.002	0.725
9	3.409	2.867	1.886	1.265	0.862	0.597
10	3.412	2.815	1.768	1.133	0.741	0.492
11	3.421	2.769	1.660	1.013	0.637	0.407
12	3.436	2.728	1.561	0.916	0.550	0.337
13	3.460	2.694	1.472	0.826	0.475	0.179
14	3.492	2.668	1.391	0.746	0.411	0.148
15	3.534	2.649	1.318	0.677	0.357	0.124
16	3.589	2.638	1.253	0.616	0.312	0.104
17	3.658	2.638	1.196	0.562	0.273	0.087
18	3.743	2.647	1.146	0.515	0.240	0.073
19	3.846	2.669	1.103	0.474	0.211	0.062
20	3.972	2.704	1.066	0.438	0.187	0.053
21	4.122	2.753	1.036	0.407	0.166	0.045
22	4.303	2.818	1.012	0.381	0.149	0.039
23	4.517	2.903	0.996	0.358	0.135	0.034
Total	73.071	56.252	31.483	19.298	12.729	8.362

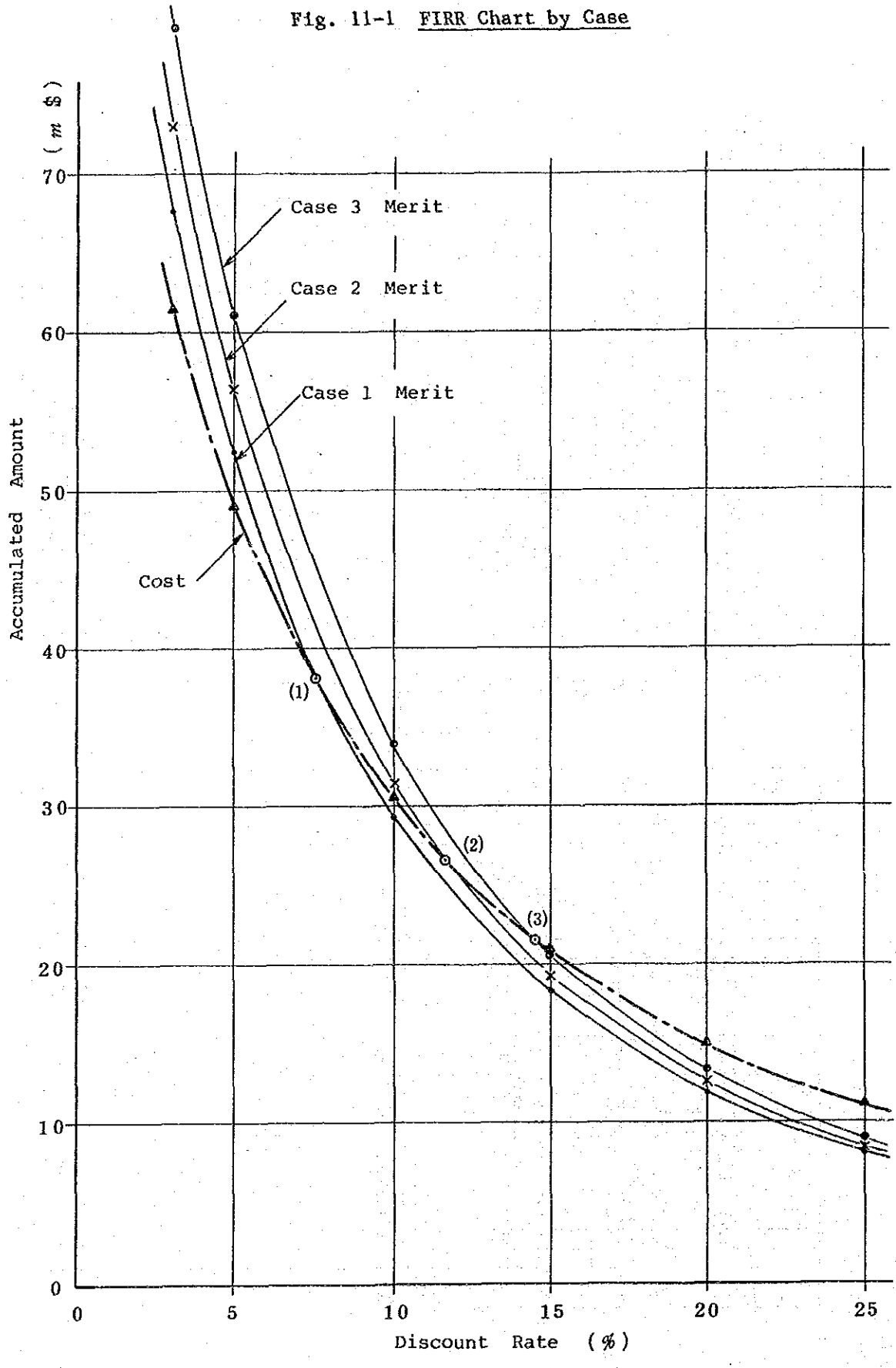
Table 11-8 Calculation of Benefit by Discount Rate: Case 3

(Fuel Escalation 3.0%)

Unit : m $

Year	3 %	5 %	10 %	15 %	20 %	25 %
1						
2						
3						
4	3.491	3.233	2.684	2.247	1.895	1.610
5	3.507	3.186	2.525	2.022	1.634	1.332
6	3.526	3.142	2.377	1.820	1.406	1.103
7	3.548	3.101	2.239	1.640	1.218	0.915
8	3.573	3.063	2.111	1.479	1.050	0.759
9	3.602	3.029	1.993	1.336	0.911	0.631
10	3.636	3.000	1.884	1.208	0.789	0.525
11	3.675	2.975	1.783	1.089	0.685	0.437
12	3.721	2.954	1.690	0.992	0.595	0.365
13	3.775	2.940	1.606	0.901	0.518	0.195
14	3.837	2.931	1.528	0.820	0.452	0.163
15	3.909	2.929	1.458	0.749	0.395	0.137
16	3.993	2.935	1.394	0.685	0.347	0.115
17	4.091	2.950	1.337	0.628	0.305	0.097
18	4.205	2.974	1.288	0.578	0.269	0.082
19	4.337	3.009	1.243	0.535	0.238	0.070
20	4.491	3.057	1.205	0.496	0.212	0.060
21	4.669	3.117	1.173	0.461	0.188	0.051
22	4.877	3.194	1.148	0.432	0.169	0.044
23	5.119	3.289	1.128	0.406	0.153	0.038
Total	79.582	61.009	33.796	20.523	13.430	8.731

Fig. 11-1 FIRR Chart by Case



APPENDIX

APPENDIX

APPENDIX-1

THE PROTECTION SYSTEM OF THE LUZON GRID

I - INTRODUCTION

The National Power Corporation (NPC) supplies electric power in Luzon to private utilities, electric cooperatives, and some industrial customers through a number of generating stations, transmission lines and substations, about three-fourths of the total power generated is supplied to manila Electric company (MERALCO), which distributes power to the Metro Manila area, at several entry points.

The NPC transmission system consists of 230/115-kV lines and 230/115-kV transformers while the MERALCO system consists of relatively short 115-kV transmission lines (Exhibit A). Both utilities have different transmission line relaying practices - the relays, communication channel and the teleprotection systems employed are different.

II - NPC TRANSMISSION RELAYING SYSTEM AND PRACTICES

A. Protective Relays Used

1. Brown Boveri Types LZ32, LZ3, L3WYS Distance Relays
   - Electromechanical
   - Switched-Scheme, Single-System for Three-Phase, Phase-to-Phase (-to Ground) and Single-Phase-to-Ground Faults
   - Three-Forward Zones and One Non-Directional Zone
   - Cross-Polarized MHO Characteristics

2. FIR K-DAR Relays (KD-4/KD-41, KDXG Phase and Ground Distance Relays) and Directional Ground Overcurrent Relays
   - Electromechanical
   - Phase Relay KD-4 has MHO Characteristic with Two Forward Zones and One Backward Zone (KD-41)
   - Ground Relay KDXG has Reactance Type Characteristic with Three Switched Zones and Three Independent Phases
3. SIEMENS Type 7SL24 Distance Relay (Not yet Installed)
   - Static Type
   - Switched-Scheme, Single-System for All Types of Faults
   - Three Forward Zones and One Non-Directional Zone
   - Quadrilateral Characteristics
   - Cross-Polarized

B. Communication Channel

Power Line Carrier (PLC) communication of BBC make is used extensively. The methods of coupling used are:

1. Inter-System Coupling (Double-Circuit Lines)
2. Phase-Phase-Ground Coupling
3. Phase-Ground Coupling

During normal operation of the power system the PLC channel is used for voice communication and a guard tone is continuously transmitted for channel monitoring. If a protective relay actuates the PLC channel the guard tone is remove and a tripping (or blocking), signal is transmitted.

III - MERALCO TRANSMISSION LINE RELAYING PRACTICE

A. Protective Relays

All protective relays used by MERALCO are of the electro-mechanical type made by general electric and westinghouse. For Phase-to-Phase and Three-Phase Faults the GE type GCY and westinghouse type KD-4 with three forward zones are used. For faults involving ground, directional overcurrent relays with both instantaneous and inverse characteristics are used. The inverse element gives back-up protection for adjoining line sections and covers the rest of the protected line.

B. Communication Channel

MERALCO uses a microwave communication system for both remote control of circuit breakers and for protection signalling.

APPENDIX-2

Table 1　　Load forecast ……NPC各変電所

Luzon Grid Total

S/S	'83	'85	'86	'87	'90
Curimao	1.05	1.42	1.47	1.57	1.87
Laoag	4.93	4.75	4.98	5.35	7.30
Bantay	5.04	5.77	5.99	6.38	7.73
Lubuagan	5.46	7.48	7.26	7.25	8.08
Bauang	14.27	13.22	13.24	14.62	17.43
Labrador	0.00	0.00	10.46	11.28	13.23
San manuel	34.64	27.21	27.95	29.59	36.03
Itogon (binga)	17.53	17.56	17.95	18.93	24.46
Beckel (ambuklao)	12.28	9.31	9.41	10.10	12.01
Baguio	31.28	31.49	32.43	34.88	38.83
San tiago	10.18	15.42	15.36	16.12	18.01
Tuguegarao	6.61	7.00	7.19	7.58	8.97
Solano	2.41	5.06	6.14	7.36	10.16
Cabanatuan	21.94	17.79	17.86	18.72	22.20
Conception	10.50	10.96	11.24	11.71	14.02
Mexico	81.87	87.46	88.95	92.92	109.12
Prado (hermosa)	17.21	11.12	11.66	12.57	16.05
Olongapo	64.03	68.10	67.76	70.18	81.98
Botocan	0.00	15.52	16.73	18.38	26.47
Bataan	24.35	21.70	21.94	22.80	26.03
Epza	12.60	9.41	10.05	10.83	13.05
Angat	0.00	5.63	5.91	6.36	8.36
San jose	27.29	34.78	37.12	40.71	53.50
Dasmarinas	17.42	14.16	14.58	15.27	18.39
Ternate	1.36	2.24	2.44	2.57	3.37
Tagaytay	0.00	1.67	1.75	1.94	2.84
Batangas	32.54	35.52	35.91	36.89	42.45
Caliraya	7.03	6.56	6.65	6.86	8.05
Mak-ban	18.89	19.52	19.71	20.45	24.04
Gumaca	5.46	5.58	5.96	6.50	9.09
Labo	3.15	3.20	3.39	3.73	5.16
Naga	10.71	10.78	10.86	11.46	13.31
Daraga (legaspi)	12.39	11.60	11.71	12.36	15.16
Tiwi	1.89	2.92	2.97	3.15	3.73
NPC total	516.30	541.88	564.99	597.37	720.49
MERALCO	1961.70	1853.12	1845.01	1912.63	2264.51
LUZON grid total	2478.00	2395.00	2410.00	2510.00	2985.00

Table 2 MERALCO LOAD FORECAST

S/S	P.F	'83 peak	'83 11am		'85 peak	'85 11am		'86 peak	'86 11am		'87 peak	'87 11am		'90 peak	'90 11am	
	(%)	(MW)	(MW)	(MVar)	(MW)	(MW)	(MVar)	(MW)	(MW)	(MVar)	(MW)	(MW)	(MVar)	(MW)	(MW)	(MVar)
Balibago	96.5	70.0	59.0	16.0	50.0	41.0	11.2	51.0	40.5	11.0	53.0	41.8	11.4	62.0	49.6	13.5
Balintawak	73.1	78.0	65.7	61.4	80.0	65.6	81.3	82.0	65.1	60.8	75.0	59.2	55.3	55.0	44.0	41.1
Bocaue 1	-86.1	94.0	79.2	-46.8	49.0	40.2	-23.8	50.0	39.7	-23.4	50.0	39.5	-23.3	59.0	47.2	-27.9
-do- 2	-86.1	0.0	0.0	0.0	37.0	30.4	17.9	38.0	30.2	17.8	39.0	30.8	18.2	45.0	36.0	21.3
Botocan	90.0	26.0	21.9	10.6	23.0	18.9	9.1	24.0	19.0	9.2	25.0	19.7	9.6	28.0	22.4	10.9
Cainta	99.8	40.0	33.7	2.2	49.0	40.2	2.5	50.0	39.7	2.5	52.0	41.0	2.6	61.0	48.8	3.1
Calauan	97.4	27.0	22.8	5.3	24.0	19.7	4.6	25.0	19.8	4.6	26.0	20.5	4.8	29.0	23.2	5.4
Carmona	90.0	0.0	0.0	0.0	23.0	18.9	9.1	24.0	19.0	9.2	25.0	19.7	9.6	18.0	14.4	7.0
Dolores	96.3	80.0	67.4	18.9	65.0	53.3	14.9	67.0	53.2	14.9	70.0	55.2	15.5	82.0	65.6	18.4
Canluban	99.7	54.0	45.5	3.5	51.0	41.9	3.2	52.0	41.3	3.2	54.0	42.6	3.3	63.0	50.4	3.9
Gardner	-90.0	121.0	102.0	-49.4	132.0	108.3	-52.5	100.0	79.4	-38.4	104.0	82.1	-39.8	111.0	88.8	-43.0
Malaya	90.0	22.0	18.5	9.0	20.0	16.4	7.9	21.0	16.7	8.1	22.0	17.4	8.4	25.0	20.0	9.7
Malibay 1	96.1	109.0	91.9	26.4	75.0	61.5	17.7	77.0	61.1	17.6	80.0	63.1	18.2	93.0	74.4	21.4
-do- 2	96.1	117.0	98.6	28.4	82.0	67.3	19.4	80.0	63.5	18.3	87.0	68.7	19.8	102.0	81.6	23.5
Malinta	78.5	114.0	96.1	75.8	90.0	73.9	58.3	92.0	73.0	57.6	80.0	63.1	49.8	84.0	67.2	53.1
Mandal'yng	97.7	125.0	105.4	23.0	74.0	60.7	13.3	77.0	61.1	13.3	80.0	63.1	13.8	71.0	56.8	12.4
Marikina 1	98.3	121.0	102.0	19.0	100.0	82.1	15.3	94.0	74.6	13.9	90.0	71.0	13.3	95.0	76.0	14.2
-do- 2	98.3	78.0	65.7	12.3	100.0	82.1	15.3	94.0	74.6	13.9	90.0	71.0	13.3	100.0	80.0	14.9
N.Port 1	98.6	126.0	106.2	18.0	80.0	65.6	11.1	82.0	65.1	11.0	85.0	67.1	11.3	100.0	80.0	13.5
-do- 2	98.6	89.0	75.0	12.7	100.0	82.1	13.9	103.0	81.8	13.8	107.0	84.4	14.3	105.0	84.0	14.2
Novaliches	100.0	73.0	61.5	0.0	64.0	52.5	0.0	66.0	52.4	0.0	50.0	39.5	0.0	59.0	47.2	0.0
Pamplona	100.0	77.0	64.9	0.0	77.0	63.2	0.0	79.0	62.7	0.0	82.0	64.7	0.0	96.0	76.8	0.0
Rockwell 3	90.0	117.0	98.6	47.8	100.0	82.1	39.7	103.0	81.8	39.6	107.0	84.4	40.9	125.0	100.0	48.5
-do- 4	90.0	120.0	101.1	49.0	100.0	82.1	39.7	103.0	81.8	39.6	107.0	84.4	40.9	125.0	100.0	48.5
Rosario	90.0	0.0	0.0	0.0	35.0	28.7	13.9	36.0	28.6	13.8	38.0	30.0	14.5	44.0	35.2	17.1
Sta.Mesa	93.0	154.0	129.8	51.3	52.0	42.7	16.9	54.0	42.9	16.9	56.0	44.2	17.5	66.0	52.8	20.8
St.Anthony	90.0	15.0	12.6	6.1	15.0	12.3	6.0	15.0	11.9	5.8	16.0	12.6	6.1	19.0	15.2	7.4
Taguig	81.2	83.0	70.0	50.3	67.0	55.0	39.5	69.0	54.8	39.4	72.0	56.8	40.8	84.0	67.2	48.3
Tegen 3	-86.3	134.0	112.9	-66.1	244.0	200.2	-117.2	253.0	200.8	-117.6	264.0	208.3	-122.0	309.0	247.3	-144.8
Teresa	90.0	42.0	35.4	17.1	48.0	37.7	18.3	47.0	37.3	18.1	49.0	38.7	18.7	58.0	46.4	22.5
Asea brev	90.0	6.3	5.3	2.6	6.3	5.2	2.5	6.5	5.2	2.5	6.8	5.4	2.6	7.9	6.3	3.1
Cigi	90.0	7.2	6.1	2.9	7.2	5.9	2.9	7.5	6.0	2.9	7.8	6.2	3.0	9.2	7.4	3.6
Met.concast	71.0	8.0	6.7	6.7	8.1	6.6	6.6	8.4	6.7	6.6	8.8	6.9	6.9	10.5	8.4	8.3
Malabon	90.0	0.0	0.0	0.0	45.0	36.9	17.9	46.0	36.5	17.7	48.0	37.9	18.3	67.0	53.6	26.0
Kamagong	86.3	0.0	0.0	0.0	35.4	29.0	17.0	36.0	28.6	16.7	38.0	30.0	17.6	44.0	35.2	20.6
Sta.Mesa 2	93.0	0.0	0.0	0.0	52.0	42.7	16.9	53.0	42.1	16.6	55.0	43.4	17.2	64.0	51.2	20.2
Parang	90.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	15.9	7.7	21.0	16.6	8.0	23.0	18.4	8.9
Sunvalley	96.1	0.0	0.0	0.0	0.0	0.0	0.0	39.0	31.0	8.9	41.0	32.4	9.3	47.0	37.6	10.8
Pas.de blas	90.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	21.3	10.3	31.0	24.8	12.0
N.G.center	98.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.0	27.6	5.2	41.0	32.8	6.1
Cubao	93.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.0	27.2	10.3
Balint'wk 2	73.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.0	44.8	41.8
San Pedro	90.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.0	17.6	8.5
Total		2327.5	1961.6	413.9	2258.0	1852.9	350.5	2324.4	1844.9	374.2	2423.4	1912.5	384.9	2829.6	2264.5	479.5

Table 3 Demand & Supply ballance
('84 Wet PNPPin)

Gen. type	Commission. Date	Name of P/P	& No.	Rating cap(MVA)	P.F (%)	Rating cap(MW)	'84inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP		802.0	85	620	0	0	0	0	none
Geo.	Jan.'79	Tiwi	1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi	2	69.0	80	55	55	55	55	55	
	Jan.'80	Tiwi	3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi	4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi	5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi	6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban	1	69.0	80	55	55	55	55	55	
	Jul.'79	Mak-Ban	2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban	3	69.0	80	55	55	55	55	55	
	Jun.'80	Mak-Ban	4	69.0	80	55	55	55	55	55	
	Jun.'84	Mak-Ban	5	69.0	80	55	55	0	0	0	none
	aug.'84	Mak-Ban	6	69.0	80	55	55	0	0	0	none
	'90	Manito	1			55	55	0	0	0	none
	'90	Manito	2			55	55	0	0	0	none
Geo.total						770	770	550	495	495	
Coal	sep.'84	Calaca		353.0	85	300	300	0	0	0	none
Oil	sep.'75	Malaya	1	370.0	90	300	300	300	300	213	before rehabili.
	mar.'79	Malaya	2	438.0	90	350	350	350	350	300	before rehabili.
	sep.'72	Bataan	1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan	2	187.5	80	150	150	150	150	140	
	aug.'68	Sucat	1	188.0	90	150	150	150	0	0	
	Jun.'70	Sucat	2	245.0	90	200	200	160	0	0	before rehabili.
	Jul.'71	Sucat	3	245.0	90	200	200	160	0	0	before rehabili.
	sep.'72	Sucat	4	370.0	90	300	300	260	260	260	before rehabili.
	sep.'65	Manila	1	128.0	85	100	100	100	100	50	
	oct.'65	Manila	2	128.0	85	100	100	100	0	0	
Oil total						1925	1925	1805	1160	963	
Pump	sep.'82	Kalayaan	1	166.6	90	150	150	150	150	100	
	aug.'82	Kalayaan	2	166.6	90	150	150	150	150	96	
Hydro	aug.'83	Magat	1	112.5	80	90	90	90	90	90	
	sep.'83	Magat	2	112.5	80	90	90	90	90	90	
	oct.'83	Magat	3	112.5	80	90	90	90	90	90	
	dec.'83	Magat	4	112.5	80	90	90	90	90	90	
	apr.'77	Pant'bgn	1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn	2	55.5	90	50	50	50	50	50	
	oct.'67	Angat	1	55.6	90	50	50	50	50	50	
	oct.'67	Angat	2	55.6	90	50	50	50	50	50	
	aug.'68	Angat	3	55.6	90	50	50	50	50	50	
	jun.'68	Angat	4	55.6	90	50	50	50	50	50	
	jul.'67	Angat	aux	20.0	90	18	18	18	18	18	
	dec.'56	Anbuklao	1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao	2	28.7	90	25	25	25	25	25	
	sep.'57	Anbuklao	3	28.7	90	25	25	25	25	25	
	jan.'60	Binga	1	27.8	90	25	25	25	25	25	
	jan.'60	Binga	2	27.8	90	25	25	25	25	25	
	mar.'60	Binga	3	27.8	90	25	25	25	25	25	
	mar.'60	Binga	4	27.8	90	25	25	25	0	0	mainte.
	aug.'42	Caliraya	1	10.0	80	8	8	8	8	8	
	aug.'42	Caliraya	2	10.0	80	8	8	8	8	8	
	oct.'47	Caliraya	3	10.0	80	8	8	8	8	8	
	feb.'50	Caliraya	4	10.0	80	8	8	8	8	8	
	'29	Botocan	1	10.0	80	8	8	8	8	8	
	'29	Botocan	2	10.0	80	8	8	8	8	8	
	'29	Botocan	3	12.0	80	8	8	8	8	8	
	dec.'80	Masiway		13.3	90	12	12	12	12	10	
Hydro total(incl.pump)						1221	1221	1221	1196	1090	
Oil	oct.'60	Rockwell	6			65	0	0	0	0	retire
	sep.'60	Rockwell	7			65	0	0	0	0	retire
	oct.'63	Rockwell	8			65	0	0	0	0	retire
											(Hargin)
Total(excl.Rockwell)						4838	4218	3576	2851	2548	303
Load										2478	
(Loss)										70	

Table 4-1 Demand & Supply ballance ('85 Wet PNPPin)

Gen. type	Commission. Date	Name of P/P & No.	Rating cap(MVA)	P.F (%)	Rating cap(MW)	'85inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP	802.0	85	620	620	620	620	500	
Geo.	Jan.'79	Tiwi 1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi 2	69.0	80	55	55	55	55	55	
	Jan.'80	Tiwi 3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi 4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi 5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi 6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban 1	69.0	80	55	55	55	55	55	
	jul.'79	Mak-Ban 2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban 3	69.0	80	55	55	55	55	55	
	jun.'80	Mak-Ban 4	69.0	80	55	55	55	55	55	
	jun.'84	Mak-Ban 5	69.0	80	55	55	55	55	55	
	aug.'84	Mak-Ban 6	69.0	80	55	55	55	55	55	
	'90	Manito 1			55	0	0	0	0	none
	'90	Manito 2			55	0	0	0	0	none
Geo.total					770	660	660	605	605	
Coal	sep.'84	Calaca	353.0	85	300	300	300	300	260	
Oil	sep.'75	Malaya 1	370.0	90	300	300	260	0	0	before rehabili.
	mar.'79	Malaya 2	438.0	90	350	350	320	320	80	before rehabili.
	sep.'72	Bataan 1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan 2	187.5	80	150	150	150	150	70	
	aug.'68	Sucat 1	188.0	90	150	150	150	0	0	
	jun.'70	Sucat 2	245.0	90	200	200	160	0	0	before rehabili.
	jul.'71	Sucat 3	245.0	90	200	200	160	0	0	before rehabili.
	sep.'72	Sucat 4	370.0	90	300	300	260	0	0	before rehabili.
	sep.'65	Manila 1	128.0	85	100	100	100	0	0	
	oct.'65	Manila 2	128.0	85	100	100	100	0	0	
Oil total					1925	1925	1735	470	150	
Pump	sep.'82	Kalayaan 1	166.6	90	150	150	150	150	75	
	aug.'82	Kalayaan 2	166.6	90	150	150	150	150	70	
Hydro	aug.'83	Magat 1	112.5	80	90	90	90	90	90	
	sep.'83	Magat 2	112.5	80	90	90	90	90	90	
	oct.'83	Magat 3	112.5	80	90	90	90	90	90	
	dec.'83	Magat 4	112.5	80	90	90	90	90	90	
	apr.'77	Pant'bgn 1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn 2	55.5	90	50	50	50	50	50	
	oct.'67	Angat 1	55.6	90	50	50	50	50	50	
	oct.'67	Angat 2	55.6	90	50	50	50	50	50	
	aug.'68	Angat 3	55.6	90	50	50	50	50	50	
	jun.'68	Angat 4	55.6	90	50	50	50	50	24	
	jul.'67	Angat aux	20.0	90	18	18	18	18	18	
	dec.'56	Anbuklao 1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao 2	28.7	90	25	25	25	25	25	
	sep.'57	Anbuklao 3	28.7	90	25	25	25	25	25	
	jan.'60	Binga 1	27.8	90	25	25	25	25	25	
	jan.'60	Binga 2	27.8	90	25	25	25	25	25	
	mar.'60	Binga 3	27.8	90	25	25	25	25	25	
	mar.'60	Binga 4	27.8	90	25	25	25	0	0	mainte.
	aug.'42	Caliraya 1	10.0	80	8	8	8	8	8	
	aug.'42	Caliraya 2	10.0	80	8	8	8	8	8	
	oct.'47	Caliraya 3	10.0	80	8	8	8	8	8	
	feb.'50	Caliraya 4	10.0	80	8	8	8	8	8	
	'29	Botocan 1	10.0	80	8	8	8	8	8	
	'29	Botocan 2	10.0	80	8	8	8	8	8	
	'29	Botocan 3	12.0	80	8	8	8	8	8	
	dec.'80	Hasiwy	13.3	90	12	12	12	12	12	
Hydro total(incl.pump)					1221	1221	1221	1196	1015	
Oil	oct.'60	Rockwell 6			65	0	0	0	0	retire
	sep.'60	Rockwell 7			65	0	0	0	0	retire
	oct.'63	Rockwell 8			65	0	0	0	0	retire
										(Hargin)
Total(excl.Rockwell)					4836	4726	4536	3191	2530	661
Load									2395	
(Loss)									135	

Table 4-2 Demand & Supply ballance
('85 Dry PNPPin)

Gen. type	Commission. Date	Name of P/P & No.	Rating cap(MVA)	P.F (%)	Rating cap(MW)	'85inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP	802.0	85	620	620	620	620	500	
Geo.	jan.'79	Tiwi 1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi 2	69.0	80	55	55	55	55	55	
	jan.'80	Tiwi 3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi 4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi 5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi 6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban 1	69.0	80	55	55	55	55	55	
	jul.'79	Mak-Ban 2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban 3	69.0	80	55	55	55	55	55	
	jun.'80	Mak-Ban 4	69.0	80	55	55	55	55	55	
	jun.'84	Mak-Ban 5	69.0	80	55	55	55	55	55	
	aug.'84	Mak-Ban 6	69.0	80	55	55	55	55	55	
	'90	Manito 1			55	0	0	0	0	none
	'90	Manito 2			55	0	0	0	0	none
Geo.total					770	660	660	605	605	
Coal	sep.'84	Calaca	353.0	85	300	300	300	300	300	
Oil	sep.'75	Malaya 1	370.0	90	300	300	260	260	99	before rehabili.
	mar.'79	Malaya 2	438.0	90	350	350	320	320	290	before rehabili.
	sep.'72	Bataan 1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan 2	187.5	80	150	150	150	150	100	
	aug.'68	Sucat 1	188.0	90	150	150	150	0	0	
	jun.'70	Sucat 2	245.0	90	200	200	160	0	0	before rehabili.
	jul.'71	Sucat 3	245.0	90	200	200	160	0	0	before rehabili.
	sep.'72	Sucat 4	370.0	90	300	300	260	260	90	before rehabili.
	sep.'65	Manila 1	128.0	85	100	100	100	0	0	
	oct.'65	Manila 2	128.0	85	100	100	100	0	0	
Oil total					1925	1925	1735	990	579	
Pump	sep.'82	Kalayaan 1	166.6	90	150	150	150	150	100	
	aug.'82	Kalayaan 2	166.6	90	150	150	150	150	100	
Hydro	aug.'83	Magat 1	112.5	80	90	90	90	90	60	
	sep.'83	Magat 2	112.5	80	90	90	90	90	63	
	oct.'83	Magat 3	112.5	80	90	90	90	0	0	
	dec.'83	Magat 4	112.5	80	90	90	90	0	0	
	apr.'77	Pant'bgn 1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn 2	55.5	90	50	50	50	0	0	
	oct.'67	Angat 1	55.6	90	50	50	50	50	50	
	oct.'67	Angat 2	55.6	90	50	50	50	0	0	
	aug.'68	Angat 3	55.6	90	50	50	50	0	0	
	jun.'68	Angat 4	55.6	90	50	50	50	0	0	
	jul.'67	Angat aux	20.0	90	18	18	18	0	0	
	dec.'56	Anbuklao 1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao 2	28.7	90	25	25	25	0	0	
	sep.'57	Anbuklao 3	28.7	90	25	25	25	0	0	
	jan.'60	Binga 1	27.8	90	25	25	25	25	25	
	jan.'60	Binga 2	27.8	90	25	25	25	0	0	
	mar.'60	Binga 3	27.8	90	25	25	25	0	0	
	mar.'60	Binga 4	27.8	90	25	25	25	0	0	
	aug.'42	Caliraya 1	10.0	80	8	8	8	0	0	
	aug.'42	Caliraya 2	10.0	80	8	8	8	0	0	
	oct.'47	Caliraya 3	10.0	80	8	8	8	0	0	
	feb.'50	Caliraya 4	10.0	80	8	8	8	0	0	
	'29	Botocan 1	10.0	80	8	8	8	8	8	
	'29	Botocan 2	10.0	80	8	8	8	0	0	
	'29	Botocan 3	12.0	80	8	8	8	0	0	
	dec.'80	Masiway	13.3	90	12	12	12	0	0	
Hydro total(incl.pump)					1221	1221	1221	638	481	
Oil	oct.'60	Rockwell 6			65	0	0	0	0	retire
	sep.'60	Rockwell 7			65	0	0	0	0	retire
	oct.'63	Rockwell 8			65	0	0	0	0	retire
										(Hargin)
Total(excl.Rockwell)					4836	4726	4536	3153	2465	688
Load									2395	
(Loss)									70	

Table 4-3 Demand & Supply ballance ('85 Wet PNPPout)

Gen. type	Commission. Date	Name of P/P & No.		Rating cap(MVA)	P.F (%)	Rating cap(MW)	'85inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP		802.0	85	620	620	620	0	0	mainte.
Geo.	jan.'79	Tiwi	1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi	2	69.0	80	55	55	55	55	55	
	jan.'80	Tiwi	3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi	4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi	5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi	6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban	1	69.0	80	55	55	55	55	55	
	Jul.'79	Mak-Ban	2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban	3	69.0	80	55	55	55	55	55	
	jun.'80	Mak-Ban	4	69.0	80	55	55	55	55	55	
	jun.'84	Mak-Ban	5	69.0	80	55	55	55	55	55	
	aug.'84	Mak-Ban	6	69.0	80	55	55	55	55	55	
	'90	Manito	1			55	0	0	0	0	none
	'90	Manito	2			55	0	0	0	0	none
Geo.total						770	660	660	605	605	
Coal	sep.'84	Calaca		353.0	85	300	300	300	300	300	
Oil	sep.'75	Malaya	1	370.0	90	300	300	300	260	260	110 before rehabili.
	mar.'79	Malaya	2	438.0	90	350	350	320	320	262	before rehabili.
	sep.'72	Bataan	1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan	2	187.5	80	150	150	150	150	100	
	aug.'68	Sucat	1	188.0	90	150	150	150	0	0	
	jun.'70	Sucat	2	245.0	90	200	200	160	0	0	before rehabili.
	jul.'71	Sucat	3	245.0	90	200	200	160	0	0	before rehabili.
	sep.'72	Sucat	4	370.0	90	300	300	260	260	70	before rehabili.
	sep.'65	Manila	1	128.0	85	100	100	100	0	0	
	oct.'65	Manila	2	128.0	85	100	100	100	0	0	
Oil total						1925	1925	1735	990	542	
Pump	sep.'82	Kalayaan	1	166.6	90	150	150	150	150	77	
	aug.'82	Kalayaan	2	166.6	90	150	150	150	150	75	
Hydro	aug.'83	Magat	1	112.5	80	90	90	90	90	90	
	sep.'83	Magat	2	112.5	80	90	90	90	90	90	
	oct.'83	Magat	3	112.5	80	90	90	90	90	90	
	dec.'83	Magat	4	112.5	80	90	90	90	90	90	
	apr.'77	Pant'bgn	1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn	2	55.5	90	50	50	50	50	50	
	oct.'67	Angat	1	55.6	90	50	50	50	50	50	
	oct.'67	Angat	2	55.6	90	50	50	50	50	50	
	aug.'68	Angat	3	55.6	90	50	50	50	50	50	
	Jun.'68	Angat	4	55.6	90	50	50	50	50	50	
	jul.'67	Angat	aux	20.0	90	18	18	18	18	18	
	dec.'56	Anbuklao	1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao	2	28.7	90	25	25	25	25	25	
	sep.'57	Anbuklao	3	28.7	90	25	25	25	25	25	
	jan.'60	Binga	1	27.8	90	25	25	25	25	25	
	jan.'60	Binga	2	27.8	90	25	25	25	25	25	
	mar.'60	Binga	3	27.8	90	25	25	25	25	25	
	mar.'60	Binga	4	27.8	90	25	25	25	0	0	mainte.
	aug.'42	Caliraya	1	10.0	80	8	8	8	8	8	
	aug.'42	Caliraya	2	10.0	80	8	8	8	8	8	
	oct.'47	Caliraya	3	10.0	80	8	8	8	8	8	
	feb.'50	Caliraya	4	10.0	80	8	8	8	8	8	
	'29	Botocan	1	10.0	80	8	8	8	8	8	
	'29	Botocan	2	10.0	80	8	8	8	8	8	
	'29	Botocan	3	12.0	80	8	8	8	8	8	
	dec.'80	Masiway		13.3	90	12	12	12	12	12	
Hydro total(incl.pump)						1221	1221	1221	1196	1048	
Oil	oct.'60	Rockwell	6			65	0	0	0	0	retire
	sep.'60	Rockwell	7			65	0	0	0	0	retire
	oct.'63	Rockwell	8			65	0	0	0	0	retire
											(Margin)
Total(excl.Rockwell)						4836	4726	4536	3091	2495	596
Load										2395	
(Loss)										100	

Table 4-4 Demand & Supply ballance ('85 Dry PNPPout)

Gen. type	Commission. Date	Name of P/P & No.	Rating cap(MVA)	P.F (%)	Rating cap(MW)	'85inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP	802.0	85	620	620	620	0	0	mainte.
Geo.	jan.'79	Tiwi 1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi 2	69.0	80	55	55	55	55	55	
	jan.'80	Tiwi 3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi 4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi 5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi 6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban 1	69.0	80	55	55	55	55	55	
	jul.'79	Mak-Ban 2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban 3	69.0	80	55	55	55	55	55	
	jun.'80	Mak-Ban 4	69.0	80	55	55	55	55	55	
	jun.'84	Mak-Ban 5	69.0	80	55	55	55	55	55	
	aug.'84	Mak-Ban 6	69.0	80	55	55	55	55	55	
	'90	Manito 1			55	0	0	0	0	none
	'90	Manito 2			55	0	0	0	0	none
Geo.total					770	660	660	605	605	
Coal	sep.'84	Calaca	353.0	85	300	300	300	300	300	
Oil	sep.'75	Malaya 1	370.0	90	300	300	260	260	260	before rehabili.
	mar.'79	Malaya 2	438.0	90	350	350	320	320	300	before rehabili.
	sep.'72	Bataan 1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan 2	187.5	80	150	150	150	150	50	
	aug.'68	Sucat 1	188.0	90	150	150	150	0	0	
	jun.'70	Sucat 2	245.0	90	200	200	160	160	90	before rehabili.
	jul.'71	Sucat 3	245.0	90	200	200	160	160	89	before rehabili.
	sep.'72	Sucat 4	370.0	90	300	300	260	260	260	before rehabili.
	sep.'65	Manila 1	128.0	85	100	100	100	100	60	
	oct.'65	Manila 2	128.0	85	100	100	100	0	0	
Oil total					1925	1925	1735	1410	1109	
Pump	sep.'82	Kalayaan 1	166.6	90	150	150	150	150	60	
	aug.'82	Kalayaan 2	166.6	90	150	150	150	150	63	
Hydro	aug.'83	Magat 1	112.5	80	90	90	90	90	90	
	sep.'83	Magat 2	112.5	80	90	90	90	90	90	
	oct.'83	Magat 3	112.5	80	90	90	90	0	0	
	dec.'83	Magat 4	112.5	80	90	90	90	0	0	
	apr.'77	Pant'bgn 1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn 2	55.5	90	50	50	50	0	0	
	oct.'67	Angat 1	55.6	90	50	50	50	50	50	
	oct.'67	Angat 2	55.6	90	50	50	50	0	0	
	aug.'68	Angat 3	55.6	90	50	50	50	0	0	
	jun.'68	Angat 4	55.6	90	50	50	50	0	0	
	jul.'67	Angat aux	20.0	90	18	18	18	0	0	
	dec.'56	Anbuklao 1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao 2	28.7	90	25	25	25	0	0	
	sep.'57	Anbuklao 3	28.7	90	25	25	25	0	0	
	jan.'60	Binga 1	27.8	90	25	25	25	25	25	
	jan.'60	Binga 2	27.8	90	25	25	25	0	0	
	mar.'60	Binga 3	27.8	90	25	25	25	0	0	
	mar.'60	Binga 4	27.8	90	25	25	25	0	0	
	aug.'42	Caliraya 1	10.0	80	8	8	8	0	0	
	aug.'42	Caliraya 2	10.0	80	8	8	8	0	0	
	oct.'47	Caliraya 3	10.0	80	8	8	8	0	0	
	feb.'50	Caliraya 4	10.0	80	8	8	8	0	0	
	'29	Botocan 1	10.0	80	8	8	8	8	8	
	'29	Botocan 2	10.0	80	8	8	8	0	0	
	'29	Botocan 3	12.0	80	8	8	8	0	0	
	dec.'80	Masiway	13.3	90	12	12	12	0	0	
Hydro total(incl.pump)					1221	1221	1221	638	461	
Oil	oct.'60	Rockwell 6			65	0	0	0	0	retire
	sep.'60	Rockwell 7			65	0	0	0	0	retire
	oct.'63	Rockwell 8			65	0	0	0	0	retire
										(Margin)
Total(excl.Rockwell)					4836	4726	4536	2953	2475	478
Load									2395	
(Loss)									80	

Table 4-5 Demand & Supply ballance(Night)
('85 Wet PNPPin)

Gen. type	Commission. Date	Name of P/P & No.		Rating cap(MVA)	P.F (%)	Rating cap(MW)	'85inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP		802.0	85	620	620	620	620	500	
Geo.	jan.'79	Tiwi	1	69.0	80	55	55	55	55	30	
	may.'79	Tiwi	2	69.0	80	55	55	55	55	30	
	jan.'80	Tiwi	3	69.0	80	55	55	55	55	30	
	apr.'80	Tiwi	4	69.0	80	55	55	55	55	30	
	dec.'81	Tiwi	5	69.0	80	55	55	55	55	30	
	mar.'82	Tiwi	6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban	1	69.0	80	55	55	55	55	35	
	jul.'79	Mak-Ban	2	69.0	80	55	55	55	55	35	
	apr.'80	Mak-Ban	3	69.0	80	55	55	55	55	35	
	jun.'80	Mak-Ban	4	69.0	80	55	55	55	55	35	
	jun.'84	Mak-Ban	5	69.0	80	55	55	55	55	35	
	aug.'84	Mak-Ban	6	69.0	80	55	55	55	55	35	
	'90	Manito	1			55	0	0	0	0	none
	'90	Manito	2			55	0	0	0	0	none
Geo.total						770	660	660	605	360	
Coal	sep.'84	Calaca		353.0	85	300	300	300	300	150	
Oil	sep.'75	Malaya	1	370.0	90	300	300	260	0	0	before rehabili.
	mar.'79	Malaya	2	438.0	90	350	350	320	320	130	before rehabili.
	sep.'72	Bataan	1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan	2	187.5	80	150	150	150	150	50	
	aug.'68	Sucat	1	188.0	90	150	150	150	0	0	
	jun.'70	Sucat	2	245.0	90	200	200	160	0	0	before rehabili.
	jul.'71	Sucat	3	245.0	90	200	200	160	0	0	before rehabili.
	sep.'72	Sucat	4	370.0	90	300	300	260	0	0	before rehabili.
	sep.'65	Manila	1	128.0	85	100	100	100	0	0	
	oct.'65	Manila	2	128.0	85	100	100	100	0	0	
Oil total						1925	1925	1735	470	180	
Pump	sep.'82	Kalayaan	1	166.6	90	150	150	150	0	0	
	aug.'82	Kalayaan	2	166.6	90	150	150	150	0	0	
Hydro	aug.'83	Magat	1	112.5	80	90	90	90	90	75	
	sep.'83	Magat	2	112.5	80	90	90	90	90	75	
	oct.'83	Magat	3	112.5	80	90	90	90	0	0	
	dec.'83	Magat	4	112.5	80	90	90	90	0	0	
	apr.'77	Pant'bgn	1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn	2	55.5	90	50	50	50	0	0	
	oct.'67	Angat	1	55.6	90	50	50	50	50	50	
	oct.'67	Angat	2	55.6	90	50	50	50	50	30	
	aug.'68	Angat	3	55.6	90	50	50	50	0	0	
	jun.'68	Angat	4	55.6	90	50	50	50	0	0	
	jul.'67	Angat	aux	20.0	90	18	18	18	18	18	
	dec.'56	Anbuklao	1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao	2	28.7	90	25	25	25	25	11	
	sep.'57	Anbuklao	3	28.7	90	25	25	25	0	0	
	jan.'60	Binga	1	27.8	90	25	25	25	25	25	
	jan.'60	Binga	2	27.8	90	25	25	25	25	25	
	mar.'60	Binga	3	27.8	90	25	25	25	0	0	
	mar.'60	Binga	4	27.8	90	25	25	25	0	0	
	aug.'42	Caliraya	1	10.0	80	8	8	8	8	8	
	aug.'42	Caliraya	2	10.0	80	8	8	8	8	8	
	oct.'47	Caliraya	3	10.0	80	8	8	8	8	8	
	feb.'50	Caliraya	4	10.0	80	8	8	8	8	8	
	'29	Botocan	1	10.0	80	8	8	8	8	8	
	'29	Botocan	2	10.0	80	8	8	8	8	8	
	'29	Botocan	3	12.0	80	8	8	8	8	8	
	dec.'80	Masiway		13.3	90	12	12	12	12	10	
Hydro total(incl.pump)						1221	1221	1221	516	450	
Oil	oct.'60	Rockwell	6			65	0	0	0	0	retire
	sep.'60	Rockwell	7			65	0	0	0	0	retire
	oct.'63	Rockwell	8			65	0	0	0	0	retire
											(Margin)
Total(excl.Rockwell)						4836	4726	4536	2511	1640	871
Load										1592	
(Loss)										48	

Table 5-1 Demand & Supply ballance ('86 Dry PNPPin)

Gen. type	Commission. Date	Name of P/P & No.	Rating cap(MVA)	P.F (%)	Rating cap(MW)	'85inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP	802.0	85	620	620	620	620	500	
Geo.	jan.'79	Tiwi 1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi 2	69.0	80	55	55	55	55	55	
	jan.'80	Tiwi 3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi 4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi 5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi 6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban 1	69.0	80	55	55	55	55	55	
	Jul.'79	Mak-Ban 2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban 3	69.0	80	55	55	55	55	55	
	jun.'80	Mak-Ban 4	69.0	80	55	55	55	55	55	
	Jun.'84	Mak-Ban 5	69.0	80	55	55	55	55	55	
	aug.'84	Mak-Ban 6	69.0	80	55	55	55	55	55	
	'90	Manito 1			55	0	0	0	0	none
	'90	Manito 2			55	0	0	0	0	none
Geo.total					770	660	660	605	605	
Coal	sep.'84	Calaca	353.0	85	300	300	300	300	300	
Oil	sep.'75	Malaya 1	370.0	90	300	300	260	260	154	before rehabili.
	mar.'79	Malaya 2	438.0	90	350	350	320	320	320	before rehabili.
	sep.'72	Bataan 1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan 2	187.5	80	150	150	150	150	70	
	aug.'68	Sucat 1	188.0	90	150	150	150	0	0	
	jun.'70	Sucat 2	245.0	90	200	200	160	0	0	before rehabili.
	jul.'71	Sucat 3	245.0	90	200	200	160	0	0	before rehabili.
	sep.'72	Sucat 4	370.0	90	300	300	260	260	150	before rehabili.
	sep.'65	Manila 1	128.0	85	100	100	100	0	0	
	oct.'65	Manila 2	128.0	85	100	100	100	0	0	
Oil total					1925	1925	1735	990	694	
Pump	sep.'82	Kalayaan 1	166.6	90	150	150	150	150	80	
	aug.'82	Kalayaan 2	166.6	90	150	150	150	0	0	
Hydro	aug.'83	Hagat 1	112.5	80	90	90	90	90	45	
	sep.'83	Hagat 2	112.5	80	90	90	90	90	45	
	oct.'83	Hagat 3	112.5	80	90	90	90	0	0	
	dec.'83	Hagat 4	112.5	80	90	90	90	0	0	
	apr.'77	Pant'bgn 1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn 2	55.5	90	50	50	50	0	0	
	oct.'67	Angat 1	55.6	90	50	50	50	50	50	
	oct.'67	Angat 2	55.6	90	50	50	50	50	50	
	aug.'68	Angat 3	55.6	90	50	50	50	0	0	
	jun.'68	Angat 4	55.6	90	50	50	50	0	0	
	jul.'67	Angat aux	20.0	90	18	18	18	18	18	
	dec.'56	Anbuklao 1	28.7	90	25	25	25	25	25	
	dec.'58	Anbuklao 2	28.7	90	25	25	25	0	0	
	sep.'57	Anbuklao 3	28.7	90	25	25	25	0	0	
	jan.'60	Binga 1	27.8	90	25	25	25	25	25	
	jan.'60	Binga 2	27.8	90	25	25	25	0	0	
	mar.'60	Binga 3	27.8	90	25	25	25	0	0	
	mar.'60	Binga 4	27.8	90	25	25	25	0	0	
	aug.'42	Caliraya 1	10.0	80	8	8	8	8	8	
	aug.'42	Caliraya 2	10.0	80	8	8	8	0	0	
	oct.'47	Caliraya 3	10.0	80	8	8	8	0	0	
	feb.'50	Caliraya 4	10.0	80	8	8	8	0	0	
	'29	Botocan 1	10.0	80	8	8	8	8	8	
	'29	Botocan 2	10.0	80	8	8	8	0	0	
	'29	Botocan 3	12.0	80	8	8	8	0	0	
	dec.'80	Hasiway	13.3	90	12	12	12	12	12	
Hydro total(incl.pump)					1221	1221	1221	576	416	
Oil	oct.'60	Rockwell 6			65	0	0	0	0	retire
	sep.'60	Rockwell 7			65	0	0	0	0	retire
	oct.'63	Rockwell 8			65	0	0	0	0	retire
										(Margin)
Total(excl.Rockwell)					4836	4726	4536	3091	2515	576
Load									2410	
(Loss)									105	

Table 5-2 Demand & Supply ballance ('86 Wet PNPPout)

Gen. type	Commission. Date	Name of P/P & No.	Rating cap(MVA)	P.F (%)	Rating cap(MW)	'85inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP	802.0	85	620	620	620	0	0	mainte.
Geo.	jan.'79	Tiwi 1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi 2	69.0	80	55	55	55	55	55	
	jan.'80	Tiwi 3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi 4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi 5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi 6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban 1	69.0	80	55	55	55	55	55	
	jul.'79	Mak-Ban 2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban 3	69.0	80	55	55	55	55	55	
	jun.'80	Mak-Ban 4	69.0	80	55	55	55	55	55	
	jun.'84	Mak-Ban 5	69.0	80	55	55	55	55	55	
	aug.'84	Mak-Ban 6	69.0	80	55	55	55	55	55	
	'90	Manito 1			55	0	0	0	0	none
	'90	Manito 2			55	0	0	0	0	none
Geo.total					770	660	660	605	605	
Coal	sep.'84	Calaca	353.0	85	300	300	300	300	300	
Oil	sep.'75	Malaya 1	370.0	90	300	300	260	260	150	before rehabili.
	mar.'79	Malaya 2	438.0	90	350	350	320	320	262	before rehabili.
	sep.'72	Bataan 1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan 2	187.5	80	150	150	150	150	70	
	aug.'68	Sucat 1	188.0	90	150	150	150	0	0	
	jun.'70	Sucat 2	245.0	90	200	200	160	0	0	before rehabili.
	jul.'71	Sucat 3	245.0	90	200	200	160	0	0	before rehabili.
	sep.'72	Sucat 4	370.0	90	300	300	260	260	106	before rehabili.
	sep.'65	Manila 1	128.0	85	100	100	100	0	0	
	oct.'65	Manila 2	128.0	85	100	100	100	0	0	
Oil total					1925	1925	1735	990	588	
Pump	sep.'82	Kalayaan 1	166.6	90	150	150	150	150	50	
	aug.'82	Kalayaan 2	166.6	90	150	150	150	150	47	
Hydro	aug.'83	Magat 1	112.5	80	90	90	90	90	90	
	sep.'83	Magat 2	112.5	80	90	90	90	90	90	
	oct.'83	Magat 3	112.5	80	90	90	90	90	90	
	dec.'83	Magat 4	112.5	80	90	90	90	90	90	
	apr.'77	Pant'bgn 1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn 2	55.5	90	50	50	50	50	50	
	oct.'67	Angat 1	55.6	90	50	50	50	50	50	
	oct.'67	Angat 2	55.6	90	50	50	50	50	50	
	aug.'68	Angat 3	55.6	90	50	50	50	50	50	
	jun.'68	Angat 4	55.6	90	50	50	50	50	50	
	jul.'67	Angat aux	20.0	90	18	18	18	18	18	
	dec.'56	Anbuklao 1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao 2	28.7	90	25	25	25	25	25	
	sep.'57	Anbuklao 3	28.7	90	25	25	25	25	25	
	jan.'60	Binga 1	27.8	90	25	25	25	25	25	
	jan.'60	Binga 2	27.8	90	25	25	25	25	25	
	mar.'60	Binga 3	27.8	90	25	25	25	25	25	
	mar.'60	Binga 4	27.8	90	25	25	25	25	25	
	aug.'42	Caliraya 1	10.0	80	8	8	8	8	8	
	aug.'42	Caliraya 2	10.0	80	8	8	8	8	8	
	oct.'47	Caliraya 3	10.0	80	8	8	8	8	8	
	feb.'50	Caliraya 4	10.0	80	8	8	8	8	8	
	'29	Botocan 1	10.0	80	8	8	8	8	8	
	'29	Botocan 2	10.0	80	8	8	8	8	8	
	'29	Botocan 3	12.0	80	8	8	8	8	8	
	dec.'80	Masiway	13.3	90	12	12	12	12	12	
Hydro total(incl.pump)					1221	1221	1221	1221	1018	
Oil	oct.'60	Rockwell 6			65	0	0	0	0	retire
	sep.'60	Rockwell 7			65	0	0	0	0	retire
	oct.'63	Rockwell 8			65	0	0	0	0	retire
										(Hargin)
Total(excl.Rockwell)					4836	4726	4536	3116	2511	605
Load									2410	
(Loss)									101	

Table 6-1 Demand & Supply ballance ('87 Wet PNPPin)

Gen. type	Commission. Date	Name of P/P & No.	Rating cap(MVA)	P.F (%)	Rating cap(MW)	'85inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP	802.0	85	620	620	620	620	500	
Geo.	jan.'79	Tiwi 1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi 2	69.0	80	55	55	55	55	55	
	Jan.'80	Tiwi 3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi 4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi 5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi 6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban 1	69.0	80	55	55	55	55	55	
	jul.'79	Mak-Ban 2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban 3	69.0	80	55	55	55	55	55	
	jun.'80	Mak-Ban 4	69.0	80	55	55	55	55	55	
	Jun.'84	Mak-Ban 5	69.0	80	55	55	55	55	55	
	aug.'84	Mak-Ban 6	69.0	80	55	55	55	55	55	
	'90	Manito 1			55	0	0	0	0	none
	'90	Manito 2			55	0	0	0	0	none
Geo.total					770	660	660	605	605	
Coal	sep.'84	Calaca	353.0	85	300	300	300	300	300	
Oil	sep.'75	Malaya 1	370.0	90	300	300	300	0	0	after rehabili.
	mar.'79	Malaya 2	438.0	90	350	350	350	350	100	after rehabili.
	sep.'72	Bataan 1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan 2	187.5	80	150	150	150	150	70	
	aug.'68	Sucat 1	188.0	90	150	150	150	0	0	
	jun.'70	Sucat 2	245.0	90	200	200	160	0	0	before rehabili.
	jul.'71	Sucat 3	245.0	90	200	200	160	0	0	before rehabili.
	sep.'72	Sucat 4	370.0	90	300	300	260	0	0	before rehabili.
	sep.'65	Manila 1	128.0	85	100	100	100	0	0	
	oct.'65	Manila 2	128.0	85	100	100	100	0	0	
Oil total					1925	1925	1805	500	170	
Pump	sep.'82	Kalayaan 1	166.6	90	150	150	150	150	75	
	aug.'82	Kalayaan 2	166.6	90	150	150	150	150	75	
Hydro	aug.'83	Magat 1	112.5	80	90	90	90	90	90	
	sep.'83	Magat 2	112.5	80	90	90	90	90	90	
	oct.'83	Magat 3	112.5	80	90	90	90	90	90	
	dec.'83	Magat 4	112.5	80	90	90	90	90	90	
	apr.'77	Pant'bgn 1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn 2	55.5	90	50	50	50	50	50	
	oct.'67	Angat 1	55.6	90	50	50	50	50	50	
	oct.'67	Angat 2	55.6	90	50	50	50	50	50	
	aug.'68	Angat 3	55.6	90	50	50	50	50	50	
	jun.'68	Angat 4	55.6	90	50	50	50	50	50	
	jul.'67	Angat aux	20.0	90	18	18	18	18	18	
	dec.'58	Anbuklao 1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao 2	28.7	90	25	25	25	25	25	
	sep.'57	Anbuklao 3	28.7	90	25	25	25	25	25	
	jan.'60	Binga 1	27.8	90	25	25	25	25	25	
	Jan.'60	Binga 2	27.8	90	25	25	25	25	25	
	mar.'60	Binga 3	27.8	90	25	25	25	25	25	
	mar.'60	Binga 4	27.8	90	25	25	25	0	0	mainte.
	aug.'42	Caliraya 1	10.0	80	8	8	8	8	8	
	aug.'42	Caliraya 2	10.0	80	8	8	8	8	8	
	oct.'47	Caliraya 3	10.0	80	8	8	8	8	8	
	feb.'50	Caliraya 4	10.0	80	8	8	8	8	8	
	'29	Botocan 1	10.0	80	8	8	8	8	8	
	'29	Botocan 2	10.0	80	8	8	8	,8	8	
	'29	Botocan 3	12.0	80	8	8	8	8	8	
	dec.'80	Hasiway	13.3	90	12	12	12	12	12	
Hydro total(incl.pump)					1221	1221	1221	1196	1046	
Oil	oct.'60	Rockwell 6			65	0	0	0	0	retire
	sep.'60	Rockwell 7			65	0	0	0	0	retire
	oct.'63	Rockwell 8			65	0	0	0	0	retire
										(Margin)
Total(excl.Rockwell)					4838	4726	4606	3221	2621	600
Load									2510	
(Loss)									111	

Table 6-2 Demand & Supply ballance ('87 Dry PNPPin)

Gen. type	Commission. Date	Name of P/P & No.	Rating cap(MVA)	P.F (%)	Rating cap(MW)	'85inst. cap(MW)	Avail. Cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP	802.0	85	620	620	620	620	500	
Geo.	jan.'79	Tiwi 1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi 2	69.0	80	55	55	55	55	55	
	jan.'80	Tiwi 3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi 4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi 5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi 6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban 1	69.0	80	55	55	55	55	55	
	jul.'79	Mak-Ban 2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban 3	69.0	80	55	55	55	55	55	
	jun.'80	Mak-Ban 4	69.0	80	55	55	55	55	55	
	jun.'84	Mak-Ban 5	69.0	80	55	55	55	55	55	
	aug.'84	Mak-Ban 6	69.0	80	55	55	55	55	55	
	'90	Manito 1			55	0	0	0	0	none
	'90	Manito 2			55	0	0	0	0	none
Geo.total					770	660	660	605	605	
Coal	sep.'84	Calaca	353.0	85	300	300	300	300	300	
Oil	sep.'75	Malaya 1	370.0	90	300	300	300	300	260	after rehabili.
	mar.'79	Malaya 2	438.0	90	350	350	350	350	300	after rehabili.
	sep.'72	Bataan 1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan 2	187.5	80	150	150	150	150	70	
	aug.'68	Sucat 1	188.0	90	150	150	150	0	0	
	jun.'70	Sucat 2	245.0	90	200	200	160	0	0	before rehabili.
	jul.'71	Sucat 3	245.0	90	200	200	160	0	0	before rehabili.
	sep.'72	Sucat 4	370.0	90	300	300	260	260	140	before rehabili.
	sep.'65	Manila 1	128.0	85	100	100	100	0	0	
	oct.'65	Manila 2	128.0	85	100	100	100	0	0	
Oil total					1925	1925	1805	1060	770	
Pump	sep.'82	Kalayaan 1	166.6	90	150	150	150	150	50	
	aug.'82	Kalayaan 2	166.6	90	150	150	150	150	50	
Hydro	aug.'83	Magat 1	112.5	80	90	90	90	90	90	
	sep.'83	Magat 2	112.5	80	90	90	90	90	90	
	oct.'83	Magat 3	112.5	80	90	90	90	0	0	
	dec.'83	Magat 4	112.5	80	90	90	90	0	0	
	apr.'77	Pant'bgn 1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn 2	55.5	90	50	50	50	0	0	
	oct.'67	Angat 1	55.6	90	50	50	50	25	25	
	oct.'67	Angat 2	55.6	90	50	50	50	25	25	
	aug.'68	Angat 3	55.6	90	50	50	50	0	0	
	jun.'68	Angat 4	55.6	90	50	50	50	0	0	
	jul.'67	Angat aux	20.0	90	18	18	18	0	0	
	dec.'56	Anbuklao 1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao 2	28.7	90	25	25	25	0	0	
	sep.'57	Anbuklao 3	28.7	90	25	25	25	0	0	
	jan.'60	Binga 1	27.8	90	25	25	25	25	25	
	jan.'60	Binga 2	27.8	90	25	25	25	0	0	
	mar.'60	Binga 3	27.8	90	25	25	25	0	0	
	mar.'60	Binga 4	27.8	90	25	25	25	0	0	
	aug.'42	Caliraya 1	10.0	80	8	8	8	0	0	
	aug.'42	Caliraya 2	10.0	80	8	8	8	0	0	
	oct.'47	Caliraya 3	10.0	80	8	8	8	0	0	
	feb.'50	Caliraya 4	10.0	80	8	8	8	0	0	
	'29	Botocan 1	10.0	80	8	8	8	8	8	
	'29	Botocan 2	10.0	80	8	8	8	0	0	
	'29	Botocan 3	12.0	80	8	8	8	0	0	
	dec.'80	Masiway	13.3	90	12	12	12	0	0	
Hydro total(incl.pump)					1221	1221	1221	638	438	
Oil	oct.'60	Rockwell 6			65	0	0	0	0	retire
	sep.'60	Rockwell 7			65	0	0	0	0	retire
	oct.'63	Rockwell 8			65	0	0	0	0	retire
										(Margin)
Total(excl.Rockwell)					4836	4726	4606	3223	2613	610
Load									2510	
(Loss)									103	

Table 6-3 Demand & Supply ballance ('87 Dry PNPPout)

Gen. type	Commission. Date	Name of P/P & No.		Rating cap(MVA)	P.F (%)	Rating cap(MW)	'85inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP		802.0	85	620	620	620	0	0	mainte.
Geo.	Jan.'79	Tiwi	1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi	2	69.0	80	55	55	55	55	55	
	jan.'80	Tiwi	3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi	4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi	5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi	6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban	1	69.0	80	55	55	55	55	55	
	jul.'79	Mak-Ban	2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban	3	69.0	80	55	55	55	55	55	
	jun.'80	Mak-Ban	4	69.0	80	55	55	55	55	55	
	jun.'84	Mak-Ban	5	69.0	80	55	55	55	55	55	
	aug.'84	Mak-Ban	6	69.0	80	55	55	55	55	55	
	'90	Manito	1			55	0	0	0	0	none
	'90	Manito	2			55	0	0	0	0	none
Geo.total						770	660	660	605	605	
Coal	sep.'84	Calaca		353.0	85	300	300	300	300	300	
Oil	sep.'75	Malaya	1	370.0	90	300	300	300	300	260	after rehabili.
	mar.'79	Malaya	2	438.0	90	350	350	350	350	320	after rehabili.
	sep.'72	Bataan	1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan	2	187.5	80	150	150	150	150	70	
	aug.'68	Sucat	1	188.0	90	150	150	150	150	85	
	jun.'70	Sucat	2	245.0	90	200	200	160	160	100	before rehabili.
	jul.'71	Sucat	3	245.0	90	200	200	160	160	100	before rehabili.
	sep.'72	Sucat	4	370.0	90	300	300	260	260	260	before rehabili.
	sep.'65	Manila	1	128.0	85	100	100	100	100	80	
	oct.'65	Manila	2	128.0	85	100	100	100	100	80	
Oil total						1925	1925	1805	1730	1355	
Pump	sep.'82	Kalayaan	1	166.6	90	150	150	150	150	29	
	aug.'82	Kalayaan	2	166.6	90	150	150	150	150	29	
Hydro	aug.'83	Magat	1	112.5	80	90	90	90	90	45	
	sep.'83	Magat	2	112.5	80	90	90	90	90	45	
	oct.'83	Magat	3	112.5	80	90	90	90	0	0	
	dec.'83	Magat	4	112.5	80	90	90	90	0	0	
	apr.'77	Pant'bgn	1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'bgn	2	55.5	90	50	50	50	0	0	
	oct.'67	Angat	1	55.6	90	50	50	50	25	25	
	oct.'67	Angat	2	55.6	90	50	50	50	25	25	
	aug.'68	Angat	3	55.6	90	50	50	50	0	0	
	jun.'68	Angat	4	55.6	90	50	50	50	0	0	
	jul.'67	Angat	aux	20.0	90	18	18	18	0	0	
	dec.'56	Anbuklao	1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao	2	28.7	90	25	25	25	0	0	
	sep.'57	Anbuklao	3	28.7	90	25	25	25	0	0	
	jan.'60	Binga	1	27.8	90	25	25	25	25	25	
	jan.'60	Binga	2	27.8	90	25	25	25	0	0	
	mar.'60	Binga	3	27.8	90	25	25	25	0	0	
	mar.'60	Binga	4	27.8	90	25	25	25	0	0	
	aug.'42	Caliraya	1	10.0	80	8	8	8	0	0	
	aug.'42	Caliraya	2	10.0	80	8	8	8	0	0	
	oct.'47	Caliraya	3	10.0	80	8	8	8	0	0	
	feb.'50	Caliraya	4	10.0	80	8	8	8	0	0	
	'29	Botocan	1	10.0	80	8	8	8	8	8	
	'29	Botocan	2	10.0	80	8	8	8	0	0	
	'29	Botocan	3	12.0	80	8	8	8	0	0	
	dec.'80	Hasiway		13.3	90	12	12	12	0	0	
Hydro total(incl.pump)						1221	1221	1221	638	306	
Oil	oct.'60	Rockwell	6			65	0	0	0	0	retire
	sep.'60	Rockwell	7			65	0	0	0	0	retire
	oct.'63	Rockwell	8			65	0	0	0	0	retire
											(Margin)
Total(excl.Rockwell)						4836	4726	4606	3273	2566	707
Load										2510	
(Loss)										56	

Table 7 Demand & Supply ballance ('90 Wet PNPPin)

Gen. type	Commission. Date	Name of P/P	& No.	Rating cap(MVA)	P.F (%)	Rating cap(MW)	'90inst. cap(MW)	Avail. cap(MW)	Operat. Cap(MW)	Output (MW)	Remark
Nuclear	feb.'85	PNPP		802.0	85	620	620	620	620	500	mainte.
Geo.	jan.'79	Tiwi	1	69.0	80	55	55	55	55	55	
	may.'79	Tiwi	2	69.0	80	55	55	55	55	55	
	jan.'80	Tiwi	3	69.0	80	55	55	55	55	55	
	apr.'80	Tiwi	4	69.0	80	55	55	55	55	55	
	dec.'81	Tiwi	5	69.0	80	55	55	55	55	55	
	mar.'82	Tiwi	6	69.0	80	55	55	55	0	0	mainte.
	apr.'79	Mak-Ban	1	69.0	80	55	55	55	55	55	
	jul.'79	Mak-Ban	2	69.0	80	55	55	55	55	55	
	apr.'80	Mak-Ban	3	69.0	80	55	55	55	55	55	
	jun.'80	Mak-Ban	4	69.0	80	55	55	55	55	55	
	jun.'84	Mak-Ban	5	69.0	80	55	55	55	55	55	
	aug.'84	Mak-Ban	6	69.0	80	55	55	55	55	55	
	'90	Manito	1			55	55	55	55	55	none
	'90	Manito	2			55	55	55	55	55	none
Geo.total						770	770	770	715	715	
Coal	sep.'84	Calaca		353.0	85	300	300	300	300	300	
Oil	sep.'75	Malaya	1	370.0	90	300	300	300	300	110	after rehabili.
	mar.'79	Malaya	2	438.0	90	350	350	350	350	165	after rehabili.
	sep.'72	Bataan	1	93.8	80	75	75	75	0	0	
	feb.'77	Bataan	2	187.5	80	150	150	150	150	70	
	aug.'68	Sucat	1	188.0	90	150	150	150	0	0	
	jun.'70	Sucat	2	245.0	90	200	200	200	0	0	after rehabili.
	jul.'71	Sucat	3	245.0	90	200	200	200	0	0	after rehabili.
	sep.'72	Sucat	4	370.0	90	300	300	300	300	150	after rehabili.
	sep.'65	Manila	1	128.0	85	100	100	100	100	50	
	oct.'65	Manila	2	128.0	85	100	100	100	0	0	
Oil total						1925	1925	1925	1200	545	
Pump	sep.'82	Kalaysan	1	166.6	90	150	150	150	150	65	
	aug.'82	Kalayaan	2	166.6	90	150	150	150	150	60	
Hydro	aug.'83	Magat	1	112.5	80	90	90	90	90	90	
	sep.'83	Magat	2	112.5	80	90	90	90	90	90	
	oct.'83	Magat	3	112.5	80	90	90	90	90	90	
	dec.'83	Magat	4	112.5	80	90	90	90	90	90	
	apr.'77	Pant'ban	1	55.5	90	50	50	50	50	50	
	apr.'77	Pant'ban	2	55.5	90	50	50	50	50	50	
	oct.'67	Angat	1	55.6	90	50	50	50	50	50	
	oct.'67	Angat	2	55.6	90	50	50	50	50	50	
	aug.'68	Angat	3	55.6	90	50	50	50	50	50	
	jun.'68	Angat	4	55.6	90	50	50	50	50	50	
	jul.'67	Angat	aux	20.0	90	18	18	18	18	18	
	dec.'56	Anbuklao	1	28.7	90	25	25	25	25	25	
	dec.'56	Anbuklao	2	28.7	90	25	25	25	25	25	
	sep.'57	Anbuklao	3	28.7	90	25	25	25	25	25	
	jan.'60	Binga	1	27.8	90	25	25	25	25	25	
	jan.'60	Binga	2	27.8	90	25	25	25	25	25	
	mar.'60	Binga	3	27.8	90	25	25	25	25	25	
	mar.'60	Binga	4	27.8	90	25	25	25	0	0	mainte.
	aug.'42	Caliraya	1	10.0	80	8	8	8	8	8	
	aug.'42	Caliraya	2	10.0	80	8	8	8	8	8	
	oct.'47	Caliraya	3	10.0	80	8	8	8	8	8	
	feb.'50	Caliraya	4	10.0	80	8	8	8	8	8	
	'29	Botocan	1	10.0	80	8	8	8	8	8	
	'29	Botocan	2	10.0	80	8	8	8	8	8	
	'29	Botocan	3	12.0	80	8	8	8	8	8	
	dec.'80	Masiway		13.3	90	12	12	12	12	12	
Hydro total(incl.pump)						1221	1221	1221	1196	1021	
Oil	oct.'60	Rockwell	6			65	0	0	0	0	retire
	sep.'60	Rockwell	7			65	0	0	0	0	retire
	oct.'63	Rockwell	8			65	0	0	0	0	retire
											(Hargin)
Total(excl.Rockwell)						4836	4836	4836	4031	3081	950
Load										2985	
(Loss)										96	

Table 8 (1) Transmission Line and Transformer Constants in 1985

BRANCH	NO	NF	NT	TAP	R (%)	X (%)	Y/2(%)	TAP-RATIO(P.U)	
Mexcico-Concepcion	301	501	601	0	0.6000	3.6000	3.1000	0.0	0.0
Concepcion-San Manuel	302	601	602	0	1.3000	7.7000	6.8000	0.0	0.0
San Manuel-Pantabangan	303	602	603	0	1.1000	6.4000	5.6000	0.0	0.0
Pantabangan-Cabanatuan	304	603	604	0	0.9000	5.0000	4.6000	0.0	0.0
Cabanatuan-Mexico	305	604	501	0	1.1000	6.9000	5.9000	0.0	0.0
San Manuel-Binga	306	602	607	0	0.3000	1.7000	13.0000	0.0	0.0
Binga-Baguio	307	607	608	0	0.1000	0.6000	1.9000	0.0	0.0
Baguio-Bauang	308	608	609	0	0.6000	3.7000	3.3000	0.0	0.0
Binga-Ambuklao	309	607	616	0	0.1000	0.5000	1.5000	0.0	0.0
Ambuklao-Bayombong	310	616	618	0	0.8000	4.7000	4.4000	0.0	0.0
Bayombong-Santiago	311	618	619	0	0.9000	5.1000	5.3000	0.0	0.0
Ambuklao-Santiago	312	616	619	0	1.7000	9.9000	9.3000	0.0	0.0
Santiago-Tuguegarao	313	619	621	0	1.9000	11.4000	9.9000	0.0	0.0
Santiago-Magat	314	619	620	0	0.1000	0.6000	2.5000	0.0	0.0
Cabanatuan-Masiway	315	605	606	0	0.0	0.0500	0.0	0.0	0.0
Bauang-San Esteban	316	609	612	0	1.7000	9.8000	9.2000	0.0	0.0
San Esteban-Lubuagan	317	612	613	0	1.4000	7.9000	5.0000	0.0	0.0
San Esteban(115)-Bantay	319	611	614	0	5.7000	14.0000	0.9000	0.0	0.0
Bantay-Curimao	320	614	615	0	7.5000	19.1000	1.2000	0.0	0.0
Curimao-Laoag	321	615	617	0	4.2000	10.7000	0.6000	0.0	0.0
Olongapo-Botolan	324	503	623	0	0.2700	1.8200	1.6600	0.0	0.0
Masiway(G)-Masiway	381	681	606	0	0.0	30.0000	0.0	0.0	0.0
Pantabangan(G)-Pantabangan	382	682	603	0	0.0	5.3000	0.0	0.0	0.0
Binga(G1)-Binga	383	683	607	0	0.0	19.4000	0.0	0.0	0.0
Binga(G2)-Binga	384	684	607	0	0.0	9.7000	0.0	0.0	0.0
Ambuklao(G)-Ambuklao	385	685	616	0	0.0	6.3000	0.0	0.0	0.0
Magat(G)-Magat	386	686	620	0	0.0	0.5000	0.0	0.0	0.0
Bauang(230)-(115)	388	609	610	0	0.0	19.5000	0.0	0.0	0.0
Cabanatuan(230)-(115)	389	605	604	0	0.0	6.9000	0.0	0.0	0.0
Gumaca-Kalayaan	401	701	511	0	0.7000	4.3000	15.5000	0.0	0.0
Labo-Gumaca	402	702	701	0	0.7000	4.0000	16.2000	0.0	0.0
Naga-Labo	403	703	702	0	0.8000	4.4000	18.2000	0.0	0.0
Naga-Daraga	404	703	705	0	1.2000	7.1000	6.2000	0.0	0.0
Tiwi-Naga	405	704	703	0	1.0000	5.4000	5.5000	0.0	0.0
Tiwi-Daraga	406	704	705	0	1.2000	7.1000	6.5000	0.0	0.0
Tiwi(G1)-Tiwi	481	781	704	0	0.0	1.3000	0.0	0.0	0.0
Tiwi(G2)-Tiwi	482	782	704	0	0.0	1.9500	0.0	0.0	0.0
Mexico-Hermosa	101	501	502	0	0.3000	1.8000	7.0000	0.0	0.0
Hermosa-Olongapo	102	502	503	0	0.3000	1.7000	6.4000	0.0	0.0
Hermosa-Bataan	103	502	504	0	0.6000	3.3000	3.1000	0.0	0.0
Bataan-Epza	104	504	505	0	0.1000	0.7000	2.6000	0.0	0.0
Mexcico-Balintawak	105	501	507	0	0.9000	5.5000	4.8000	0.0	0.0
Balintawak-San Jose	106	507	508	0	0.5000	2.9000	2.0000	0.0	0.0
Mexico-San Jose	107	501	508	0	0.7000	4.4000	4.2000	0.0	0.0
Malaya-Kalayaan	111	510	511	0	0.2000	1.3000	4.7000	0.0	0.0
Kalayaan-Mak Ban	112	511	512	0	0.3000	1.9000	7.3000	0.0	0.0
Mak Ban-Binan	113	512	514	0	0.3000	1.5000	6.0000	0.0	0.0
Mak Ban-Batangas	114	512	573	0	0.3000	1.7000	6.4000	0.0	0.0
Hermosa-PNPP	117	502	506	0	0.9000	5.4000	5.1000	0.0	0.0
Bataan-PNPP	119	504	506	0	0.5000	3.1000	2.4000	0.0	0.0
Binan-Calaca	120	514	513	0	0.3000	2.2000	13.9000	0.0	0.0
Bataan-Bataan(G2)	182	504	582	0	0.0	1.8000	0.0	0.0	0.0
Angat(G1)-Angat	187	587	537	0	0.0	2.1000	0.0	0.0	0.0
Angat(G2)-Angat	188	588	537	0	0.0	25.0000	0.0	0.0	0.0
Malaya(G2)-Malaya(T2)	190	590	550	0	0.0	1.5000	0.0	0.0	0.0
Kalayaan(G)-Kalayaan	191	591	511	0	0.0	1.9000	0.0	0.0	0.0

Table 8 (2)

BRANCH	NO	NF	NT	TAP	R (%)	X (%)	Y/2(%)	TAP-RATIO(P.U)	
Caliraya-Botocan	192	592	528	0	0.0	12.0000	0.0	0.0	0.0
Botocan(G)-Botocan	193	593	529	0	0.0	24.0000	0.0	0.0	0.0
Mak Ban(G)-Mak Ban	194	594	512	0	0.0	1.2800	0.0	0.0	0.0
Angat-Angat(G1)	201	537	538	0	0.3000	1.8000	1.2000	0.0	0.0
San Jose-Novaliches	202	538	539	0	9999.8984	**********	0.0	0.0	0.0
San Jose(115)-Balintawak(115)	203	538	541	0	0.7000	4.2000	0.9000	0.0	0.0
Balintawak(115)-N.Port	204	541	533	0	0.5000	2.2000	0.3000	0.0	0.0
N.Port-Manila	205	533	532	0	0.6000	2.0000	0.2000	0.0	0.0
Manila-Sta.Mesa	206	532	535	0	0.2000	1.5000	0.2000	0.0	0.0
Sta.Mesa-N.Port	207	535	533	0	0.2000	1.3000	0.2000	0.0	0.0
Malinta-Bocaue	209	534	542	0	1.9000	5.0000	0.3000	0.0	0.0
P.D.B.-Malinta	210	541	534	0	0.3000	2.0000	0.3000	0.0	0.0
Balintawak-(Nov.-Mari.)	211	541	540	0	0.3000	1.1000	0.1000	0.0	0.0
Novaliches-P.D.B.	212	539	540	0	0.6000	3.0000	0.2000	0.0	0.0
Bocaue-Metro.Con.Tap	213	542	549	0	1.1000	2.8000	0.2000	0.0	0.0
N.G.C.-Parang	214	540	530	0	0.7000	3.6000	0.2000	0.0	0.0
Marikina-Rosario	215	530	552	0	0.2000	1.8000	0.2000	0.0	0.0
Dolores-Cainta	216	524	536	0	0.1000	1.1000	0.1000	0.0	0.0
Sta.Mesa-Cubao	217	535	536	0	0.5000	3.4000	0.4000	0.0	0.0
Sta.Mesa-Rockwell	218	535	520	0	0.3000	2.5000	0.3000	0.0	0.0
Manila-(Malib.-Kama.)	220	532	519	0	0.2000	1.4000	0.2000	0.0	0.0
(Malib.-Kama.)-Malibay	221	519	518	0	0.1000	0.7000	0.2000	0.0	0.0
Malibay-Sunvalley	222	518	517	0	0.5000	4.2000	0.6000	0.0	0.0
Sucat-Rockwell	223	517	520	0	0.5000	3.8000	0.5000	0.0	0.0
Binan-Sn.Ped.Tap	225	515	545	0	0.8000	5.7000	0.4000	0.0	0.0
Rockwell-(Taguig-Mand.)	226	520	522	0	0.1000	1.0000	0.1000	0.0	0.0
(Taguig-Mand.)-Mandaluyong	227	522	531	0	0.1000	0.7000	0.1000	0.0	0.0
Marikina-Mandaluyong	228	530	531	0	0.4000	3.2000	0.4000	0.0	0.0
(Manda.-Rock.)-Taguig	229	522	523	0	0.1000	1.1000	0.2000	0.0	0.0
Sucat-Taguig	230	517	523	0	0.3000	3.4000	0.4000	0.0	0.0
Dolores-Taguig	231	524	523	0	0.3000	2.1000	0.3000	0.0	0.0
Dolores-(Malaya-Teresa)	232	524	521	0	0.3000	2.1000	0.3000	0.0	0.0
(Teresa-Dolores)-Malaya	233	521	526	0	9999.8984	**********	0.0	0.0	0.0
Malaya-Caliraya	234	526	528	0	5.0000	12.3000	0.6000	0.0	0.0
Sucat-Pamplona.Tap	235	517	545	0	9999.8984	**********	0.0	0.0	0.0
Panplona.Tap-Pamplona	236	545	516	0	0.5000	2.5000	0.2000	0.0	0.0
Balintawak-Sta.Mesa	237	541	535	0	0.6000	2.1000	0.2000	0.0	0.0
Rosario Tap-Rosario	238	552	547	0	0.0	0.0500	0.0	0.0	0.0
St.Anthony Tap-St.Anthony	239	551	548	0	0.0	0.0500	0.0	0.0	0.0
Malinta-Novaliches	240	549	539	0	1.5000	3.6000	0.2000	0.0	0.0
Metro.Conc.Tap-Metro Conc.	242	549	546	0	0.1000	0.3000	0.0300	0.0	0.0
Binta-Cigi.Tap	245	515	560	0	0.4000	1.9000	0.2000	0.0	0.0
Cigi.Tap-Cigi	246	560	561	0	0.1000	0.3000	0.0200	0.0	0.0
Cigi.Tap-Balibago	247	560	562	0	0.1000	0.5000	0.0300	0.0	0.0
Balibago-Asia B.Tap	248	562	563	0	0.2000	0.8000	0.0500	0.0	0.0
Asia B.Tap-Asia.Brew	249	563	564	0	0.3000	0.8000	0.0600	0.0	0.0
Asia B.Tap-Calauan Tap	250	563	565	0	0.2000	1.1000	0.1000	0.0	0.0
Calauan Tap-Canlubang	251	565	566	0	0.2000	1.3000	0.1000	0.0	0.0
Calauan Tap-Calauan	252	565	567	0	1.4000	7.4000	0.4000	0.0	0.0
Caliraya-Botocan	253	528	529	0	2.6000	6.7000	0.3000	0.0	0.0
St.Ant Tap-Rosario Tap	260	551	552	0	0.1000	1.0000	0.1000	0.0	0.0
Dolores-St.Ant Tap	261	524	551	0	0.1000	0.6000	0.1000	0.0	0.0
Pamplo Tap-Sn.Ped Tap	270	515	574	0	0.1000	0.4000	0.0200	0.0	0.0
Rosario-Dasmarinas	271	574	570	0	1.9000	5.0000	0.3000	0.0	0.0
Dasmarinas-Armona	272	574	571	0	0.0	0.0500	0.0	0.0	0.0
Teresa Tap-Teresa	273	521	525	0	0.3000	0.7000	0.0400	0.0	0.0

Table 8 (3)

BRANCH	NO	NF	NT	TAP	R (%)	X (%)	Y/2(%)	TAP-RATIO(P.U)	
Binan-Dasmarinas	274	515	570	0	2.1000	5.3000	0.3000	0.0	0.0
Balintawak(230)-(115)	281	507	541	0	0.0	2.0000	0.0	0.0	0.0
Dolores(230)-(115)	283	509	524	0	0.0	1.3000	0.0	0.0	0.0
Malaya(230)-Malaya(T1)	284	510	527	0	0.0	2.3000	0.0	0.0	0.0
Malaya(230)-Malaya(T2)	285	510	550	0	0.0	2.1000	0.0	0.0	0.0
Malaya(T1)-Malaya(115)	286	527	526	0	0.0	0.1000	0.0	0.0	0.0
Malaya(T2)-Malaya(115)	287	550	526	0	0.0	0.1000	0.0	0.0	0.0
San Esteban(230)-(115)	387	612	611	0	0.0	19.9000	0.0	0.0	0.0
San Jose-Hermosa	116	508	502	0	0.3000	2.7000	17.7000	0.0	0.0
Hermosa-PNPP	118	502	506	0	0.0900	0.7800	20.4000	0.0	0.0
PNPP-PNPP(G)	196	506	596	0	0.0	0.6000	0.0	0.0	0.0
Malinta-Malabon	264	534	544	0	0.2000	1.5000	0.2000	0.0	0.0
Malabon-N.Port	265	544	533	0	0.2000	1.5000	0.2000	0.0	0.0
(Manila-Malib)-Kamag	255	519	557	0	0.0300	0.3000	0.0300	0.0	0.0
Kamag-Rockwell	256	557	520	0	0.1000	1.0000	0.1300	0.0	0.0
Binan-Sucat	275	517	636	0	0.2000	2.1000	1.1000	0.0	0.0
Calaca(230)-(115)	197	513	597	0	0.0	1.6000	0.0	0.0	0.0
San Jose-Dolores	108	508	509	0	0.0700	1.1500	10.7000	0.0	0.0
Dolores-Malaya	110	509	510	0	0.0700	1.1300	10.2000	0.0	0.0
Malaya-Kalayaan	123	510	511	0	0.0500	0.8000	7.2800	0.0	0.0
Naga-Tiwi	409	703	704	0	0.2500	2.2000	14.0700	0.0	0.0
San Jose(230)-(115)	282	508	538	0	0.0	1.9000	0.0	0.0	0.0
Binan(230)-(115)	288	514	515	0	0.0	2.8400	0.0	0.0	0.0
Sucat(115)-(230)	297	514	636	0	0.0	1.9000	0.0	0.0	0.0

Table 8 (4) Transmission Line and Transformer Constants in 1990

BRANCH	NO	NF	NT	TAP	R (%)	X (%)	Y/2(%)	TAP-RATIO(P.U)	
Mexcico-Concepcion	301	501	601	0	0.6000	3.6000	3.1000	0.0	0.0
Concepcion-San Manuel	302	601	602	0	1.3000	7.7000	6.8000	0.0	0.0
San Manuel-Pantabangan	303	602	603	0	1.1000	6.4000	5.6000	0.0	0.0
Pantabangan-Cabanatuan	304	603	604	0	0.9000	5.0000	4.6000	0.0	0.0
Cabanatuan-Mexico	305	604	501	0	1.1000	6.4000	5.9000	0.0	0.0
San Manuel-Binga	306	602	607	0	0.3000	1.7000	13.0000	0.0	0.0
Binga-Baguio	307	607	608	0	0.1000	0.6000	1.9000	0.0	0.0
Baguio-Bauang	308	608	609	0	0.3000	1.8500	6.6000	0.0	0.0
Binga-Ambuklao	309	607	616	0	0.1000	0.5000	1.5000	0.0	0.0
Ambuklao-Bayombong	310	616	618	0	0.8000	4.7000	4.4000	0.0	0.0
Bayombong-Santiago	311	618	619	0	0.9000	5.1000	5.3000	0.0	0.0
Ambuklao-Santiago	312	616	619	0	1.7000	9.9000	9.3000	0.0	0.0
Santiago-Tuguegarao	313	619	621	0	1.9000	11.4000	9.9000	0.0	0.0
Santiago-Magat	314	619	620	0	0.1000	0.6000	2.5000	0.0	0.0
Cabanatuan-Masiway	315	605	606	0	0.0	0.0500	0.0	0.0	0.0
Bauang-San Esteban	316	609	612	0	1.7000	9.8000	9.2000	0.0	0.0
San Esteban-Lubuagan	317	612	613	0	1.4000	7.9000	5.0000	0.0	0.0
San Esteban(115)-Bantay	319	611	614	0	5.7000	14.0000	0.9000	0.0	0.0
Bantay-Curimao	320	614	615	0	7.5000	19.1000	1.2000	0.0	0.0
Curimao-Laoag	321	615	617	0	4.2000	10.7000	0.6000	0.0	0.0
Olongapo-Botolan	324	503	623	0	0.2700	1.8200	1.6600	0.0	0.0
Masiway(G)-Masiway	381	681	606	0	0.0	30.0000	0.0	0.0	0.0
Pantabangan(G)-Pantabangan	382	682	603	0	0.0	9.3000	0.0	0.0	0.0
Binga(G1)-Binga	383	683	607	0	0.0	19.4000	0.0	0.0	0.0
Binga(G2)-Binga	384	684	607	0	0.0	9.7000	0.0	0.0	0.0
Ambuklao(G)-Ambuklao	385	685	616	0	0.0	6.3000	0.0	0.0	0.0
Magat(G)-Magat	386	686	620	0	0.0	0.9000	0.0	0.0	0.0
Bauang(230)-(115)	388	609	610	0	0.0	19.5000	0.0	0.0	0.0
Cabanatuan(230)-(115)	389	605	604	0	0.0	6.9000	0.0	0.0	0.0
Gumaca-Kalayaan	401	701	511	0	0.7000	4.3000	15.5000	0.0	0.0
Labo-Gumaca	402	702	701	0	0.7000	4.0000	16.2000	0.0	0.0
Naga-Labo	403	703	702	0	0.8000	4.4000	18.2000	0.0	0.0
Naga-Daraga	404	703	705	0	1.2000	7.1000	6.2000	0.0	0.0
Tiwi-Naga	405	704	703	0	1.0000	5.4000	5.5000	0.0	0.0
Tiwi-Daraga	406	704	705	0	1.2000	7.1000	6.5000	0.0	0.0
Tiwi(G1)-Tiwi	481	781	704	0	0.0	1.3000	0.0	0.0	0.0
Tiwi(G2)-Tiwi	482	782	704	0	0.0	1.9500	0.0	0.0	0.0
Mexico-Hermosa	101	501	502	0	0.3000	1.8000	7.0000	0.0	0.0
Hermosa-Olongapo	102	502	503	0	0.3000	1.7000	6.4000	0.0	0.0
Hermosa-Bataan	103	502	504	0	0.6000	3.3000	3.1000	0.0	0.0
Bataan-Epza	104	504	505	0	0.1000	0.7000	2.6000	0.0	0.0
Mexcico-Balintawak	105	501	507	0	0.9000	5.5000	4.8000	0.0	0.0
Balintawak-San Jose	106	507	508	0	0.5000	2.9000	2.0000	0.0	0.0
Mexico-San Jose	107	501	508	0	0.7000	4.4000	4.2000	0.0	0.0
Malaya-Kalayaan	111	510	511	0	0.2000	1.3000	4.7000	0.0	0.0
Kalayaan-Mak Ban	112	511	512	0	0.3000	1.9000	7.3000	0.0	0.0
Mak Ban-Binan	113	512	514	0	0.3000	1.5000	6.0000	0.0	0.0
Mak Ban-Batangas	114	512	573	0	0.3000	1.7000	6.4000	0.0	0.0
Hermosa-PNPP	117	502	506	0	0.9000	5.4000	5.1000	0.0	0.0
Bataan-PNPP	119	504	506	0	0.5000	3.1000	2.4000	0.0	0.0
Binan-Calaca	120	514	513	0	0.3000	2.2000	13.9000	0.0	0.0
Bataan-Bataan(G2)	182	504	582	0	0.0	1.8000	0.0	0.0	0.0
Manila(G)- Manila	183	583	532	0	0.0	4.2000	0.0	0.0	0.0
Sucat(g3)-Sucat	186	586	517	0	0.0	1.6000	0.0	0.0	0.0
Angat(G1)-Angat	187	587	537	0	0.0	2.1000	0.0	0.0	0.0
Angat(G2)-Angat	188	588	537	0	0.0	25.0000	0.0	0.0	0.0

Table 8 (5)

BRANCH	NO	NF	NT	TAP	R (%)	X (%)	Y/2(%)	TAP-RATIO(P.U)	
Malaya(G1)-Malaya(T1)	189	589	527	0	0.0	1.6000	0.0	0.0	0.0
Malaya(G2)-Malaya(T2)	190	590	550	0	0.0	1.5000	0.0	0.0	0.0
Kalayaan(G)-Kalayaan	191	591	511	0	0.0	1.9000	0.0	0.0	0.0
Caliraya-Botocan	192	592	528	0	0.0	12.0000	0.0	0.0	0.0
Botocan(G)-Botocan	193	593	529	0	0.0	24.0000	0.0	0.0	0.0
Mak Ban(G)-Mak Ban	194	594	512	0	0.0	1.2800	0.0	0.0	0.0
Angat-Angat(G1)	201	537	538	0	0.3000	1.8000	1.2000	0.0	0.0
San Jose-Novaliches	202	538	539	0	9999.8984	**********	0.0	0.0	0.0
San Jose(115)-Balintawak(115)	203	538	541	0	0.7000	4.2000	0.9000	0.0	0.0
Balintawak(115)-N.Port	204	541	533	0	0.5000	2.2000	0.3000	0.0	0.0
N.Port-Manila	205	533	532	0	0.6000	2.0000	0.2000	0.0	0.0
Manila-Sta.Mesa	206	532	535	0	0.2000	1.5000	0.2000	0.0	0.0
Sta.Mesa-N.Port	207	535	533	0	0.2000	1.3000	0.2000	0.0	0.0
Malinta-Bocaue	209	534	542	0	1.9000	5.0000	0.3000	0.0	0.0
P.D.B.-Malinta	210	631	534	0	0.2000	1.5000	0.2000	0.0	0.0
Balintawak-(Nov.-Mari.)	211	541	540	0	0.3000	1.1000	0.1000	0.0	0.0
Novaliches-P.D.B.	212	539	540	0	0.3000	1.8000	0.2000	0.0	0.0
Bocaue-Metro.Con.Tap	213	542	549	0	1.1000	2.8000	0.2000	0.0	0.0
N.G.C.-Parang	214	632	633	0	0.5000	2.7000	0.2000	0.0	0.0
Marikina-Rosario	215	530	552	0	0.2000	1.8000	0.2000	0.0	0.0
Dolores-Cainta	216	524	536	0	0.1000	1.1000	0.1000	0.0	0.0
Sta.Mesa-Cubao	217	535	634	0	0.2000	1.6000	0.2000	0.0	0.0
Sta.Mesa-Rockwell	218	535	520	0	0.3000	2.5000	0.3000	0.0	0.0
Manila-(Malib.-Kama.)	220	532	519	0	0.2000	1.4000	0.2000	0.0	0.0
(Malib.-Kama.)-Malibay	221	519	518	0	0.1000	0.7000	0.2000	0.0	0.0
Malibay-Sunvalley	222	518	635	0	0.3000	2.6000	0.4000	0.0	0.0
Sucat-Rockwell	223	517	520	0	0.5000	3.8000	0.5000	0.0	0.0
Binan-Sn.Ped.Tap	225	515	598	0	0.2000	0.9000	0.1000	0.0	0.0
Rockwell-(Taguig-Mand.)	226	520	522	0	0.1000	1.0000	0.1000	0.0	0.0
(Taguig-Mand.)-Mandaluyong	227	522	531	0	0.1000	0.7000	0.1000	0.0	0.0
Marikina-Mandaluyong	228	530	531	0	0.4000	3.2000	0.4000	0.0	0.0
(Manda.-Rock.)-Taguig	229	522	523	0	0.1000	1.1000	0.2000	0.0	0.0
Sucat-Taguig	230	517	523	0	0.3000	3.4000	0.4000	0.0	0.0
Dolores-Taguig	231	524	523	0	0.3000	2.1000	0.3000	0.0	0.0
Dolores-(Malaya-Teresa)	232	524	521	0	0.3000	2.1000	0.3000	0.0	0.0
(Teresa-Dolores)-Malaya	233	521	526	0	9999.8984	**********	0.0	0.0	0.0
Malaya-Caliraya	234	526	528	0	5.0000	17.3000	0.6000	0.0	0.0
Sucat-Pamplona.Tap	235	517	545	0	9999.8984	**********	0.0	0.0	0.0
Panplona.Tap-Pamplona	236	545	516	0	0.5000	2.5000	0.2000	0.0	0.0
Balintawak-Sta.Mesa	237	541	535	0	0.6000	2.1000	0.2000	0.0	0.0
Rosario Tap-Rosario	238	552	547	0	0.0	0.0500	0.0	0.0	0.0
St.Anthony Tap-St.Anthony	239	551	548	0	0.0	0.0500	0.0	0.0	0.0
Malinta-Novaliches	240	631	539	0	1.2000	2.9000	0.2000	0.0	0.0
Metro Conc.Tap-Metro Conc.	242	545	546	0	0.1000	0.3000	0.0300	0.0	0.0
Binta-Cigi.Tap	245	515	560	0	0.4000	1.9000	0.2000	0.0	0.0
Cigi.Tap-Cigi	246	560	561	0	0.1000	0.3000	0.0200	0.0	0.0
Cigi.Tap-Balibago	247	560	562	0	0.1000	0.5000	0.0300	0.0	0.0
Balibago-Asia B.Tap	248	562	563	0	0.2000	0.8000	0.0500	0.0	0.0
Asia B.Tap-Asia.Brew	249	563	564	0	0.3000	0.8000	0.0600	0.0	0.0
Asia B.Tap-Calauan Tap	250	563	565	0	0.2000	1.1000	0.1000	0.0	0.0
Calauan Tap-Canlubang	251	565	566	0	0.2000	1.3000	0.1000	0.0	0.0
Calauan Tap-Calauan	252	565	567	0	1.4000	7.4000	0.4000	0.0	0.0
Caliraya-Botocan	253	528	529	0	2.6000	6.7000	0.3000	0.0	0.0
St.Ant Tap-Rosario Tap	260	551	552	0	0.1000	1.0000	0.1000	0.0	0.0
Dolores-St.Ant Tap	261	524	551	0	0.1000	0.6000	0.1000	0.0	0.0
Pamplo Tap-Sn.Ped Tap	270	545	598	0	0.7000	4.5000	0.3000	0.0	0.0

Table 8 (6)

BRANCH	NO	NF	NT	TAP	R (%)	X (%)	Y/2(%)	TAP-RATIO(P.U)	
Rosario-Dasmarinas	271	638	570	0	3.7000	5.4000	0.4000	0.0	0.0
Dasmarinas-Armona	272	570	571	0	1.6000	4.4000	0.2000	0.0	0.0
Teresa Tap-Teresa	273	521	525	0	0.3000	0.7000	0.0400	0.0	0.0
Binan-Dasmarinas	274	514	574	0	0.1000	0.7000	2.5000	0.0	0.0
Balintawak(230)-(115)	281	507	541	0	0.0	2.0000	0.0	0.0	0.0
Dolores(230)-(115)	283	509	524	0	0.0	1.3000	0.0	0.0	0.0
Malaya(230)-Malaya(T1)	284	510	527	0	0.0	2.3000	0.0	0.0	0.0
Malaya(230)-Malaya(T2)	285	510	550	0	0.0	2.1000	0.0	0.0	0.0
Malaya(T1)-Malaya(115)	286	527	526	0	0.0	0.1000	0.0	0.0	0.0
Malaya(T2)-Malaya(115)	287	550	526	0	0.0	0.1000	0.0	0.0	0.0
San Esteban(230)-(115)	287	612	611	0	0.0	20.6000	0.0	0.0	0.0
San.Jose-Hermosa	116	508	502	0	0.3000	2.7000	17.7000	0.0	0.0
Hermosa-PNPP	118	502	506	0	0.0900	0.7800	20.4000	0.0	0.0
PNPP-PNPP(G)	196	506	556	0	0.0	0.6000	0.0	0.0	0.0
Malinta-Malabon	264	534	544	0	0.2000	1.5000	0.2000	0.0	0.0
Malabon-N.Port	265	544	533	0	0.2000	1.5000	0.2000	0.0	0.0
(Manila-Malib)-Kamag	255	519	557	0	0.0300	0.3000	0.0300	0.0	0.0
Kamag-Rockwell	256	557	520	0	0.1000	1.0000	0.1300	0.0	0.0
Binan-Sucat	275	514	636	0	0.0500	0.5700	4.0300	0.0	0.0
Calaca(230)-(115)	197	513	597	0	0.0	1.6000	0.0	0.0	0.0
San Jose-Dolores	108	508	509	0	0.0700	1.1500	10.7000	0.0	0.0
Dolores-Malaya	110	509	510	0	0.0700	1.1300	10.2000	0.0	0.0
Malaya-Kalayaan	123	510	511	0	0.0500	0.8000	7.2800	0.0	0.0
Naga-Tiwi	409	703	704	0	0.2500	2.2000	14.0700	0.0	0.0
San Jose(230)-(115)	282	508	538	0	0.0	1.9000	0.0	0.0	0.0
Binan(230)-(115)	268	514	515	0	0.0	5.6000	0.0	0.0	0.0
Sucat(115)-(230)	297	517	636	0	0.0	1.2700	0.0	0.0	0.0
Botolan-Labrador	293	623	641	0	0.9000	5.4000	4.7000	0.0	0.0
Bauang-Labrador	294	609	641	0	1.2400	7.1500	26.5000	0.0	0.0
Metro.Con.Tap-P.D.B.	276	549	631	0	0.2700	0.6500	0.1000	0.0	0.0
Balintawsk-Malikina	413	541	530	0	1.0000	4.7000	0.3000	0.0	0.0
(Nova-Balin)-NBC	278	540	632	0	0.4000	2.4000	0.2000	0.0	0.0
Malikina-PARA	279	530	633	0	0.5000	2.7000	0.2000	0.0	0.0
Balintawak-P.O.B.	277	541	631	0	0.5000	3.6000	0.5000	0.0	0.0
Dasmarinas(230)-(115)	296	574	570	0	0.0	19.9000	0.0	0.0	0.0
Kalayaan-Naga	291	511	703	0	0.5000	7.4000	60.0000	0.0	0.0
Sunbo-Sucat	289	635	517	0	0.1000	1.4000	0.2000	0.0	0.0
Sn.Ped.Tap-Sn.Ped.	290	598	637	0	0.0	0.0500	0.0	0.0	0.0
Manito-Daraga	292	639	705	0	0.5000	2.9000	11.0000	0.0	0.0
Manito-Manito(G)	295	639	640	0	0.0	3.8400	0.0	0.0	0.0
Cainta-Cubao	298	536	634	0	0.3000	2.6000	0.4000	0.0	0.0
Kamagong-Sucat	280	557	517	0	0.6000	4.6000	0.6000	0.0	0.0
San Jose-Kalayaan	414	508	511	0	0.1600	3.0500	29.2000	0.0	0.0