REPUBLIC OF THE PHILIPPINES

REPORT ON LONG-RANGE POWER DEVELOPMENT PROGRAM IN THE VISAYAS

Volume I

March 1973

Overseas Technical Cooperation Agency
Government of Japan

· 5419

Republic of the Philippines

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Volume I

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Preface

The Government of Japan, in response to the request of the Government of the Philippines, undertook to conduct a study for the long-range power development program in the Visayas region, Republic of the Philippines and entrusted the execution of the study to the Overseas Technical Cooperation Agency.

Being cognizant of the importance of power development program in the region in the light of Four Year Development Plan as well as of social and economic significance of infrastructures as a basis for development, the Agency organized a survey team comprising six members, headed by Mr. Tsutomu Kidahashi and sent it to the Philippines for a period of 88 days from October 10, 1972.

Thanks to the kind cooperation of the Government of the Philippines and the organizations concerned, the study could have been carried out quite satisfactorily. On the basis of the interim report, which was submitted while the team was in the Philippines, the team made again a comprehensive study of the data and information gathered after its arrival in Japan, and thus the final report is now ready for presentation.

The mission assigned to the team was to make a power development program for the entire Visayas region as well as to review the feasibility report which had been prepared by the National Power Corporation. The former is summarized in Vol. I and the latter in Vol. II. What the team recommends is to have a long-range plan targeting the year 1987 with the economic, social and power implications, and is highly, we think, conducive to the future development of the country.
I sincerely hope that this recommendation is implemented as scheduled in the report.

It is also my pleasure that the report will prove helpful to the social development and thus contribute to the economic relationship and friendship between Republic of the Philippines and Japan.

Finally, I wish to take this opportunity to express my appreciation and gratitude to the officials of the Government of Republic of the Philippines for the wholehearted cooperation and support extended to us in the execution of the mission.

March, 1973

Keiichi Tatsuke
Director General
Overseas Technical Cooperation Agency

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CABLE ADDRESS:
ELECTPOWER TOKYO

Mr. Keiichi Tatsuke,
Director General
Overseas Technical
Cooperation Agency

Dear Mr. Tatsuke

Submitted herewith is the report on the Long-Range Electric Power Development Program in the Visayas, Republic of the Philippines. The report consists of two volumes; Volume I covering the entire region of the Visayas, and Volume II depicting the details of studies made on the feasibility of the Electric Power Grid on the island of Cebu.

The Overseas Technical Cooperation Agency (hereinafter called OTCA), for the purpose of formulating the long-range electric power development program, organized and sent an engineering team consisting of six experts of Electric Power Development Co., Ltd. (or otherwise known as EPDC) and OTCA to Republic of the Philippines for the period of October 1972 through January 1973.

After conducting the site investigations, and based on the data and information made available to the team by the Government of the Philippines, as well as, international organizations, such as, Asian Development Bank, International Bank for Reconstruction and Development, the United Nations and Economic Commission for Asia and the Far-East, the team prepared and submitted an interim report to the Government of the Philippines in January before leaving the Philippines. The interim report has been amplified and refined into further details in Japan by mobilizing engineers and experts of EPDC, as well as, electronic computers for system analysis to form the present final report.

Located between Luzon and Mindanao, the Visayas have been developed along with the expansion of entrepots in the region. Cebu is the center of Visayan commerce, while Panay and Negros are treasure houses of rice and sugar respectively. Adverse effects on the economic circle brought about by floating pesos on the world exchange market in 1970 is now diminishing, and it is a general outlook that the economic recession is coming to an end. It is believed, at this transitional stage from recovery to development, that the reinforcement of power industry, by constituting

island wide grids connected with large scale generating facilities, are indispensable to support the economic development; island wide grid being capable of supplying reliable and low-cost energy.

In order to meet the projected demand in the years from 1976 to 1987, fixed capital investment of US$ 175 million will be required. This amount is believed reasonable in the light of the projected investment in the electric industry in the entire Philippines. Electrification will be promoted. Stable power supply in sufficient quantity will not only support industrial growth but contribute to the betterment of living standard in the Visayas region.

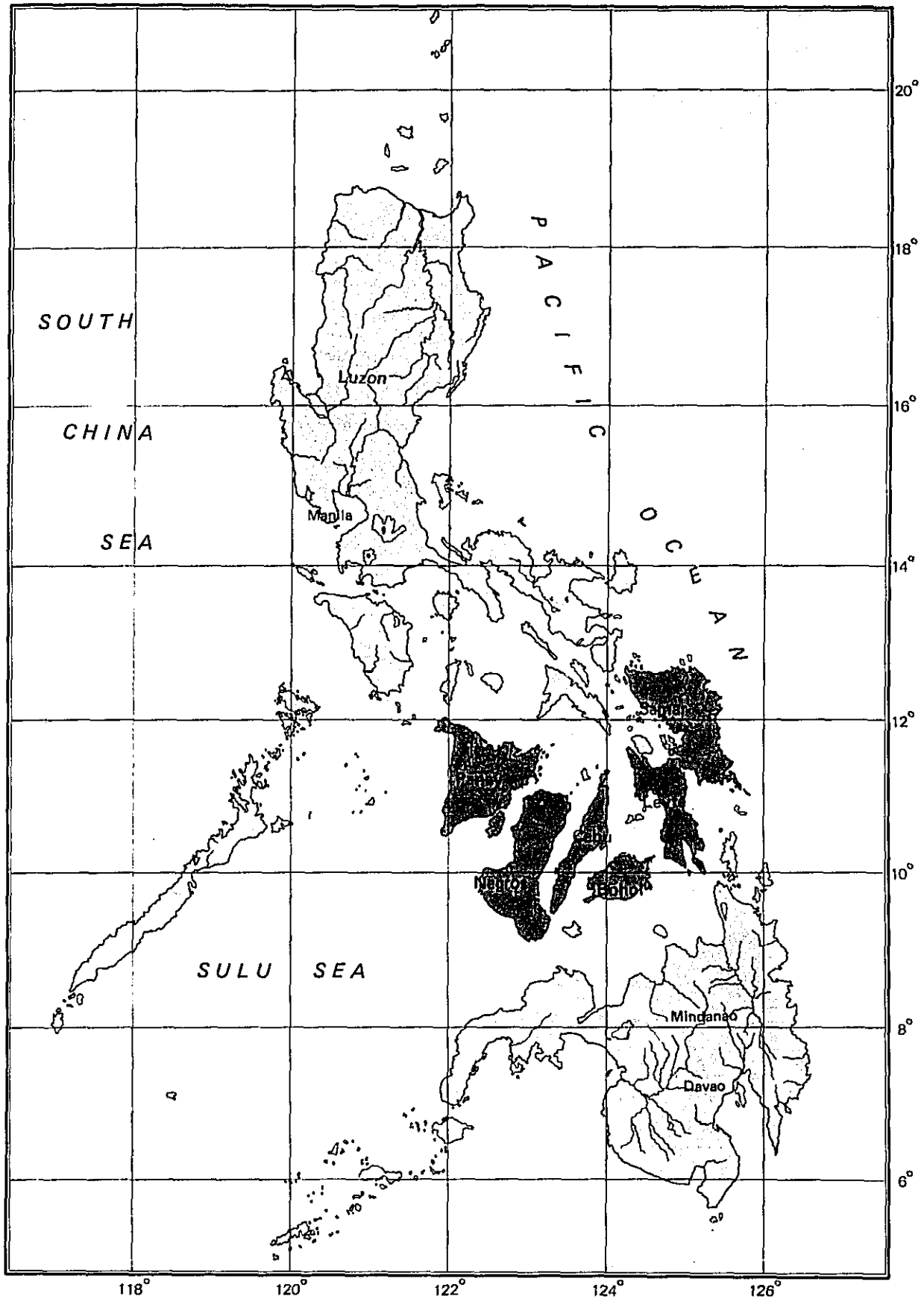
In closing, it is wished to express the heartfelt gratitude to the officials concerned of the National Power Corporation, the National Economic Council, the Presidential Economic Staff, the Embassy of Japan to the Philippines, the Government of Japan and Asian Development Bank, as well as, the OTCA of their generous assistance and cooperation in performing the studies.

March 1973

Yours respectfully,

T. Kidahashi

Tsutomu Kidahashi, Chief
Japanese Survey Team
for Long-Range Electric
Power Development Program
in the Visayas Region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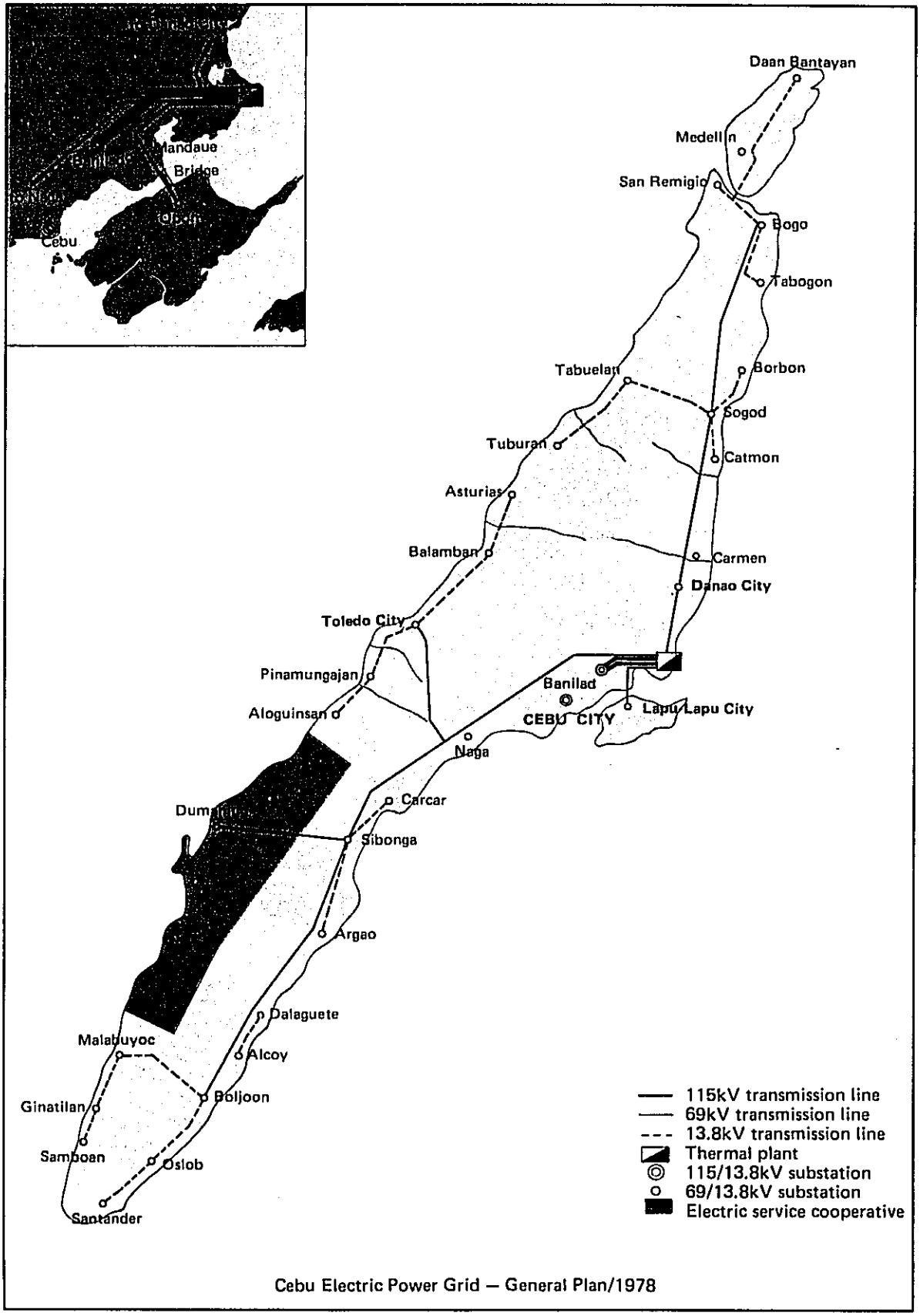


Cebu Electric Power Grid — General Plan/1978

Contents

Chapter 1 Introduction

1-1 Objective of Study

In response to the request of the Government of the Philippines, the survey team has been dispatched to the Philippines by the Government of Japan to perform field investigations in connection with the (i) demand forecast, (ii) power resources and their development, (iii) expansion program of transmission and transformation systems (iv) system analysis and (v) economic evaluation, thereby to formulate an electric power development program in the Visayas including generation, transmission and transformation of electricity covering a period of up until 1987. The program formulated is compiled in the report together with the descriptions on the process of studies.

1-2 Background

(1) Aware of the importance of infrastructure in developing the country, the Government of the Philippines is also intensifying the facilities and installations in the field of electric power industry. Due to the geographical conditions and peculiar nature of power industry, the country has been divided, in planning power development program, into three regions, Luzon, Mindanao and the Visayas. Development is being implemented in Luzon and Mindanao under the

auspices of IBRD and ADB respectively.

(2) In the Visayas, there are power utilities of small scale only, in addition to industrial power plants, the small islands being divided into smaller franchise terrtories. Cognizant of this present situation of the Visayas, the Government of the Philippines requested the Government of Japan to extend technical cooperation in formulating power development program to supply less expensive and high quality energy.

(3) In response to the request, the Government of Japan agreed to make and constitute the scope of technical cooperation as enumerated in 1-3 hereinunder, and organized and dispatched a survey team consisting of six experts for investigations at site from mid October 1970 to early January 1973. The results of investigations and studies conducted in the Philippines were compiled in an interim report submitted to the Government of the Philippines before the team left the Philippines.

(4) The interim report has been, after return to Japan of the survey team, further studied and refined to form the present report.

1-3 Scope of Studies

(1) Areas studied cover and include the islands of Panay, Negros, Cebu, Bohol, Leyte and Samar.

(2) The studies include preparation of long-range power demand forecast in each island covering a period of more than 10 years; establishment of implementation program for construction of power plants, transmission lines and substations; and preliminary study on the interconnections between the islands.

(3) The studies also include review on the Feasibility on the Development of the Cebu Electric Power Grid (see 1-7) prepared by the National Power Corporation (hereinafter called NPC) and establishment of implementation and financial programs, as well as, analysis of the feasibility established in NPC report.

1-4 Survey Team

The team consisted of the following six members of EPDC and OTCA:

Chief:	Tsutomu KIDAHASHI Foreign Activities Dep't. EPDC	
Member:	Masahiko IKEDA Foreign Activities Dep't. EPDC	Economic and financial analysis

Hiroshi KAGAMI Foreign Activities Dep't. EPDC	Market survey and load forecast
Kazuo FUSE Hydro-Electric Engineering Dep't. EPDC	Power development planning and cost estimation
Jiro KURODA Development Survey Div. OTCA	Macro socio-economic survey
Yoshikazu INOUE Operation and Maintenance Dep't., EPDC	Power network planning

1-5 Period of Survey

The survey was conducted for a period of 88 days from October 10, 1972 to January 5, 1973.

1-6 Principles of Study

(1) Load Forecast and Its Relation to Economy

The power demands and power utilities in the Visayas and Cebu should be considered in the light of economic activities of the Philippines, as well as, the Visayas. In order to arrive at a more probable forecast of load, analysis should be made from various aspects. Therefore, the economy of the Philippines, as well as, the Visayas was carefully studied and duly taken into consideration in estimating the future load.

At the same time, in consideration of that the development of the Philippines is, in one way or another, connected or linked with the development of ECAFE countries, the Philippines being a member country of ECAFE, attention was also paid to her position in the entire ECAFE group.

(2) Program Formulation and Investment

The development program was formulated with a primary emphasis on the economy to the extent that the engineering practices would allow. Reserve capacity was considered as 10 percent of the total installed capacity of a system, giving more favor to the economy. Construction cost is one of the most important factors in determining a development program. In the report, it was estimated based on the recent international bid prices, as well as, the past records of the country.

(3) Report

The report consists of two volumes; Volume I pertains to the power development program of the Visayas region as a whole, and Volume II describes into details the Cebu Electric Power Grid which is the project of an urgent demand. The same descriptions may be found in Volume I and Volume II. Such descriptions found in Volume II were intentionally repeated for the convenience of readers, since Volume II is a complete report itself concerning the feasibility of the Cebu Electric Power Grid.

1-7 Report Prepared by NPC

A feasibility report was prepared by NPC on the Cebu Power Grid in May 1972. In the report, NPC has proposed to construct a power plant accommodating two 75 MW steam turbine-generators and appurtenant 115 kV transmission lines in 1976 with a total capital investment of US$ 36 million. As to the other islands of the Visayas, no such report has been prepared by any organization or individual.

Chapter 2 Summary and Recommendation

The present report contains the electric power development program including the development of generating facilities and expansion of power grid on the major islands of the Visayas, namely Cebu, Panay, Negros, Bohol, Leyte and Samar. The program covers a period of up to 1987. The development on the island of Cebu is discussed into details in Volume II.

2-1 Present Situation of Power Supply

In 1970 the population of the Visayas was 9 million comprising one fourth of the Philippines' total, while the power supply capability was 114 MW which is only 7 percent of the nation's total. Per capita energy production in the Visayas is 38 kWh on the average, and it is 107 kWh, one half of the Philippines' average, on the island of Cebu which is the most developed island in the Visayas. Electrification ratio is 20 percent in Cebu, but it is less than 10 percent on the Visayan average. Such retardation in development is partly attributable to the insular formation of the region. Except for the utilities serving to the largest cities of the respective islands, power utilities are all small in scale and not capable of reinforcing and expanding the facilities of service. Consequently, the service territories are limited, and the facilities are old.

2-2 Basic Policy of Development

Under such circumstances as described in the above, the development program should be carried out based on the policies stated in the followings:

(1) At the present stage, the power development should be contemplated on the intra-island basis, and inter-island connection of power grids should be considered separately.

(2) The power plants to be constructed by NPC should be centralized, and energy produced by the power plants will be wholesaled to electric cooperatives and private utilities.

(3) NPC will participate in power development on an island in which are more than one major distribution network of either cooperative or private utility, or a combination of the two.

(4) At the centralized power plants, an installed capacity of 10 MW, two 5 MW units, was considered as the minimum in view of the present situation of power industry in the Visayas except Bohol and Samar where 6 MW, two 3 MW units, was considered as the minimum. Power grids should be expanded corresponding to the growth in demand and should cover the entire island in the future.

(5) The timing of NPC's participation in power development on an island will be only when the power demand of cooperatives and/or private utilities becomes large enough to pay off the capital investment.

The present power development program was established on the assumtion that cooperatives proposed or now under construction will be established as scheduled.

2-3 Development by Island

Cebu

In estimating the future demand in Cebu, the island was divided into Metropolitan Cebu and Rural Area. The estimate predicts that the demand will grow at an annual rate of 15 percent till 1980, and thereafter at 14 percent. The electrification ratio of the present 5 percent in rural area was projected to rise to the present level of Metropolitan Cebu by 1990. After studying generating facilities including steam turbine generators, diesel driven generators, and gas turbine generators, it was found most economical to install two 25 MW gas turbine units to be operational in 1976 and one 50 MW steam turbine unit in 1978 followed by the installation of another 50 MW steam turbine unit and three 75 steam turbine units, totaling 375 MW in installed capacity in 1987. The power plant will be located near to Cebu City. Power generated there will be transmitted to Metropolitan Cebu by 115 kV transmission line and to rural area by 69 kV transmission line. The power grid will cover the entire island by

1978 when 50 MW steam turbine becomes operational.

Panay

The power supply of NPC will start to the distribution networks in Iloilo City and that of cooperative in Iloilo. Then, the grid will be expanded westward to a cooperative in Antique and northward to Roxas City and cooperatives in Aklan and Capiz, thereby to constitute island wide trunk lines for the future expansion of the grid. According to the program, two 5 MW units will be installed to be operational in 1977 to supply power to PECO and the cooperative in Iloilo. After an addition of 5 MW unit in 1978, a 35 MW steam turbine unit will be installed to be operational in 1980, at the same time, a 115 kV transmission line will be constructed to connect to Roxas City and a cooperative in Capiz, and 69 kV transmission lines from Capiz to a cooperative in Aklan and from Iloilo to a cooperative in Antique. Along with the expansion of transmission lines, a step-down substation will be built at Pototan to supply power to rice field district. The steam turbine unit of 35 MW will be added one by one in 1982 and 1985, and in 1987 the total installed capacity will amount to 120 MW. The power plant was scheduled to be constructed near to Iloilo City, the load center of the island.

Negros

In the incipient stage, the power development in Negros will be carried out in the two provinces separately, and these two power grids will be interconnected when the demand becomes large. In Negros Occidental, power supply will be made with diesel driven units to Diaz Electric, VRESCO and the proposed cooperative in 1977. In 1980 a 35 MW steam turbine unit will be added, and the grid will be connected with that in Negros Oriental by a 115 kV transmission line via southern route in 1981. In Negros Oriental, two 5 MW units will start operation in 1977 to supply power to a cooperative and to utilities in Bais and Dumaguete. To cope with the increasing demand, diesel units will be relocated from Negros Occidental in 1980. The power supply capability will be augmented by 195 MW; 40 MW by diesel units and 155 MW by steam turbine units. The 115 kV and 60 kV transmission lines will be extended for distances of 175 and 70 kilometers respectively, and a total capacity of substantions will be 100 MVA.

Bohol

The initial grid in Bohol will be connected to Tagbilaran, which is now receiving power from Loboc Hydro Power Plant of NPC, and to a cooperative. Since the demand of the island is small, the establishment of NPC with two 3 MW diesel units will be delayed to 1979. The power plant will be constructed near Tagbilaran and the pertinent 69 kV transmission line will be 44 kilometers long. The addition of three 5 MW units by 1984 will suffice the power capability up to 1987.

Leyte

Major utilities on the island of Leyte are in Tacloban and Ormoc, and two

cooperatives have been proposed in Leyte and Southern Leyte. In the beginning, NPC grid will be connected to Tacloban and the cooperative in Leyte, and later on connected to Ormoc and to the cooperative in Southern Leyte as demand grows large. Due to the dense population in the cooperative area in Leyte and the anticipated power supply to INCO Mining Company, the load of NPC grid was estimated to be relatively large from the beginning. Therefore NPC's plant will start operation with three 5 MW units in 1977. In 1982 the first 35 MW steam turbine unit will be operational after the addition of two 10 MW diesel units.

Samar

Of the six Visayan islands, Samar is the most retarded and therefore the demand is small. The power demand there will not justify the power development by NPC during the 1970's. It was scheduled to construct a power plant in Calbayog, Capital of Northern Samar, connected with a cooperative in Northern Samar by a 69 kV line in 1983. The transmission line will be extended to Catbalogan in the future.

2-4 Inter-Island Connection

Inter-island connections are conceivable between Leyte and Samar, between Cebu and Negros Oriental (Dumaguete) and between Iloilo City and Bacolod. Due to the small scale in demand the first two will create little benefit. Therefore, studies were made only on the interconnection between Iloilo and Bacolod. Tentative calculation has revealed that the inter-connection of these two islands will be practicable in the early 1980's because the demands in these two grids are expected to grow at rapid pace. Furthermore, this interconnection will be advantaged by the introduction of 75 MW steam turbine units instead of 35 MW units. Therefore, it is considered worthwhile to carry out at site investigations as well as, detailed studies on the feasibility. The construction cost of submarine cable line will be largely influenced by the underwater conditions as well as the traffic of boat since damages to submarine cable by anchors are frequent. If the interconnection proves itself feasible, the power development programs on the two islands will have to be altered. In the meantime, however, the present power development programs may be implemented as they are.

2-5 Investment Schedule

(1) The total fixed capital investment requirement up to 1986 will be US$ 175 million, US$ 138 million in foreign curreney requirement (79 percent) and US$ 37 million in domestic currency requirement (21 percent). The capital disbursements will be made during the 13 years of 1974 to 1986 with an average disbursement of 13.4 million dollars annually. The breakdown by the island is as shown in the following.

2-5 Investment Schedule

(in million US dollars)

	Foreign currency	Domestic currency	Total	% share
Cebu	55.5	15.9	71.4	41
Panay	23.2	6.9	30.1	17
Negros	37.8	9.6	47.4	27
Bohol	4.5	1.0	5.5	3
Leyte	13.4	3.4	16.8	10
Samar	3.2	0.9	4.1	2
Total	137.6	37.7	175.3	100

The amount of capital investment requirement reflects the climate of economic activities of the island; 41 percent of the total in Cebu, 17 percent in Panay, and 27 percent in Negros; the three islands comprising 85 percent of the Visayan total.

(2) The capital investment requirement estimated in this report is believed to be justifiable in the light of the amount appropriated in Four-Year Development Plan for investment in the power industry in the Philippines. It was also confirmed that the rate of return on rate base in the Visayas as a whole would be over 8 percent after 1980 at a wholesale price of 15.5 mills (10.2 centavos) per kWh which is less expensive than the estimated energy cost of private utilities and would go over 10 percent in 1983, creating a possibility to lower the power rate.

(3) Capital investment requirements to start supplying power on the respective islands total to US$ 42.7 million in the entire Visayas. This amount includes the installation of a 50 MW steam turbine unit to be operational following the two gas turbine units in Cebu. If Cebu is excluded, the capital investment will be US$ 22.6 million as shown in the following.

(in million US dollars)

	Foreign currency	Domestic currency	Total	% share
Cebu	14.7	5.4	20.1	47
Panay	2.1	0.5	2.6	6
Negros	8.6	2.3	10.9	26
Bohol	1.6	0.6	2.2	5
Leyte	3.3	0.7	4.0	9
Samar	2.3	0.7	3.0	7
Total	32.6	10.0	42.7	100

2-6 Conclusion

This report provides the fundamental concept of power development on the six islands of the Visayas and expatiates its method of formulating a program from the technical, as well as, economical point of view. The report aimed at, in compliance with the policy of the Philippine government to extend electric services to every part of the country, the electrification of all the areas of the six Visayan islands. Except the island of Cebu, the development program of the Visayas is still of a preliminary nature, therefore, further investigations are recommended to be conducted at an early stage in order to expedite the implementation of the project.

Chapter 3 Natural and Economic Environment

3-1 Natural Conditions

3-1-1 The Philippines

Republic of the Philippines, consisting of approximately 7,000 islands, lies about 800 kilometers off the south-east coast of Asia. To the west and north is the stormy China sea, east the Pacific Ocean where typhoons originate, and south the Sea of Sulawesi and the coastal waters of Borneo. Eleven islands have an area of over 3,000 square kilometers each, namely, Luzon, Mindanao, Samar, Negros, Palawan, Panay, Mindoro, Leyte, Cebu, Bohol and Masbate, and an aggregate area of these eleven comprises 96 percent of the total of 30 million hectares.

The islands, featured by irregular configuration of coastlines, volcanic mountain ranges, isolated volcanoes, irregular masses of hills and mountains and narrow coastal plains, have volcanic, coral and all principal rock formations. The highest peaks are Mt. Mayon (2,423 meters) in Luzon, Mt. Kanlaon (2,466 meters) in Negros, and Mt. Apo (2,955 meters) in Mindanao.

The plains lying amid the mountains, e.g., the central plain of Luzon, the Bicol plain of southeastern Luzon, the Cagayan plain of northern Luzon, the

central plain of Panay, and the Agusan and Cotabato valleys in Mindanao, have the densest populations of the islands except in Cebu, where the people live mostly on the coastal plain.

Climate

The archipelago has a decided variety of climate. Temperature differences are very small, ranging from 23 to 30 degrees Centigrade in monthly average throughout the country. However, rainfall differences give a criterion to classify the Philippine climate into four. The first has two pronounced seasons, one dry in winter and spring and the other wet in summer and autumn. This prevails generally over the western part. The second has no dry season but a pronounced rainy period in winter; generally, on the Pacific side. The third has no very pronounced maximum rain period, but a short dry season; generally, over the central plain of Luzon and the central islands. The forth has no dry season and no very pronounced maximum rain period; generally, in Batanes, northeastern Luzon, Camarines, Albay, northern Cebu, northern Negros and most of central eastern and southern Mindanao.

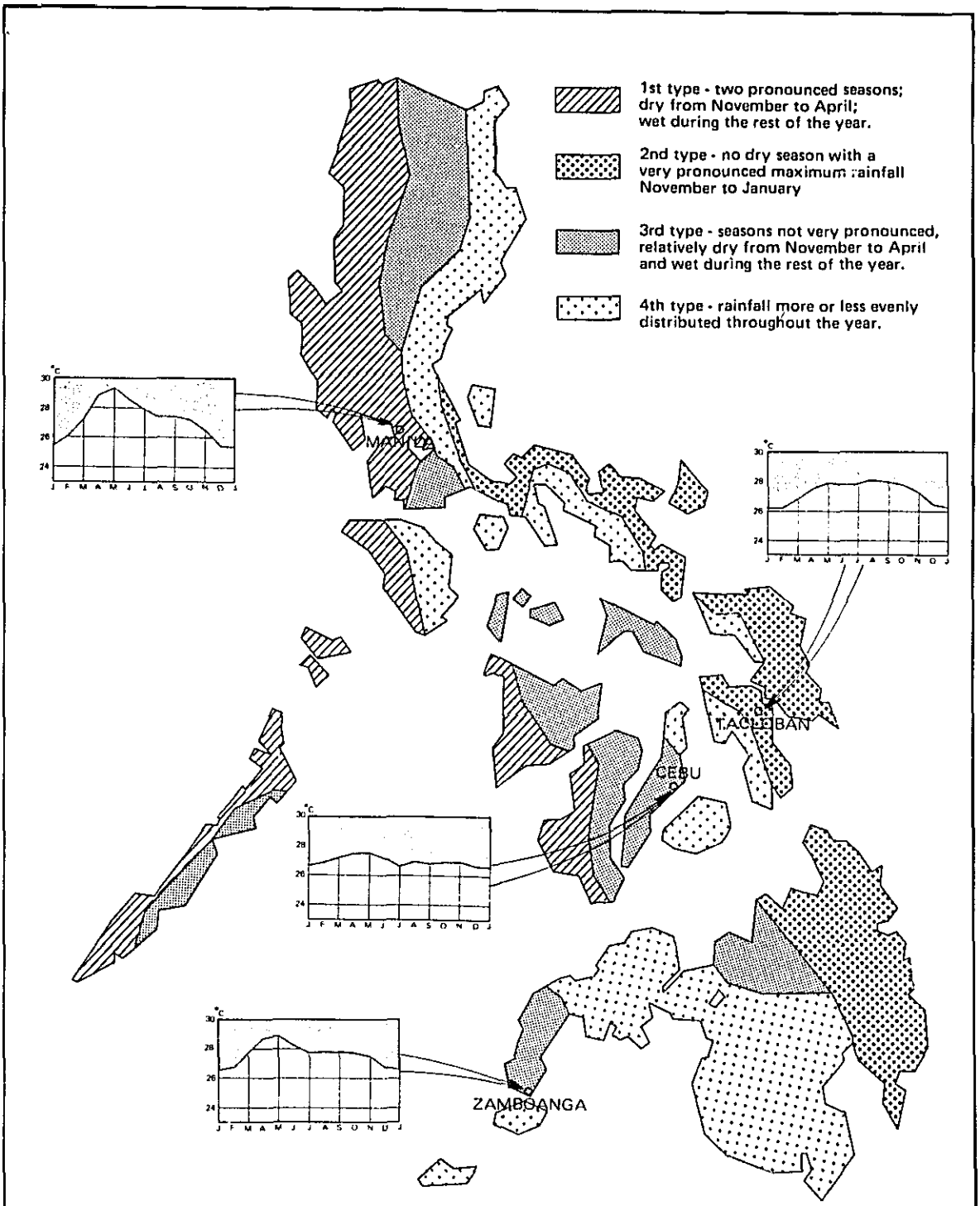
Typhoons strike the islands from the east to the southeast, then curve to the north, sometimes crossing the land, sometimes only touching the eastern shores. Both rainfalls and winds bring about damages to property, but more destructively are the rains which cause floods.

Population

Today, the Philippines is inhabited by about 38 million people. The first census held in 1903 showed the population of the Philippines to be 7,635 thousand. The rate of population growth was a little over 2 percent per annum up until 1940's. However, the last census in 1970 disclosed an annual growth rate of as high as 3.1 percent averaged over the preceding decade. Medical knowledge and application has reduced mortality rate and raised life expectancy from 37.2 years in 1905 to 52.5 years in 1965.

Table 3-1 Population of the Philippines: 1903 to 1970

Census year	Population	Increase		Averaged annual rate increased(%)
		Number	Percent	
1903	7,635,426	...	...	...
1918	10,314,310	2,678,884	35.1	1.90
1939	16,000,303	5,685,993	55.1	2.22
1948	19,234,182	3,233,879	20.2	1.91
1960	27,087,685	7,853,503	40.8	3.06
1970	36,684,486	9,596,801	35.4	3.01



Rainfall Pattern and Monthly Average Temperature

Aware of the rapid increase in population, the Government launched family planning program as part of Four-Year Development Plan, aiming at one percent reduction in the annual growth rate of population in the comming 10 years.

Language spoken is diversified innumerably into divisions and subdivisions. Principal divisions, but not covering the whole, are Visayan, Tagalog, Iloilo, Bicol, Pampangan, Pangasinan, etc., which are, in may cases, not communicable with one another. Linguistic zoning represents local linkage of economic activities at one time before recent migration movement started. Much is expected from the dissemination of the national radio and television broadcastings which use Tagalog, the standard Philippine language, to unify the language throughout the country.

Labor

It was reported that in fiscal 1969 there were 11,706 thousand persons considered as labor force. The sectorial distribution of labor force was changing. The labor share of agriculture, including forestry, hunting and fishing, dropped from 63.0 percent to 55.4 percent during the period of 1959 to 1969. Obviously, this drop was due to the growth of industry, including tertiary industry. The production index of industry alone, not inclusive of the tertiary industry, increased from 80.7 to 144.8 during the same time period, while that of agriculture from 82 to 116.

Unemployment

Unemployment is large in the Philippines. Revealed unemployment, or the ratio of persons totally unemployed to the labor force, was 7.3 percent in 1969; 9.1 percent in urban area and 6.5 percent in rural area, urban life being attractive, yet fewer chances of employment in cities. Urbanization is taking place in many parts of the Philippines, at some places, rapidly. But, industries are hardly catching up with the pace of ever increasing population. However, to look at the number of employed persons who, working less than 40 hours a week, are reportedly wanting additional work, this urban-rural pattern in employment situation is the reverse. They are designated as visibly underemployed. The visibly underemployed can be seen more in the rural area, partly, if not totally, attributable to the seasonal fluctuation in labor requirement of agriculture.

Migration Movement

There are large variations among provinces in the percentage of population growth. Provinces where sites have been chosen for new industrial expansion and where favorable conditions to agriculture are prevailing are attracting immigrants. They are Bukidnon (113.4 percent in incremental ratio during years 1960 to 1970), Rizal (95.3 percent), Occidental Mindoro (70.8 percent), Agusan del Sur (86.5 percent) and Davao Oriental (87.0 percent) in the top five. The Visayas is a region where the lowest percentage (18.3 percent) was recorded which is apparently a consequence of emigration movement out of the Visayas to such provinces as enumerated above.

Natural Resources

(Timber)

Out of the total land area of 30 million hectares in the Philippines, over 6 million have now been identified as timberland. While reforestation program is underway in open lands and along watersheds. Logs and lumber are now leading export materials of the country, comprising over 25 percent of the total export. However, timberlands in the Visayas occupy only 12 percent of Visayan lands, while it is 28 percent in the entire Philippines.

(Mineral Deposit)

The Philippines is endowed with abundant mineral resources. The precious metal production of gold and silver was 2. 2 million ounces valued at 134. 4 million pesos in fiscal 1970. Copper deposits occur mostly along the Philippine fault zone running northwest-southeast across the Visayas, and its production is prominent, 151 thousand metric tons in fiscal 1970. Other mineral productions are rion ore, chromite ore, pyrite cinders, manganese ore, zinc, molybdenum, lead and nickel. Limestone formation is providing a fair ground for the establishment of cement factories. If the lands are further explored, mining industry in the Philippines, even including fossil fuel, will be promising. The Visayas is not an exception in this future prospect of mining industry, in view of the present large scale exploitations of mineral deposits, such as, magnetic sand and copper ore respectively in the islands of Leyte and Cebu.

3-1-2 The Visayas

The Visayas, as regarded as one, is retarded in some aspects when compared with the other regions, namely, Luzon, Metropolitan Manila, and Mindanao. The Visayan islands are mostly hilly, and the people are living along the coast line. Inland transportation are poor. Arable land is limited, except rice field of Iloilo and sugarcane field in Negros Occidental. In the Visayas, agricultural people, the largest single sector, are living in the topographically adverse conditions for farming. In addition, the geological conditions are not altogether favorable for agriculture.

Today, Luzon and Mindanao are booming up with their increase in agricultural production, recording almost 75 to near 90 percent increment over the production of 10 years ago while it is a little over 20 percent in the Visayas. The increase in Luzon and Mindanao is attributable to the expansion of cultivated land. There are still vast land left untouched. While in the Visayas, most of the arable land has been brought under cultivation, and the people there, with a burden of high population density, are striving in their small area of land.

The agriculture in Mindanao, in contrast with that of Luzon, has a nature of mono-culture, producing a large amount of commercial products that are for export, and is not as strongly linked with the other part of the Philippines as Luzon is. When it comes to sugar, the Visayas has a pattern similar to Mindanao. However, it is noteworthy that the industrial productivity has been rising in the

Visayas in relation to the other regions as shown in Table 3-3. Metropolitan Manila should be put aside in this case, because it is where measures have been contemplated to avoid excessive concentration of industry.

Although remote from the large agricultural productive centers, middle and small scale industries should be contemplated in the Visayas of their establishments. The land reclamation project which is under way in Cebu with a target to establish middle sized industries, as well as, commercial centers, is an exaple of this sort. Semi-capital intensive industries, if not fully capital-intensive, are demanded there, together with the public utility industries including electricity and water supply which will support the development of private enterprises. Industries in Mindanao and Luzon, especially in Mindanao, are primarily orientated to agricultural processing both for export and domestic consumption. The Visayas will find its way---it is thought primarily but not exclusively--- in developing import substitute industries.

No data were obtainable on the field of servises in the Visayas. However, in consideration of the dense population and active trades, the production of services is deemed considerably large. Fishing is another hopful industry in the Visayas. Presently, fish consumption areas are limited near to the landing places. However, when the distribution system is developed, large scale fishery will become advantageous.

Table 3-2 Share between Regions

(in percent)

	Year	Total Philippines	Visayas	Luzon	Metro Manila	Mindanao
Land		100.0	19.3	46.7	-	34.0
Land cultivated	1969	100.0	28.0	41.4	-	30.6
Population	1969	100.0	25.4	45.4	6.9	22.4
Labor employed	1967	100.0	28.5	42.5	8.4	20.5
Capital stock	1961	100.0	10.3	37.8	45.9	6.0
	1969*	100.0*	14.4*	20.6*	53.7	11.3*
Value added Manufacture	1961*	100.0*	16.3*	16.5*	45.2*	12.0*
Crop production	1961	100.0	29.7	48.3	-	22.0
Mining	1965	100.0	31.7	61.8	-	6.5
Timber production	1961	100.0	2.0	20.0	-	78.0
Average income	1965	100.0	70.0	94.0	206.0	84.0
Comparison in retail price		-	83.3	91.9	100.0	87.1

* estimate

Table 3-3 Productivity by Region

	Total Philippines	Visayas	Luzon	Metro Manila	Mindanao
Agriculture					
1960					
Contribution to GDP (%)	27.0	6.6	10.8	-	9.6
Cultivated land	1.000	0.293	0.428	-	0.297
Land productivity	1.000	0.836	0.935	-	1.272
1970					
Contribution to GDP (%)	30.0	5.4	12.6	-	12.0
Cultuvated land	1.000	0.280	0.414	-	0. 306
Land productivity	1.000	0.639	1.014	-	1.310
Industry					
1960					
Contribution to GDP (%)	18.0	3.1	5.1	7.7	2.1
Labor employed	1.000	0.310	0.420	0.069	0.201
Labor productivity	1.000	0.555	0.674	6.188	0.587
1970					
Contribution to GDP (%)	19.0	3.3	4.5	8.9	2.3
Labor employed	1.000	0.285	0.435	0.084	0.205
Labor productivity	1.000	0.611	0.558	5.583	0.585

3-1-3 Natural Resources for Electricity in the Visayas

Normally, electric power is being generated from the following resources:

Hydro resources
Coal
Fuel oil (including natural gas)
Geothermal energy
Uranium

Of the above resources, uranium will not be prejudiced by locality of origin since the transportation cost is negligible. However, the other resources, if available locally, will help economize power generation greatly.

(1) Hydro Resources

Hydro power generation is economical only when sufficient head is obtainable, or constant quantity of water discharge is available. Needless to say, a combination of high head and constant discharge is more favorable. The Visayas is insular formation. Therefore, favorable natural conditions for hydro power generation are scarce. This is evidenced by the fact that there are only two hydro power plants of 2 MW in the total installed capacity. Table 3-4 gives the hydro power potentials in the Visayas which, among the potentials surveyed by NPC, are more than 5 MW at one site. It will be noted from the table that a head of more than 50 meters is obtainable on the Jalaur River only, and studies on the potentials are mostly on a reconnaissance stage. Run-off data cover a period of not much longer than 3 years with a few exceptions.

Jalaur River Project, which is the only project now at the preliminary stage, is multi-purpose including irrigation and power. The project was authorized by Republic Act 2651 of its implementation in 1960, but nothing seems to have been done since that time. No reason was given in respect to the negligence of the Act. The study on the Ulot River is being revised since 1972 in order to have the project updated.

Any one of the hydro power projects in the Visayas has not been studied thoroughly. Therefore, it is not practicable to include a hydro power project in the power development program of the Visayas at the present stage. As a matter of course, if a hydro porject is found feasible and economical in the future, it should be duly incorporated in the development program.

(2) Coal

Coal deposits are found in Cebu and Negros. It was reported that, of the coal deposits found at several locations in Negros Occidental, the deposits at Calatrava have a reserve of about 3 million metric tons. However, mining operation there is halted today. The coal deposits in Cebu total 35 million metric tons in reserve, and their calorific values range from 4,900 to 6,800 kcal per kilogram (9,500 to 12,500 BTU per pound). Mining is operational at four locations with monthly output of about 4,000 metric tons for local consumption.

Coal, as fuel of thermal power plants, should be not only competitive with oil price but stable in supply over a long range period. It is a worldwide tendency in power industry to transfer from solid fossil fuel to liquid fossil fuel. The coal mining industry in the Philippines, too, is diminishing rapidly.

The coal presently produced on Cebu is less expensive, but the production scale is very small. It is not certain if the production can be increased enough

Table 3-4 Hydro Potentials in the Visayas

River/Fall	Location		Head	Capacity	Energy production	Purpose	Stage of Study
	Island	Province	(m)	(MW)	(million kWh)		
Jalaur River	Panay	Iloilo	85	8	38.5	Multipurpose	Preliminary (1965)
Tapaz River	Panay	Iloilo	-	7	-		Reconnaisance
Amanhoray Falls	Negros	Negros Oriental	-	5	-		ditto
Ilog River	Negros	Negros Occidental	-	45	-	Multipurpose	ditto
Kayakyan	Negros	Negros Oriental	-	10	-		ditto
Wahig River	Bohol	Bohol	48	10	51.3	Multipurpose	ditto (1965)
Daguitan River	Leyte	Leyte	33.5	8	46.5		ditto (1967)
Subao River	Samar		40	17	74.5		ditto
Ulot River	Samar	Eastern Samar	40	24	123		ditto (1969)

to supply a power plant with fuel coal in stable quantity and for a long time period. Consequently, the cost of coal as mined on a large scale has not been estimated. Therefore, it is the judgement that, in formulating a long-range power development program, all the thermal power plants should be contemplated to be fired by oil until a coal fired power plant is proved to be superior to an oil fired plant.

(3) Petroleum

In the Visayas, no oil vein, including that of natural gas, that can provide economical fuel has been found. Therefore, oil consumption is totally dependent on import. Oil deposits are said to be existing in Panay, Cebu and Leyte, and exploration works are on-going. However, no finding has been reported.

(4) Geothermal Energy

Technical aid has been extended by the government of New Zealand by investigating and studying the availability of geothermal resources found in a mountainous area between Ormoc and Burauen of Leyte. The investigations conducted were on the surface only, and the report submitted to the government of the Philippines in October 1972 concludes that "more exhaustive exploration would be justified to establish whether there is potential for generation of electricity", and further it recommends "exploratory wells be drilled and scientific investigation of Burauen field be continued."

The past experiences of Japan and of other countries in the world in developing geothermal energy would predict that many drills should be sunk before geothermal energy of economical magnitude for power generation can be confirmed, requiring lengthy time and speculative investment. In the report of the New Zealand government, a geothermal power plant is contemplated with a capacity of not more than 15 MW. However, a proposal of such preliminary nature can not be included in the development program that will be a basis of project implementation. No geothermal energy as power generation resources has been reported available in the other Visayan islands.

At the present stage of power development, it is the judgment that the power industry in the Visayas should for some time rely on fuel oil only. In the meantime, however, hydro power potentials should be investigated to obtain low cost energy.

3-2 Economic Environment

3-2-1 Philippine Economy

(1) Present State of Philippine Economy

The economy has been growing at more than 6 percent annually in real term in the preceding several years, getting ahead of the projected target of the Four

Year Development Plan. The growth rate in 1970-71 by NEC announcement was also at 6.5 percent. The Government and NEC, having been amending the Plan on a previous-years' performance basis by the name of rolling plan, and upgraded the growth target.

This remarkable high rate of growth is, supposedly, due to the rapid growth of private capital formation, which has been covering the relatively slowing down attainments of agriculture and mining sector. This state is a sort of what is called "private-sector leading type". The per capita income, however, is growing at somewhere around 3 percent because of high population growth of 3 percent or more.

Table 3-5 Gross National Product

Year	1963	65	66	67	68	69	70
GNP (billion pesos)	19.0	23.0	25.7	28.1	29.6	31.8	39.3
Estimate (million US dollars)	7,191	8,931	8,562	8,852	10,308	11,837	12,590
Per capita GNP (US dollars)	238	245	251	255	297	331	342

With this recent growth of economy, however, the imports of capital goods and machineries have increased significantly, to cause an unstability of international baclance of payments of the country as well as to decrease the country's international reserve.

Table 3-6 External Trade and International Reserve by Central Bank

(in million US dollars

Year	Imports	Exports	Balance	International reserve
1965	807.6	768.5	- 39.1	188.50
1966	852.8	828.2	- 24.6	166.09
1967	1,062.2	821.5	-240.7	179.77
1968	1,150.2	857.3	-292.5	161.40
1969	1,131.5	854.6	-276.9	120.66
1970	1,090.1	1,061.7	- 28.4	250.96
1971	1,186.0	1,121.8	- 64.2	375.46

As is common to most of developing countries, the Philippines is import-dependent on its economic structure, and therefore subject to the pressure from the balance of payment. The Government introduced the floating exchange sys-

tem in February 1970 and strived to build up the vital economy through financial and monetary measures. The new peso-dollar ratio was 6.25, which was about 60 percent devaluation. By this new system, the balance of payments got into the improving line and the Central Bank's international reserve increased, showing a healthy sign of getting rid of the foreign exhange crisis. In the year 1971, being identified as the one of economic growth, the country was, on the other hand, suffering inflational tendency. The 20 percent growth in nominal terms could be reportedly counted for 5 percent increase in production and 15 percent increase in price, which, if true, is suppressing the people's consuming life considerably.

Table 3-7 Consumer Price Index

Year	Manila (1955=100)		Outside Manila (1957=100)	
1965	140.4	% increase	138.8	% increase
1966	149.1	6.5	145.2	4.6
1967	157.6	5.7	153.8	5.9
1968	158.1	0.3	155.2	0.9
1969	160.4	1.4	157.9	1.7
1970	188.2	17.3	181.0	14.6
1971	224.0	19.0	225.4	24.5

The structural feature of the Philippine economy is known as agriculture-dependence and in fact, it depends on agricultural sector as much as 30 percent of GNP through 1960's. In the year 1971, adverse conditions such as typhoon, tungro (rice stem borer) disease and curtailment of agricultural subsidy, depressed the rice production as shown in the relative slowness in the growth ration and forced the country to import rice. The rise in consumers' price as shown above is reported to be partly due to the rise in rice price. That the rice production, which is so influential to the whole economy, fell short of the target meant a sort of a warning to the whole production and regionally speaking to Luzon without doubt.

Table 3-8 Gross Domestic Product by Kind of Economic Activity

Year	GDP (million pesos)	% Distribution					
		Agriculture	Industry	Construction	Wholesale & retail	Transport	Others
1960	13,390	27	18	3	11	3	24
1963	19,048	26	18	3	9	3	23
1968	29,616	30	18	3	9	3	24
1969	31,782	32	18	3	9	3	24
1970	39,346	30	19	2	8	3	22

Among agriculture, sugar and coconut industries, the important dollar earners, did successfully and had been thought to have increased their crops by 10 and 20 percent respectively. The year 1971 favoured these traditional crops especially since both could enjoy the windfall of peso devaluation altogether.

Table 3-9 Production of Selected Commodities of Agriculture

(in thousand metric tons)

Year	1965	1966	1967	1968	1969	1970	1971
Rice	3,993	4,073	4,094	4,561	4,445	5,223	5,343
Coconut product							
Copra	1,471	1,485	1,577	1,542	1,516	1,656	1,574
Desiccated coconut	63	72	83	51	44	70	106
Coconut oil	627	657	576	656	566	766	810
Copra meal or cake	200	263	204	207	195	255	317
Sugar product							
Sugar, centrifugal	1,557	1,402	1,560	1,595	1,596	1,927	2,051
Muscovado	63	58	62	63	64	61	51

Manufacturing is on the way of recovery in general. Since it was affected in many ways by devaluation in 1970, the activity in 1971 was sluggish except those which were favored by the Government with dollar allocation for their imported inputs. Those active industries were chemical industry and textile industry. The former, having increased its exports outstandingly since 1969, had also shown a smooth growth in 1971. Chemical industry, as well as textile industry, is known as high import and export dependency. The government, being cognizant of the significance of export and industry diversification, is giving some assistance and this growth is responding to it. Oil industry were distressed both by the devaluation and OPEC agreements and have been petitioning for their product price increase to cover the increased price of crude oil. They had to wait for the decision of Price Control Council. The price zooming of crude oil, however, gave much influence on such industries which used oil as needed inputs or material as electric utilities. Since the operating costs of electric utilities are mostly occupied by fuel cost - somewhere around 55 percent - and many of those utilities are indebted to the foreign makers for plant units facilities, OPEC agreement and the devalution hit them hardest. Utilities are now in a very difficult position where they can hardly find their way out. The rate increase seems now to be the only way left. Public Service Commission had been reluctant to raise the tariff in view of the price escalation and therefore kept the petition pending. The utilities have many problems to be solved in the future.

Table 3-10 Index of Physical Volume of Selected Production in Manufacturing (1955=100)

Year	1965	1966	1967	1968	1969	1970	1971
Food manufacturing	201.1	209.7 (4.2)	224.3 (6.9)	227.1 (1.2)	236.5 (4.1)	229.3 (-3.1)	257.2 (12.1)
Textile	328.0	328.6 (0.1)	344.0 (4.8)	332.4 (-3.4)	332.6 (0)	327.1 (-1.7)	392.9 (20.1)
Chemicals	187.9	196.1 (4.3)	199.4 (1.6)	197.0 (-1.3)	207.9 (5.5)	225.7 (8.5)	254.9 (12.9)
Non-metal mineral products	269.2	287.9 (6.9)	297.3 (3.2)	326.4 (9.7)	329.9 (1.0)	314.7 (-4.6)	316.4 (0.5)
Metal products	330.2	347.2 (5.1)	347.2 (0)	335.9 (-3.3)	371.5 (10.6)	322.3 (-13.3)	328.2 (1.8)
Elect machinery	323.6	340.4 (5.2)	412.5 (21.2)	437.5 (6.0)	501.1 (14.5)	574.5 (14.6)	563.5 (-2.0)
Miscellaneous products of petroleum	161.0	208.4 (29.4)	231.5 (11.1)	282.7 (22.1)	328.4 (16.1)	342.1 (4.2)	361.0 (5.5)
Pulp & paper	270.0	253.2 (-6.3)	272.1 (7.5)	247.8 (-9.0)	244.2 (-1.4)	223.6 (-9.4)	284.3 (27.2)

Note: Indices in parentheses show the percentege increase or decrease to the previous year.

(2) Some Structural Features of Philippine Economy

The following observations have been made on the basis of "Inter-Industry Relations Study of the Philippine Economy: 1965" prepared jointly by Bureau of Census and Statistics (BCSO) and University of the Philippines (UP), the part of which is disclosed in 1971. This table is a 97 x 97 matrix. The characteristics of the Philippine economy presented here could be found through studying this I-O table, which could be summarized as follows:

(a) Agricultual sector vs. non-agricultural sector

(b) High import dependence and low-flexibility of export

(c) Role of the government sector

Agricultural Sector vs. Non-Agricultural Sector

The country's total value-added in 1965 was 25,600 million pesos and the composition of net national income is shown in Table 3-11.

Table 3-11 Net Value Added

(in million pesos)

	Compensation for employee	Operational surplus	Rent	Net Value added
Primary ind.	2,738	2,348	415	5,501
Secondary ind.	2,912	3,611	0	6,522
Tertiary ind.	3,142	5,498	1,082	9,722
Final demand	1,613	0	0	1,613
Total	10,405	11,457	1,496	23,359

The ratio of value added by industry is shown when one sees the column of "Compensation for employee". Primary industry earned 26.3 percent of total wage value-added, secondary 28.0 percent and tertiary 45.7 percent. Referring to the number of employee by industry, we tried to work out the value-added per employee in different industries in the Philippines.

Table 3-12 Value-Added (VA) per Employee

	Number of employee (thousands)	% Share to the total (%)	VA/employee (pesos)
Primary ind.	5,914	57.43	463
Secondary ind.	1,161	11.27	2,507
Tertiary ind.	3,223	31.30	975

As shown clearly, the income level of primary industry such as agriculture, fishery, forestry and mining is relatively low. One can easily sense that laborers in these sectors are largely unskilled and illiterate and have low living standard, and high incidence of diseases. When one sees the total of each column of Table 3 - 11, then the ratio of income by participation type in industry is shown. Namely, wage value-added counted 44 percent, whereas operational surplus and rent, which is to be interpreted as employers' earnings, 56 percent. In order to enhance the income and the living standard of laborers, the Minimum Wage Law was enacted in June 1970, thus giving an opportunity to the country to solve the gap problem. The effect of this Minimum Wage Law is analyzed on the assumptions that (1) the unit production costs of the industries remain same as in 1965, (2) inter-dependence among the industries is kept as it was in 1965, (3) the supply elasticity of industries is constant and (4) there is no time-lag in price fluctuation. On these assumptions, the effect can be known by virtue of I-O table. The total expenditures of the final demand sector was raised up by 46.48 percent. On the products whose wage-contents are supposedly high, this Minimum Wage Law gave directly much effects. Some were compelled to raise their unit cost by 60 percent or more. Agriculture was one of those cases. In the sense that agricultural products might have raised its cost by this Minimum Wage Law, the relative depression of agriculture in 1971 may partly be imputed to this Law.

On the other hand, when one sees the column of operation surplus, he will notice that the operational surplus brought by secondary and tertiary industries are bigger than that of agriculture. This may reflect the relative high value-added and capital accumulation in those industries. To support this discussion, industrial cost is usefully introduced. (See Table 3-13 below.) The ratio of value-added to the total cost of industry is high in the case of tertiary industry. The components of the cost of industries also disclose that the wage cost decreases in tertiary and secondary industries compared with that of primary industry and that the deprectiation cost is overwhelmingly big in the secondary and tertiary industries, with that of primary industry remaining small. One can sense the social marginal productivity of secondary and tertiary industries is high.

Table 3-13 Value and Percent of Surplus in Relation to the Total Industry Cost

	A: Operational surplus (Million pesos)	B: Industry cost (Million pesos)	A/B (%)
Agriculture	1,374	6,320	21.7
Forestry & fishing	808	2,043	39.5
Food manufactures	1,234	6,339	19.5
Textile products	289	989	29.3
Chemicals	247	820	30.1
Petroleum products	339	776	43.7
Iron & steel products	42	214	19.7
Electrical machinery	135	436	30.9
Transport equipment	137	546	25.0
Services, total	5,498	15,300	35.0
Trade, wholesale, retail	3,204	4,949	64.7

Therefore there exists a big difference in marginal revenue between agricultural sectors and industrial and service sectors. Can this be enough to explain that traditional and mono-cultural agriculture and modern and capitalistic industries do coexist in the Philippines without having their capital stock in-and-out flow each other, thus without interferring with each other? We, however, should not forget the fact that there is a predominance of agricultural employee in its number and yet this majority, about 57 percent of total employees, is living on agriculture which is of low marginal productivity and is easily subject to such outside conditions as climate. Various indices clarify the difference between the greater Manila area and the outside Manila area. One can feel the need of fostering and encouraging the rural industries. In this regard, Board of Investment (BOI) has been strenuous to have industries dispersed throughout the country with policies of granting dispersal incentives. So far, unfortunately this has not been proved so successful. The more maneuvers of BOI and the Government are to be expected.

Above all factors which constitute the present agriculture of the Philippines, the land reform should be highlighted. Land reform was proclaimed by Presidential decrees No. 2 and No. 27, respectively on September 26 and October 21, 1972. Decree 27 reads "since reformation must start with the emancipation of the tiller of the soil from his bondage..... order the emancipation of all tenant farmers as of this day, October 21, 1972; This shall apply tenant farmers of private agricultural lands primarily devoted to rice and corn under a system of share-crop or lease-tenancy, ... "In all cases, the landowner may retain an area of not more than seven (7) hectares, if such landowner is cultivating such area or will now cultivate it, . . . "

Such reform is one of the main objectives of the Government under Martial Law, and if carried out successfully, it will cause to generate drastic changes in economy of the nation. Emancipation of tenant farmers means their complete enrolment into the circle of money circulation. They will come into the circle with much strong morale to work. Productivity will be raised, and directly reflected in the increase of purchasing power which will, in turn, serve to stimulate private capital investment in the fields of services and industries of such products as will directly consumed by farmers. Growth of hinterland has a mighty power to develop the country.

Although not counted for in this report, effects to be brought about by the land reform will greatly help electrify the rural area of the country.

High Import-Dependency and Low Flexibility of Export

In 1965, total import marked 4,273,617,000 pesos (exchange rate = 3.9 pesos) and its absorption can be shown as follows:

Table 3-14 Industrial Imports Absorption

	Value of imports	
	Million pesos	% share
Manufacturing	1,276	29.9
Households	1,137	26.6
Services	750	17.5
Gross fixed capital formation	705	16.5
Agriculture, forestry & fishery	233	5.5
Net inventory change	146	3.4
Exports	19	0.5
Government	8	0.2
Total	4,274	100
Final demand	2,015	47.1
Intermediate	2,259	52.9

From Table 3-14, it will be understood that only 27 percent of total imports is absorbed by household sector and the rest, 73 percent, is inflowing into the national economy stream, directly or indirectly, in the form of capital goods, productive goods or inputs for intermediate transactions, thus conducive to the increase of national income. What counts here is the "extent" of converting imports to exports, or of compensating dollars for imports by dollars earned through exports. It is taken for granted that the financial and monetary policies of the government have to be favorable for export industries enabling them to expand in scale and scope. Because the expansion of the Philippine economy depends, without doubt, on how high it can draw up the ceiling set by the balance of payments. When exports are not successful and balance of payments aggravates, very common and frequent discussions are "country's import-dependence is too high," "Regulations on imports should be imposed," and "Among existing import industries, those which are not so contributive to the national economy should be suspended right away," etc. Setting aside the question whether the views are right or wrong, the comparison of the value of industry's import and the value of total output of the industry will give some indication on this matter.

Table 3-15 Import Dependency

	A: Value of imports (1,000 pesos)	B: Total industry sales (1,000 pesos)	% share A/B
Other services *	211,498	401,263	52.71
Petroleum refinery products	296,723	773,226	38.37
General bardware	89,221	265,502	33.60
Iron & steel basic shapes	71,828	214,396	33.50
Private communication	37,463	131,251	28.54
Motor vehicles & parts	110,145	425,524	25.88
Other manufactured products	22,701	105,925	21.43
Private construction	304,423	1,528,900	19.91

* Other services means those services other than electricity, gas, water, business services, personal services, recreational services, private education, banking, non-banking lending institution, insurance, real estate, rental of fixed assets and private hospitals.

Table 3-15 above is a mere comparison. In reality, the industries which are sometimes under dispute are those whose absolute value of imports are big. In 1965, industries whose imports exceed one hundred million pesos are petro-

leum products, other services, made-up textile products, knitting and textile mill products and motor vehicles and parts. Those exceeding twenty million pesos are general hardware, iron and steel basic shapes and forms, paper and other paper products, printed and published materials, private communication, medical and pharmaceutical products, metallic mining, other manufactured products, electricity and tires and other rubber products. These industries can be judged indispensable for modern life. The import dependency of the country is clearly high. The comparison of the total value of industry's imports and its total value-added will pinpoint the contribution of the industry to national income. If the industry's value-added exceeds its imports, it can be said conducive numerically, in the sense that the industry that depends on imported inputs generates enough value-added in the course of working on these inputs as well as add possibly to the national economy.

Table 3-16 Value-Added/Imports Ratio

	A: Industry Net value-added	B: Import Million pesos	A/B
Other service	164.5	211.5	0.78
Made-up textile products	176.1	156.3	1.13
Iron & steel basic shapes & forms	78.2	71.3	1.10
Private construction	361.0	304.4	1.19
Petroleum refinery products	370.1	296.7	1.25
Private communication	40.9	37.5	1,09
General hardware	122.1	89.2	1.37
Paper & other paper products	150.0	57.5	2.61
Electrical appliances	63.1	17.6	3.59
Knitting & textile mill products	417.2	128.6	3.25
Structural & architectural metal products	61.3	17.0	3.61
Air transportation	72.7	15.8	4.59
Electricity	109.1	29.7	3.67
Metallic mining	172.0	27.3	6.29
Industrial chemical	108.7	13.3	8.15

From the results of Table 3-16 above, every industry except other service is producing more value-added than its import and thus contributing to national economy.

But this result is not still enough to justify those importing industries. Problems are still left unsolved. If the exchange rate of dollar to peso is not $1.00 = 3.9 pesos or in other words, if the devaluation takes place, the import's value expressed in peso will hike up and consequently the ratio shown has to come below down. The point in question is the value of dollar to the peso or to the Philippine economy, which is hidden behind the talble. The true evaluation and deduction of this problem requires to go further looking into the shadow price or accounting price of dollar. On the basis of the accounting price, the industry can be more indicatively discussed if it should keep importing or not.

The another aspect of international trade is export. In 1965, total export recorded 3,100 million pesos, and most of them were raw materials, which is shown in Table 3-17 below.

Table 3-17 Export

	Value (million pesos)	% share to total
Coconut (copra)	627.8	20.3
Forestry	520.4	16.8
Metallic mining	295.4	9.5
Abaca & fiber	87.2	2.8
Sugar	504.7	16.3
Made-up textile	98.0	3.2
Plywood	99.0	3.2
Desiccated coconut	365.6	11.8

It can be easily understood that coconut, sugar, forestry, metallic mining are the major export items and these four share 74.6 percent of the total Philippine export. The Philippine export is verified to be lacking for price elasticity of supply and to be of the type which is heavily dependent on the outside conditions. Aside from sugar whose quota and price are given, an example of copper mining export in 1971 is typical. It increased the production by as much as 70 percent of that in the previous year and yet earned the same dollar as the previous year due to the decrease of international marked price. In other words, country s balance of payments in its structure is solely depending on these outside factors.

For the further details of export industries, the following two coefficients

are worked out; (1) direct export content and (2) direct and indirect export content, which can be known by means of premultiplying the column vector of export coefficient of industries by the transpose of inverse matrix. Comparison of these two content coefficients in each of export industry brings about the fact that those industries whose differences in two coefficients are big are important industries not only as export industries but also as those whose inputs to the rest of economy play a significant role. In other words, the differences of export industries which have some intermediate transactions with other industries are bigger than those of industries which are exporting solely the raw materials. If the country attempts to take off from the mono-cultural export structure, these industries with high differences are to be fostered and encouraged.

Table 3-18 Comparison of Direct Export Content and Direct and Indirect Export Content

	Direct and indirect export content	Direct export content	Difference
Desiccated & other coconut products	0.01481	0.64240	0.37241
Pressure bonded boards (plywood and venear)	0.79881	0.58103	0.21778
Coconut and copra	0.55681	0.33305	0.22376
Lumber	0.26181	0.07625	0.18556
Other vegetable oils and fats	0.24519	0.00032	0.24487
Washing and cleansing compounds	0.23444	0.01568	0.21876
Metallic mining	0.86381	0.84268	0.02113
Forestry	0.58617	0.57097	0.01520
Abaca and other fibers	0.56736	0.56738	0.00898
Sugar and sugar confectionery products	0.48714	0.46041	0.02673
Processed fruits and vegetables	0.32510	0.27888	0.04622

Role of the Government Sector

Table 3-19 GNP & Composition

in million pesos

Year	1961	1965	Actual 1970	Estimate 1971
GNP	16,846 (100%)	25,660 (100%)	31,320 (100%)	33,042 (100%)
1. Personal consumption	12,047 (71.51%)	20,175 (78.62%)	24,007 (76.65%)	25,180 (76.21%)
2. Government consumption	1,529 (9.08%)	2,127 (8.29%)	3,038 (9.69%)	2,835 (8.57%)
3. Gross domestic capital formation	1,830 (10.87%)	2,757 (10.75%)	7,041 (22.48%)	6,678 (20.21%)
a. private		2,413	6,359	6,223
b. government		344	682	455
4. Net inventory change	1,762 (10.46%)	1,773 (6.91%)		
5. Exports	1,332 (7.91%)	3,100 (12.08%)	4,482 (14.31%)	5,921 (17.92%)
6. Less: Imports	1,656 (9.83%)	4,274 (16.67%)	5,669 (18.10%)	6,272 (18.99%)

From Table 3-19 above, the ratio of government expenditures i.e., (the sum of government consumption and government capital formation where both figures are available) to the total gross national products is obtained as below.

Year	1961	1965	1970	1971
Ratio	9.08%	9.62%	11.87%	9.96%

The government role of the Philippines in its economy has been alleged to be too small. The figure supports such assertions. It was even small comparing with the developing countries. In 1965, 59.2 percent of government expenditure was spent on compensations for employees and only 12.5 percent on services of roads, bridges, ports and harbors and other public services. The government has been spending very little on construction of roads, bridges and ports and harbors which can offer the external economy to the rest of the economy. The so-called social overhead capital has been lacking outstandingly in the Philippines.

Money supply (in million pesos)

Year	1965	1966	1967	1968	1969	1970	1971
Money supply	3,067	3,371	3,783	3,982	4,754	5,047	5,567
% change		9.9	12.2	5.3	19.4	6.2	10.3

On the other hand, the efforts made by the Government to support economic growth are seen in monetary policies. Since 1969 on, the money supply by the Central Bank is increased considerably to facilitate smooth money circulation.

One remark on this point should be cited. The statistics in 1965 taught us the import-dependence of construction is very high. If the government keeps spending on public investment, it has to be cautious not to stimulate the inflational tilt as well as to overload balance of payments of the country.

3-2-2 Visayas Economy

Table 2-20 cited hereinafter will facilitate one to understand the situation where the Visayas is located economically in the whole Philippines. The Visayas has been characterized by its agricultural products, sugar and coconut and mining products, which hold still true. As sugar and coconut are important dollar earners for the country, they are still widely produced in the Visayas. Aside from agriculture, one will notice from the said table that industry in the Visayas is getting its way at almost the same speed as that of the country. Of course Manila, the country's most industrialized zone, is leading in this sector, but the Visayas - actually the Western Visayas - is also following industrialization. Since, unlike other regions, the Visayas comprises many scattered islands, the conditions for industrialization may not seem favorable. But yet the fact that capital accumulation in the Visayas is proceeding well connote the latent industrialization in the area. When the infrastructure problem in the Visayas is solved, the region will have its way to industrial development.

(1) Sugar

Sugar canes are grown chiefly in haciendas around Bacolod City, Negro Occidental. Export sugar to the United States with a quota system comprises about 20 percent of total dollars which the Philippines earns. The production in Negros will directly affect the total production of sugar in the Philippines. Numerically, more or a little less75 percent of total sugar production is from the Visayas. The number of sugar centrals has also increased in the Visayas and the Visayas leans against more sugar production.

This tendency might be understandable in view of the position occupied by sugar among the entire exports of the Philippines and of the preferential relation with the U. S. quota. In the year 1971, the sugar production has reached at the

Table 3-20 Economic Activities by Region

	Year	Visayas	Luzon	Mindanao	Manila	Philippines
Employment (1,000 persons)	1960	2,681.7	3,530.8	1,784.0	861.5	8,808.0
	70	3,279.2	5,159.0	2,622.2	1,036.6	12,097.0
Growth in 10 years	-	22.3%	46.1%	51.2%	20.3%	37.3%
Fixed assets (10^6 pesos)	1960	411.3	1,509.4	239.6	1,832.8	3,993.1
at 1961 price	69	938.9	1,857.5	1,002.4	5,462.1	9,260.9
Growth in 9 years	-	228.3%	23.1%	418.4%	298.0%	231.9%
Agriculture (10^6 pesos)	1960	807.5	1,318.4	1,170.1	-	3,296.0
at 1955 price	70	979.2	2,297.4	2,193.4	-	5,470.0
Growth in 10 years		21.3%	74.2%	87.4%	-	66%
Industry (10^6 pesos)	1960	391.1	643.5	268.3	971.0	2,274.0
at 1955 price	70	711.6	969.3	490.8	1,918.3	4,090.0
Growth in 10 years	-	81.9%	50.6%	82.9%	97.6%	79.8%
Production index	1961	100	100	100	100	100
	69	117.8	145.0	169.0	174.0	149.1
Productivity index	1961	77.0	91.0	84.0	261.0	100
(Philippines=100)	65	70.0	94.0	84.0	259.0	100
Total production index	1961	100	100	100	100	100
	63	108.5	104.7	111.7	109.2	107.3
	65	115.9	111.2	123.8	123.0	117.1
	67	122.5	119.4	135.7	133.1	125.7
	69	130.3	128.4	158.2	152.1	138.0
Capital stock index	1961	100	100	100	100	100
	1969	322.1	125.6	438.9	270.1	231.9

Table 3-21 Centrifugal Sugar Production

(in thousand metric tons)

Year	Total Philippines		Visayas Region		
	No. of central	Production	No. of central	Production	% share
1956	25	1,105.5	16	792.3	71.7
57	25	1,036.9	16	723.4	69.8
58	25	1,249.9	16	899.9	72.0
59	25	1,371.8	16	1,039.7	75.8
60	24	1,386.9	16	1,013.9	73.1
61	24	1,316.7	16	1,002.3	76.1
62	26	1,468.2	17	1,110.7	75.4
63	25	1,554.8	16	1,127.0	72.5
64	25	1,683.6	16	1,273.5	75.6
65	27	1,557.4	18	1,144.2	73.5
66	26	1,401.9	18	1,048.3	74.8
67	26	1,560.0	18	1,185.3	76.0
68	27	1,594.9	19	1,233.8	77.4
69	28	1,596.1	19	1,227.1	76.9
70	33	1,926.6	24	1,523.6	79.1
71	35	2,050.8	26	1,606.3	78.3

highest level in the past, both in production and in earning. The port of Iloilo, more than 2/3 of whose handling cargoes are reportedly sugar, cleared off about 1.4 times the bulk handled previously in 1970. Thus the western Visayas might be said to have had a happy year.

The background of this happy year should briefly be analyzed. Since Philippine sugar is for export solely to the United States and to nowhere else and it could benefit out of Peso devaluation, the year 1971 was a fortune. The Laurel-Langley agreement is to be expired in 1973 and nobody knows yet how it would be renewed. And the competitiveness of the Philippine sugar is another question. Therefore, sugar industry might be said to leave problems to be solved in the future.

Table 3-22 Exports of Sugar

(FOB value in thousand US dollars)

Year	Total exports	Sugar	% Share
1965	768,448	146,784	19.1
66	828,195	140,657	17.0
67	821,456	150,987	18.4
68	857,715	150,598	17.6
69	854,601	155,861	18.2
70	1,061,702	196,496	18.5
71	1,121,821	226,284	20.2

(2) Coconut

Coconut trees are planted throughout the country and there is no specified region as in the case of sugar for Negros but it has significance for the Visayas economy especially for Leyte and Samar. The area cultivated for coconut is the third largest, following rice and corn, and coconut products are wide-ranged and of many use.

Copra, desiccated coconut, coconut oil and coconut meat have been exported in bulk and they have been acquiring dollars more than sugar did, although the trend is a little descending recently. Coconut is more important than sugar since it has intermediate transactions with the rest of the Philippine economy, whereas sugar is solely for export. From the standpoint of export diversification as well as industry diversification, coconut is important.. Leyte and Samar, which are at present mainly dependent on coconut will have more development if coconut production is more rationalized.

Table 3-23 Export of Copra, Desiccated Coconut, Coconut Oil and Coconut Meat

(in thousand US dollars)

Year	Copra	Desiccated coconut	Coconut oil	Coconut meat	Total	% share to total export
1965	170,004	20,447	68,095	11,803	270,349	35.2
66	157,163	17,713	74,509	17,231	266,616	32.2
67	129,435	17,046	59,274	10,920	216,675	26.4
68	123,029	24,605	77,311	11,033	235,978	27.5
69	87,295	16,146	50,565	9,401	163,407	19.1
70	80,077	19,449	95,585	13,923	209,034	19.6
71	114,040	20,741	103,451	16,243	254,475	22.7

(3) Market

Cebu is the center for the entire Visayas. Its function as transshipping port plays an important role in the Visayas economy. However, as far as the team's observation and data are concerned, the intra-regional incoming and outgoing of products and goods are too small to set up a common market for the Visayas. The islands in the Visayas are at present connected with either Luzon, Cebu or Mindanao and not much with each other. In other words, the Visayas, though called in a single name, is not functioning as an economic body although each island has its own specialty or its own products. There might be historical and linguistic reasons for this, but above all, the infrastructure, especially transportation, might have been defying the linkage of these islands. Much is expected to improve the present transportation between the islands.

Chapter 4 Present Power Utilities

4-1 Salient Feature of Power Utilities in the Philippines

Contrasting enough with the other ECAFE countries, the power utilities of the Philippines are operated primarily by private enterprises, with franchise allotted to each utility. This, however, is hampering the growth of power industry, especially in electrifying the rural areas, and a reform measure is underway.

In the Philippines, power is supplied by private utility companies, NPC, and local autonomies. The private utility companies numbered 335 in 1970, and MERALCO outstandingly is the largest of all. Their sizes as of 1969 are shown in Table 4-1.

The energy production of MERALCO and NPC alone amounted to over 90 percent of the total, and the remaining some 8 percent was produced by as much as 454 power utilities, which, corresponding to 400 kW of installed capacity if averaged, overtly indicates how small the 454 utilities are.

Of the total energy production, component ratio of hydro, steam and diesel is 26:69:5. The weight of steam, the highest presently, is expected to increase in view of the development plan which is primarily composed of construction of

steam power plants.

Table 4 1 Electric Utilities in the Philippines

	No. of utilities	Installed capacity (MW)	(%)	Energy production (million kWh)	(%)
Private utilities					
MERALCO	1	990	58	4,320	66
Other utilities	334	172	10	410*	7
Publicly owned utilities					
NPC	1	534	31	1,645	25
Municipal utilities	121	7	1	60*	1
T o t a l	456**	1,703	100	6,522	100

* estimated
** as of 1970

The growth of energy production in the whole Philippines recorded 13.7 percent in the annual average during the period of 1959 to 1969. Per capita energy production in 1969 was 220 kWh, which can be ranked in the middle group of ECAFE countries. Figures 4-1 and 4-2 give various trends of production growths in ECAFE region.

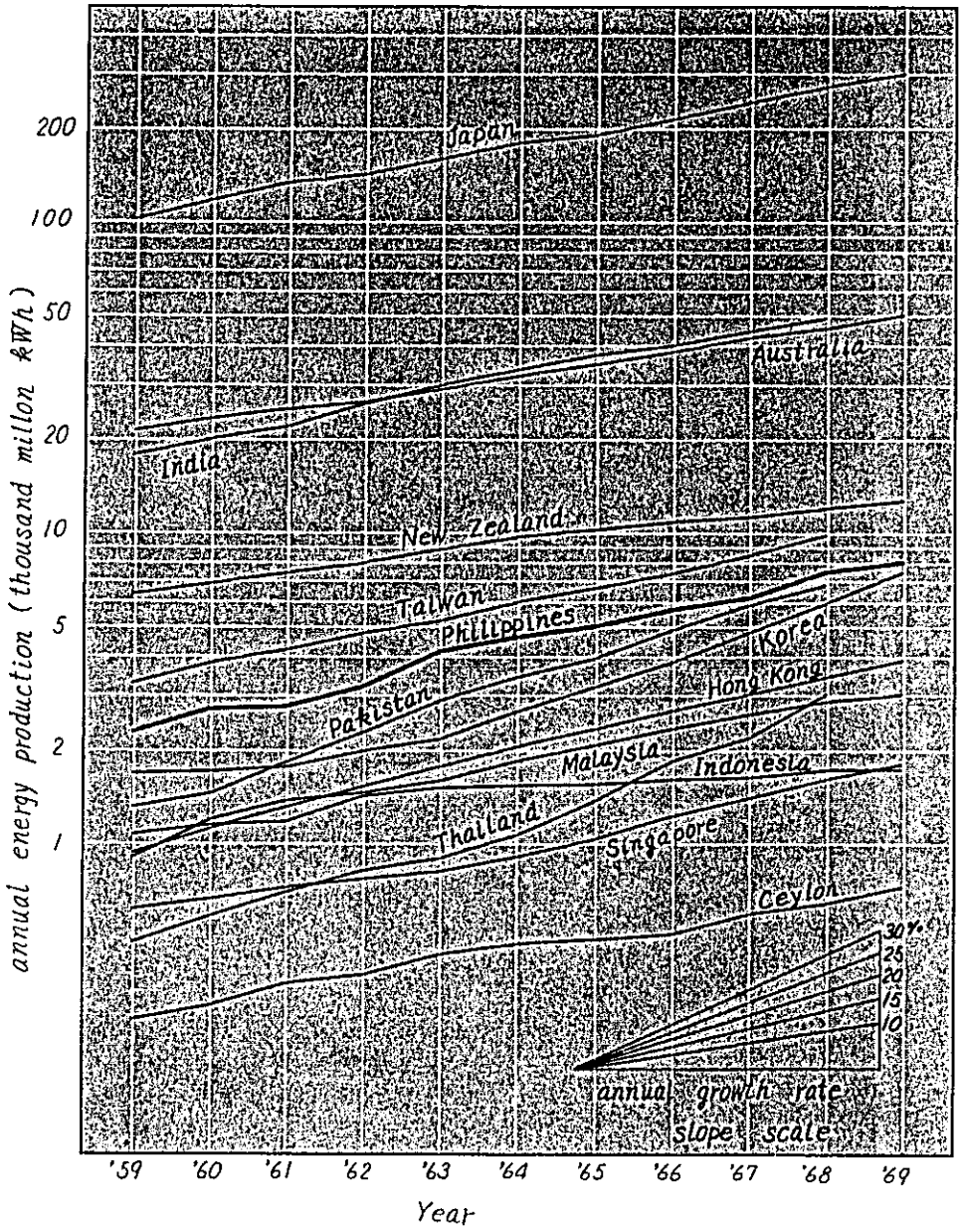
In Luzon, in which is great Manila, there are 230 kV system connected to hydro power plants of NPC and 138 kV system of MERALCO. These two systems are interconnected at Balintawak Substation to constitute so-called Luzon grid. A program has been contemplated and already being implemented by NPC to expand the Luzon grid.

Mindanao is endowed with hydro potentials. Mindanao grid is being established at a voltage of 115 kV with the Maria Cristina Hydro Power Plant as its central power source, supplying low cost energy to the public. The industrial areas around Cagayan de Oro and Iligan, north of Mindanao, were built up with this less expensive energy.

In the Visayas, because of its insular formation, a large single system is not possible, and isolated systems centered around cities and towns are common. Visayan Electric Company (VECO), holding its franchise in and around Cebu City, the second largest city in the Philippines, ranks the second in scale among private utilities following MERALCO.

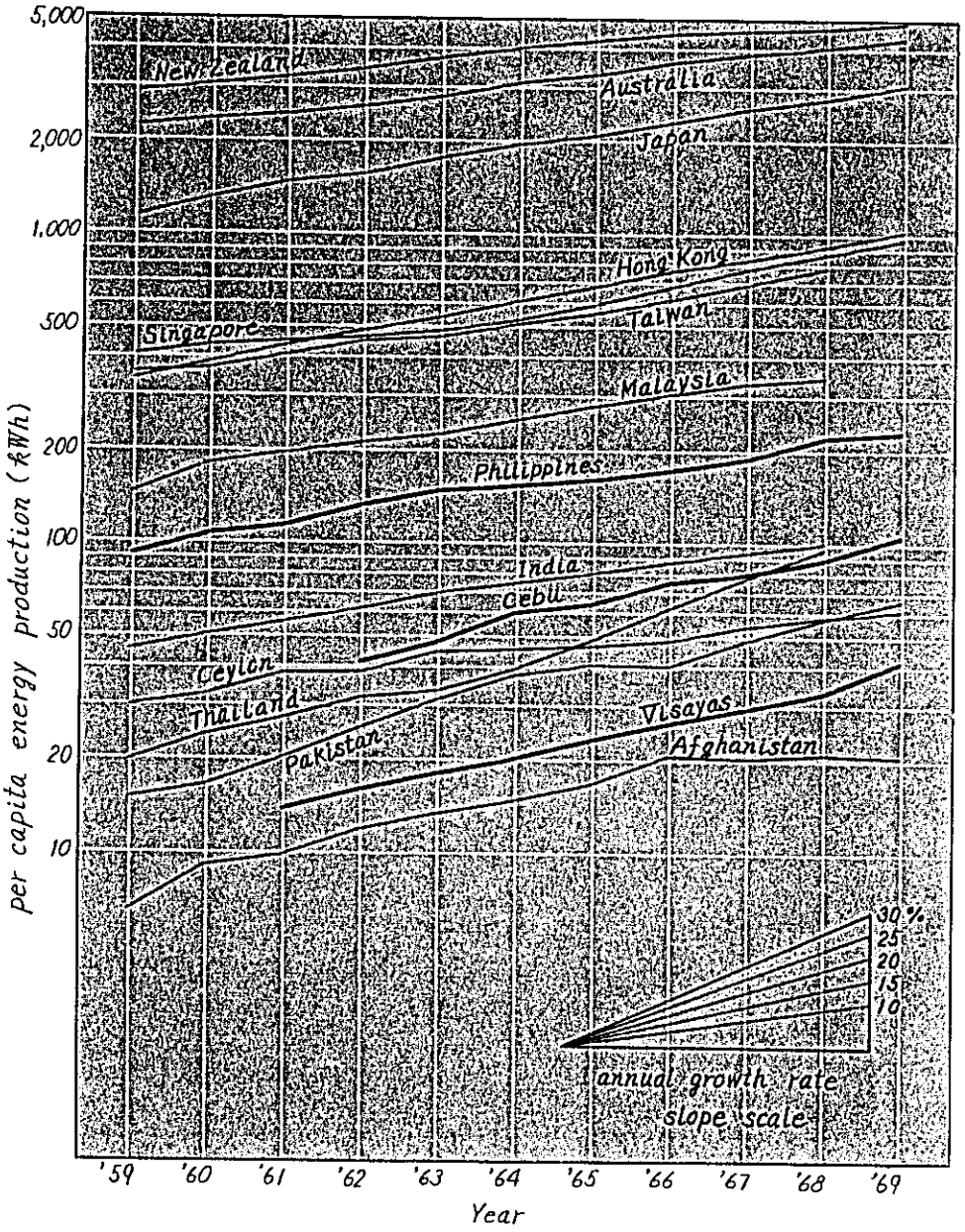
The natural and geographical conditions are different from one region to another, and the power industries are varied accordingly. Power rate schedules are also various. In Luzon where there are large scale steam plants of MERALCO

Fig. 4-1 Trend of Energy Production in ECAFE Countries



and hydro resources harnessed by NPC at low cost, people are enjoying less expensive energy. A residential customer whose monthly consumption is 100 kWh is paying 10.6 centavos per kWh, while a customer of VECO has to pay 23 centavos per kWh. The power rate schedules of major utilities in the Visayas are illustrated in Table 4-2 in comparison with that of MERALCO. Since NPC is not supplying power to final customers, the power rate of NPC is not comparable with those of the utilities mentioned in the above. Power sales revenue of NPC was: 0.058 pesos, 0.027 pesos and 0.082 pesos per kWh respectively in Luzon, Mindanao and the Visayas in FY 1971/1972; the 0.058 pesos in Luzon dose not include power for pooling with MERALCO.

Fig. 4-2 Per Capita Energy Production in ECAFE Countries



The Power Development Council (PDC) and the Public Service Commission (PSC) are the competent government agencies of power industries in the Philippines; the former carrying out nation wide development planning and coordination between the power utilities, and the latter administering the utilities by granting approvals on franchise area and power rate schedules. NPC, however, may be characterized by its peculiar position in this framework as described later.

Of the private utilities, 184 joined together to form the Philippine Electric Plant Operator's Association (PEPOA). Recently, for the purpose to provide financial and technical assistance to the utilities, founded was the Utilities

Table 4-2 Comparison of Power Rate Schedule

(in pesos/kWh)

	Residential (kWh/month)		Commercial (kWh/month)			Industrial (kW)			
	100	200	200	500	1,000	50	100	200	500
MERALCO	0.106	0.128	0.182	0.181	0.157	0.109	0.109	0.109	0.109
VECO	0.23	0.20	0.225	0.22	0.20	0.14	0.117	0.117	
Dancar	0.231	0.191	0.21	0.192	0.186		none		
PECO	0.257	0.203	0.287	0.253	0.241	0.148	0.144		
Diaz	0.297	0.218	0.40	0.35	0.344	0.167 (0.177)	0.166 (0.177)		
Dumaguete (VECO)	0.172	0.148	0.19	0.18	0.188	0.099			
Tacloban	0.275	0.238	0.238	0.215	0.208	0.099 (0.105)			
Ormoc	0.368	0.309		none		0.137			
Catbalogan	0.24	0.22		none			none		

Note:

1. Energy consumption of industrial load is assumed at 50% load factor
2. Figures in parentheses are on-peak rate

Development and Finance Corporation with equity participation by PEPOA and three financial institutions.

Franchise System

A utility operator should be in possession of franchise which is obtainable in two ways. One is through the Congress with approval by the President, and the other with a permit of municipal council of the town. In the former case, the franchise granted by the Congress will be absolute and mandatory on the part of the Public Service Commision to issue the corresponding permit or certificate of public convenience. In the latter case, however, it is only temporary and must be referred to the Public Service Commission for final approve.

With the franchise granted, the operator is entitled to operate utility business within the franchise territory. The utility operation is subject to franchise tax which is variable according to the franchise grantee, or the operator, within a range of 2 to 5 percent of the gross earnings from the business. Recent grantees will have to pay 5 percent. At the same time, the business operation is restricted in terms of the maximum rate of return of 12 percent on rate base.

A public utility is a monopoly in the franchise area. However, it seems to be not obligated to supply electricity to all or any percentage of the inhabitants in the territory. Private utility is always controversial in the profit motivated operation against public welfare. In fact, it is the profit motive rather than the public interest that controls the action and operation of utilities. Especially small utilities tend to concentrate their services into urban area, leaving rural areas not electrified.

Petty as described in 4-1, private utilities are unable to replace old facilities with new; present old facilities are getting no way but much older. Consequently, the level of services are, as may be seen today, very low. Hike of power rate has not been approved by the Public Service Commission. There were apparently the dictates of public opinion behind it. On the other hand, the introduction of floating rate on pesos in 1970 have caused to raise the prices of all the goods and services, as well as, to increase the debt service payment, which has driven many of the local utilities in pecuniary embarrassments.

Rural Electrification

According to data made available by the National Electrification Administration (NEA), the electrification ratio in the Philippines was 22.5 percent in 1971. This means that electricity is served to only one person out of five. In actual figures, only 8.5 million people are receiving electricity out of the Philippines' total 37.7 million, and the remaining some 29 million are living without having the benefit of electricity. Of the electrified 8.5 million, about 70 percent is distributed in and around Manila and a few large cities. Rural areas of the country are hardly electrified.

However, it can not be expected much from the local utilities who are all

small in scale as can be seen in 4-1, to electrify rural areas, since the rural electrification will require fixed capital investments aplenty which is beyond the capacities of the utilities. This was the background when NEA was established in 1969 with a target to extend electric service to all prospective customers on so-called area coverage basis. NEA is a lending institution to provide funds, as well as, technical and professional assistance to public service utilities, especially to electric cooperatives for construction of power plants, transmission lines and distribution lines that are designed for rural electrification. The function of NEA was modeled on the National Rural Electric Cooperative Association of USA, which is extending technical and financial assistance to NEA. Japan, also, participates in the assistance in terms of reparation program by providing funds to procure materials. The present target with which NEA is primarily undertaking is to establish one cooperative in each province during the period of 1972 to 1974. Two pilot cooperatives are already in operation; one in Negros Occidental and the other in Misamis Oriental, respectively called VRESCO and MORESCO. The performances and achievements of these two pilot cooperatives will be very much informative and instructive in implementing the establishment of new cooperatives.

Another target of NEA, which is contemplated in a long range, is to establish power grids in Luzon, Mindanao and the Visayas by 1980 with a goal to electrify the entire Philippines within a twenty year period. Being one of the programs on which the government puts strong stress under the Martial Law, electrification is expected to be pushed forward with a great force of momentum.

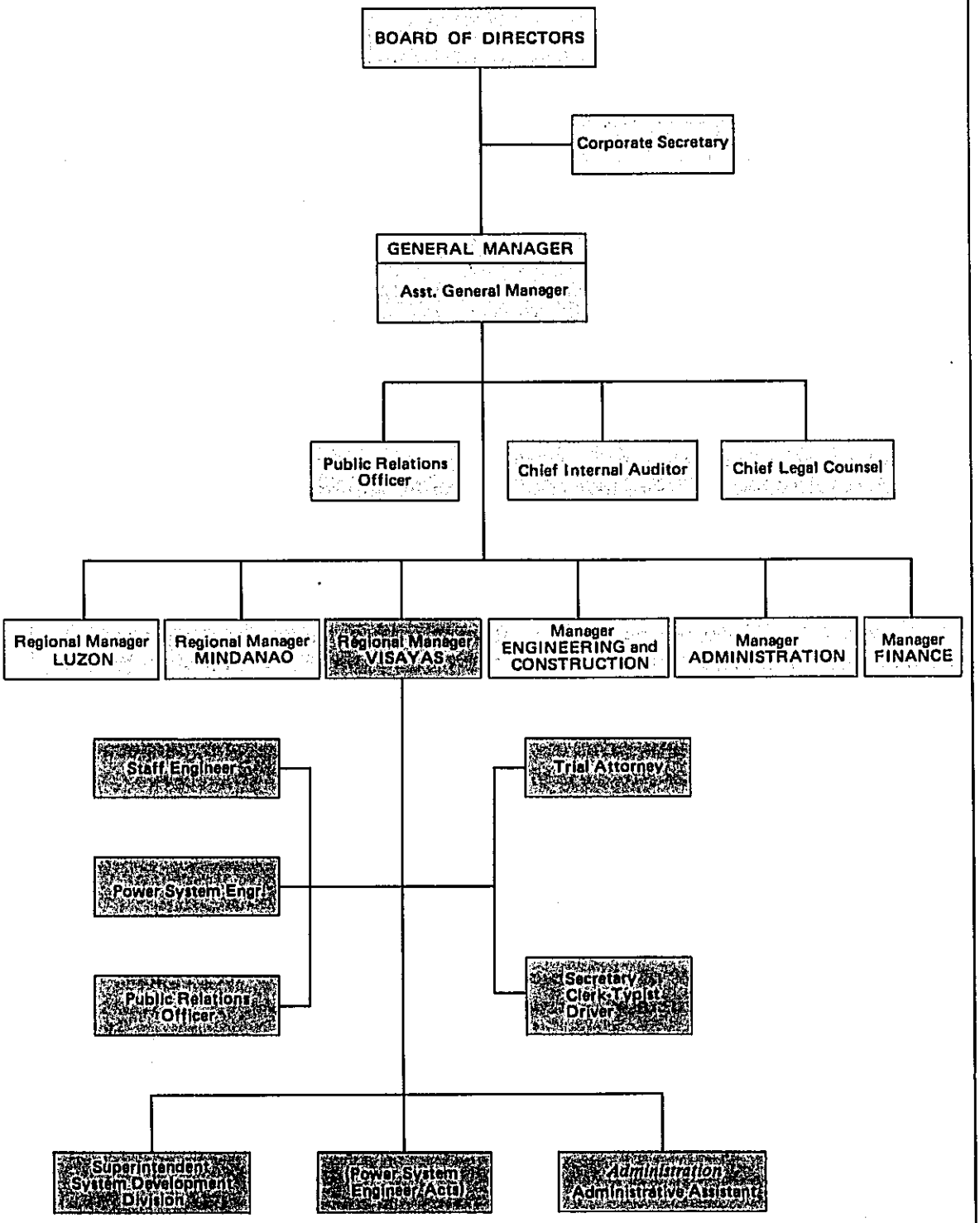
It is a general policy to establish a cooperative at such a place with high priority where utility service is not available. However, there will be cases, so is true with VRESCO, in which a cooperative will be selling energy to small utilities which will have come in the territory of cooperative. In a way, the establishment of cooperatives may be considered as a challenge by the government to private utility owners who are incompetent for fulfilling their task of extending their services into rural areas. As the area coverage of cooperatives will expand, electrification will take place to cover the whole country.

4-2 National Power Corporation (NPC)

NPC was organized in 1936 for the purpose to investigate and develop hydroelectric power potentials in the Philippines. Later on, its activities have come to include the development of other electric power resources. At present, NPC is carrying out investigations on various power plants and power resources, construction and operation of power plants and transmission lines thereby to wholesale energy to other power utilities. The energy wholesale revenue is now the major single item of its earnings. By an amendment of Act in 1960, NPC was remodeled into a corporation issuring stocks to the only share holder of the government. The authorized capital, that has been paid-up in full, is 300 million pesos.

The executive body of NPC is called the National Power Board consisting of seven members appointed by the President. The General Manager shall be the

Fig. 4-3 Organization Chart of NPC



ex-officio Vice-Chairman of the Board.

Since its foundation as a government agency NPC has been engaged in the construction of major hydro power plants and the pertinent transmission lines and substations. Luzon grid and Mindanao grid are the achievements.

In 1972, NPC's first thermal power plant was completed at Bataan with an installed capacity of 75 MW to meet base load. The second stage construction of the power plant is now examined at financing level. The major installations of NPC are as follows:

Luzon

In combination with the second stage construction of Bataan Power Plant, it is proposed to extend the grid in Luzon to almost the double in the total length of the present transmission lines. In addition, an aggregate capacity of substations was 1,200 MVA in 1970.

Table 4-3 NPC Installations in Luzon

Power Plant		Installed capacity (MW)
Caliraya hydro		36
Ambuklao hydro		75
Binga hydro		100
Angat hydro		212
Bataan thermal		75
	Total	498
Trunk transmission lines		**Length (km)**
230 kV		480
115 kV		200
69 kV		680

Mindanao

There is Maria Cristina hydro power plant, 150 MW in installed capacity, on the Agus river originating from Lake Lanao. Preparatory works are underway for an addition of the fifth unit in the plant, as well as, for the construction of Agus No. 2 power plant at a site upstream of Maria Cristina. The voltage of trunk transmission line is set at 69 kV at the present time which will be hightened to 138 kV when the upstream project is completed.

The Visayas

There are no NPC facilities in the Visayas except two small hydro power plants.

NPC Charter

An amendment was approved by the government in September 1971 of the Charter of NPC, with the result that the powers and functions of NPC have been amplified and strengthened. The outline of amendments are as follows:

(a) The powers and authorities of the National Power Board and the General Manager were reinforced. NPC now has authority to determine and fix its power rate schedule by itself provided that the NPC's rate of return does not exceed 10 percent, which is quite a privilege in view of the other power utilities whose power schedule can not be fixed or altered without approval by PSC. Although PSC has power to exercise jurisdiction over all cases contesting the power rates fixed by NPC and to render decision thereon within 90 days after the complaint is filed with PSC, the power rate schedule fixed by NPC may stay effective until the decision is rendered.

(b) The limit of outstanding debt at any time was raised to 500 million pesos in domestic currency and US$ 200 million in foreign currency which had been 500 million pesos including US$ 100 million previously.

(c) NPC has become exempted from all texes, duties and fees, which is serving today to lower the power rates of NPC as much.

(d) In the Board, there are three members representing one each region of Luzon, Mindanao and Visayas, while in the organization of NPC, there are three regional managers assigned to the regions. Further, power rate schedule will be set up independently by the region. Such regionalized policy is indicative of the intention of the government to intensively develop a retarded region.

The number of employees of NPC as of May end 1971 was 2,300 approximately including about 700 engineers. Pursuant to the amendments to the Charter of NPC, three regional offices were established in 1972 in Luzon, Mindanao and the Visayas. The Visayas Regional Office was placed in Cebu City, the central city of the region. Organization of the office, although not complete yet, is shown in Fig. 4-3.

Presidential Decree No. 40

On September 21, 1972, the entire Philippines were placed under Martial Law with a hope to build a new society with various attempts to renovate the whole country. On November 7, 1972, the basic policies were clarified by Presidential Decree No. 40 for the electric power industry. According to the

decree, it is a declared policy to electrify the entire country by assigning NPC to the construction of power plants and transmission lines forming grids in the major islands, at the same time, by setting-up cooperatives for expansion of distribution networks.

Noteworthy is the role assigned by the decree to NPC. It is clearly stated in the decree as "The setting-up of transmission line grids and the construction of associated generation facilities in Luzon, Mindanao and major islands of the country, including the visayas, shall be the responsibility of the National Power Corporation (NPC) as the authorized implementing agency of the State." The existing private and municipal utilities are expected to function as distributors of energy produced by NPC in the future, except where such utilities will stay outside the area covered by NPC grids.

4-3 Power Industry in the Visayas

The six islands of the Visayas, which are the coverage of this report, differ from each other in the level of electric service as shown in Table 4-4. Cebu is the only island where electrification ratio is near to 20 percent, the national average, while other islands are very low in electrification. This is attributable to their economies that are primarily based on agriculture, excepting Cebu. Therefore, rapid growth in power demand can not be expected in these islands, although there are some areas where power demand is being suppressed due to shortage in power supply capability or limited transmission and distribution networks. In such areas, load would increase rapidly for a certain period if sufficient services were extended.

Today, the government is pushing a program to electrify rural areas by establishing electric cooperatives as pilot projects in all the islands in the Visayas with a target date of operation in 1974 and another target to electrify 80 percent of the total dwellers in the Visayas by 1990. The population coverage of one cooperative is about 43 percent on the average which is estimated to have a peak demand of approximately 3,000 kW in the first year of operation. The establishments of cooperatives are now on the stage of procurement of equipment and materials or preparation of definite designs by NEA.

The survey team has visited major 10 utilities in the Visayas and one cooperative in Negros, or VRESCO, that is in operation since 1966 as one of the two pilot cooperatives in the Philippines. Table 4-6 gives the past operation records of Visayan Electric Co., Inc. (VECO) in Cebu, Panay Electric Co., Inc. (PECO) in Panay, A. S. Diaz Electric Service, Inc. in Negros and Tacloban Electric & Ice Plants Co., Inc. in Leyte.

The highest growth rate in energy production was achieved by VECO, 14.2 percent annually over the last decade, while the lowest was PECO, 9.3 percent during the same time period. The number of residential customers are comprising 70 to 85 percent in all the four utilities. However, the per customer consumption of Diaz Electric is more than two times of the other utilities, which is presumed to be attributable to high generalization of air

Table 4-4 Per Capita Energy Consumption in the Visayas (1970)

Province	Population in 1970 (persons)	Population Increase (%)*	Area (sq. km)	Population density (person/sq. km)	Installed capacity (kW)***	Maximum demand (kW)***	Energy production (MWh)***	Energy production per capita (kWh/capita))	Electrification ratio (%)**
Cebu	1,634,182	2.1	5,088	321	42,300	33,800	178,200	109	19
Panay	2,114,544	1.9	12,297	172	15,790	11,100	54,410	26	6
Aklan	263,358	1.5	1,818	145	780	680	1,710	7	2
Antique	289,172	2.0	2,522	115	440	250	290	1	2
Capiz	394,041	2.3	2,633	150	1,400	1,200	4,010	10	3
Iloilo	1,167,973	1.9	5,324	219	13,170	8,970	48,400	42	10
Negros	2,219,022	1.4	13,672	162	24,020	17,300	82,000	37	7
Negros Occidental	1,503,782	1.2	7,926	190	19,620	13,800	70,600	48	7
Negros Oriental	715,240	1.8	5,746	124	4,400	3,500	11,400	16	6
Bohol	683,297	1.4	4,117	166	1,470	1,210	4,320	6	3
Leyte	1,362,051	1.5	8,003	170	6,700	5,170	19,900	15	5
Leyte	1,110,626	1.4	6,268	177	6,200	4,870	19,400	17	6
Southern Leyte	251,425	1.8	1,735	145	500	300	500	2	2
Samar	1,019,358	1.6	13,431	76	1,940	1,700	4,840	5	5
Eastern Samar	271,000	1.3	4,340	62	-	-	-	-	-
Northern Samar	306,114	1.6	3,500	87	-	-	-	-	-
Western Samar	442,244	1.9	5,591	79	-	-	-	-	-
Total	9,032,454	1.7	56,608	160	92,220	70,280	343,670	38	8

Note: * Growth rate of population was calculated based on the census of 1960 and 1970
** Estimated based on the number of customer.
*** Source: from "Electric Utilities Data of the Philippines in 1970" prepared by NPC.

conditioners. The week day load curve of Diaz Electric shown in Fig. A3-3, in which peak demand appears in day time with a load factor of 78 percent, supports the above presumption.

Generally speaking, per customer energy consumption in the Visayas is high due to the generalization of air conditioners. Major buildings are almost air conditioned, and some of the residences are also equipped with air conditioners. The component ratio in number of customers of commercial and industrial sectors are respectively 12 to 15 percent and less than one percent in the four utilities.

The utilities which the team visited are all private enterprises except one in Tagbilaran in Bohol. Small in scale, these private utilities except the four mentioned above, do not have any positive expansion program. The details of utilities on each island are described hereinunder. Daily load curves of the respective utilities are as shown in figures A3-1 through A3-4 in Appendix.

4-3-1 Cebu

(1) Utilities

In Cebu is Visayan Electric Co., Inc. (VECO) which, with an installed capacity of more than 95 percent of the total utilities' capacity in Cebu, is supplying energy to Cebu City (347 thousand in 1970 population) and its surroundings. The other utilities, run privately or by municipalities, are all small, each having an installed capacity of around 100 kW. Table 4-5 gives the annual production and sectorial consumptions of VECO system.

Table 4-5 Generated Energy and Consumption by Sector in 1971

Visayan Electric Co. (VECO) in Cebu City, Cebu

Installed capacity	51,100	kW
Max. demand	34,800	kW
Energy production	173,220	MWh

Sector	Energy sold (MWh)	No. of customer	Consumption per customer (kWh)
Residential	40,500	36,165	1,100
Commercial	33,800	5,195	6,500
Industrial	66,200	411	161,000
Flat-rate	900	2,496	400
Street lightings	1,700	16	106,800
Gov't. building	4,200	248	16,800
Total	147,400	44,471	-

Table 4-6 Comparison of Generation & Consumption of Electric Utilities in the Visayas as of 1971

	VECO (Cebu)			PECO (Panay)		
Installed capacity(kW)	51,100			11,449		
Maximum demand(kW)	34,800			9,700		
Energy production(MWh)	179,220			47,579		
No. of customers	44,471			15,115		
	Consumption per customer (MWh)	Ratio of consumption (%)	Ratio of No. of customer (%)	Consumption per customer (MWh)	Ratio of consumption (%)	Ratio of No. of customer (%)
(1) Consumption						
Residential	1.1	27.5	81.3	0.9	34.1	84.9
Commercial	6.5	23.0	11.7	3.8	22.3	13.4
Industrial	162.2	44.9	0.9	121.9	32.2	0.6
Street lightings	106.8	1.2	0.6	7.2	3.2	1.0
Flat-rate	0.4	0.6	5.6	-	-	-
	No. of Customer	Energy Sold	Revenue	No. of Customer	Energy Sold	Revenue
(2) Growth rate (1962-1971)						
Residential (%)	7.4	14.1	17.3	4.7	(9.2)	13.1
Commercial (%)	6.7	15.7	18.3	7.0	(9.2)	
Industrial (%)	6.0	15.4	20.6	4.0	(7.4)	
Street lightings (%)	8.1	9.7	9.7	-	10.5	-
Gov. buildings (%)	4.1	15.4	29.2	-	24.8	-
Flat-rate (%)	- 3.8	3.5	2.3	-	-	-
Energy production(%)		14.2			9.3	

Diaz Electric (Negros)			Tacloban Electric (Leyte)		
	14,370			4,188	
	10,609			3,200	
	59,299			15,545	
	11,409			7,589	
Consumption per customer (MWh)	Ratio of consumption (%)	Ratio of No. of customer (%)	Consumption per customer (MWh)	Ratio of consumption (%)	Ratio of No. of customer (%)
2.4	47.3	81.8	0.5	26.2	69.0
6.2	21.1	14.0	2.5	29.7	16.2
167.9	28.4	0.7	102.3	40.4	0.5
19.7	2.6	0.5	0.4	3.0	10.5
0.9	0.7	3.0	-	-	-
No. of Customer	Energy Sold	Revenue	No. of Customer	Energy Sold	Revenue
8.9	20.0	(20.5)	9.7	14.6	28.4
4.2	9.5	(13.2)			
(20.3)	(28.8)	(37.2)	4.8	12.3	13.2
12.8	18.9	17.8	3.9	11.3	9.3
-	-	-	-	-	-
- 9.0	6.3	0.9	-	-	-
	(16.3)			13.1	

On the other hand, it has been proposed by NPC to establish Cebu Power Grid with 115 kV and 69 kV transmission lines to be connected to a central power plant in order to cope with the increasing demand after 1976, including that of VECO, as well as, to electrify rural areas with less expensive power.

(2) Non-Utilities

It has been reported by NPC that, as shown in Table 4-7, the industries that have their own power plants number 12 in 1971, 80 MW in their total demand and 584 million kWh in the total annual production. Of the twelve, Atlas Consolidated and Development Corporation (Atlas Mining) on the west cost of Cebu is equipped with a 103 MW generating capacity to produce copper concentrates as one of the top ten producers in the world. However, excepting large industries of Atlas Mining, Universal Cement, Apo Cement, San Miguel Brewery and LUDO, industrial demand is less than 1,000 kW per customer.

In projecting the future load, Atlas Mining was not considered since it has advised NPC of its intention to continue to stay outside the utility services. Further, the industries of more than 1,000 kW in demand were not included in the projection.

(3) Electric Cooperative

An electric cooperative is scheduled to be established on the west coast of the southern Cebu, encompassing 7 towns and covering an area of about 600 thousand hectares in which are approximately 124 thousand inhabitants. The feasibility study is already complete, and the date of operation is expected in 1974 with an initial peak demand of 3.2 MW. This is forecasted to increase to 9.4 MW in 1984. The electrification ratio will be raised from 50 percent in the first year of operation to 86 percent within 10 years after start of operation. The energy consumption per residential customer is also expected to increase from 38 kWh per month to 91 kWh per month during the same period. The forecast prepared by NEA is as follows:

Year of operation	No. of customers	Demand (kW)
First year	11,696	3,200
Fifth year	16,595	6,200
Tenth year	23,000	9,400

4-3-2 Panay

(1) Utilities

The major utilities in Panay, which consists of four provinces of Iloilo, Aklan, Antique and Capiz, are Panay Electric Company, Inc. (PECO) and Roxas

Table 4-7 Self-Generating Industrial Plant in Cebu (1971)

Industrial plant	Location	Products	Installed cap. (kW)	Max. demand (kW)	Annual energy production (million kWh)	Annual load factor (%)
1. Atlas Mining	Toledo	Copper	103,000	59,000	442.5	86
2. Universal Cement	Danao	Cement	23,200	7,800	54.6	80
3. Danao Sugar Central	"	Sugar		300	1.1	40
4. Danao Ice Plant	"	Ice		400	3.2	91
5. APO Portland Cement	Naga	Cement	10,000	4,000	28.0	80
6. San Miguel Corp.	Mandawe	Beer and glass	5,700	3,700	22.2	69
7. Ludo	Cebu	Coconut oil	5,900	3,000	21.0	80
8. Bogo-Medellin Sugar Central	Bogo	Sugar	2,315	800	2.4	34
9. General Milling Corp.	Lapu-Lapu	Flour	–	500	2.5	57
10. White Manufacturing	Asturias	Cement	–	500	3.0	68
11. Acoje Soy Sauce and Glass	Liloan	Soy sauce and glass	1,200	500	3.0	68
12. Argao Coal Mines	Argao	Coal	–	200	1.0	57
Total			–	80,700	584.4	83
Total excluding Atlas Mining			–	21,700	142.0	75

Electric Power Co.; the former supplying power to Iloilo City and its vicinity, and the latter to Roxas City. Other than the above two, there are 15 private utilities and 10 municipal utilities, but these are all very small in scale.

Due to the topographical condition, 70 percent of Panay's population is concentrated in an area within a reach of 60 kilometers from Iloilo City. The city's population was 210 thousand in 1970. Therefore, it is envisaged that a power grid will be developed with the present PECO system as its center.

Roxas City, north of Panay, was populated by about 67 thousand in 1970 and falls in the franchise area of Roxas Electric Co. However, Roxas Electric Co. is supplying energy to only about 2,000 customers which is about 40 percent of the total staying in an area circumambient with a radius of 1.5 kilometers from the powerhouse. The total installed capacity is 1,200 kW against the peak demand of 1,200 kW, allowing no expansion of its services. Increase of supply capability is urgently demanded.

Table 4-8 gives the energy production and sectorial energy sales recorded by PECO in 1971.

Table 4-8 Generated Energy and Consumption by Sector in 1971
Panay Electric Co., (PECO) in Iloilo City, Panay

Installed capacity	11,449	kW
Max. demand	9,720	kW
Energy production	47,580	MWh

Sector	Energy sold (MWh)	No. of customer	Consumption per customer (kWh)
Residential	11,700	12,841	900
Commercial	7,700	2,032	3,800
Industrial	11,100	91	121,900
Street lightings	1,100	151	7,200
Others	2,900	–	–
Total	34,500	15,115	–

PECO is planning to install additional three units of 5,000 kW diesel driven generators to meet the growing demand, and one of the three will start operation in 1973.

(2) Non-Utilities

No data are available on the industrial power plants in Panay. There are six sugar centrals and small scale rice mills in Panay in which is a plain producing 45 percent of the total rice product in the Visayas. There is no

industry of appreciable size in the other provinces of Panay. The sugar centrals and rice mills in Iloilo, however, were not considered in estimating the future load; rice mills being small in scale and sugar centrals for the reason stated in 4-3-3 (2) hereinafter.

(3) Electric Cooperative

One each cooperative has been proposed in the four provinces, and their load forecasts were prepared by NEA as follows:

Table 4-9 Maximum Demand of Electric Cooperatives in Panay

Electric cooperative	No. of customers		Max. demand (kW)	
	First year	10th year	First year	10th year
Aklan	11,100	26,300	2,100	7,700
Antique	12,900	30,300	2,900	9,500
Capiz	8,600	22,400	2,100	8,600
Iloilo	10,400	20,000	3,200	8,600
Total	43,000	99,000	10,300	34,400

4-3-3 Negros

(1) Utilities

The two provinces of Negros, Negros Occidental and Negros Oriental, are in a distinct contrast; Negros Occidental presenting an animated appearance with the protected sugar industry while Negros Oriental being somewhat dull due to the limited area of agricultural land. Major utilities are A.S. Diaz Electric Service, Inc. and a branch of VECO supplying energy respectively to Bacolod City and Dumaguete City. Besides, there are 16 private utilities and 8 municipal utilities of which the largest installed capacity is 700 kW.

The power demand in Bacolod, 187 thousand in population in 1970, composes 80 percent of the Negros Occidental's total. However, due to an accident on a 3,000 kW diesel unit of Diaz Electric, the load has been limited during lighting hours since July 1972. An 8,000 kW diesel unit is in test run, and the present load limit is expected to be lifted in the near future.

Dumaguete City on the southeast of Negros Oriental had a population of 52 thousand in 1970. The VECO branch is serving 4,600 customers approximately with a total installed capacity of 3,400 kW. The maximum peak recorded in 1971 was 2,570 kW. The VECO's system in Dumaguete City is connected

to a hydro power plant, 800 kW in installed capacity, of NPC at Amlan by a 34.5 kV transmission line.

The energy production and energy sales by sector of Diaz Electric are shown in Table 4-10.

Table 4-10 Generated Energy and Consumption by Sector in 1971
A. S. Diaz Electric Service, Bacolod City, Negros

Installed capacity	14,370	kW
Max. demand	10,600	kW
Energy production	59,299	MWh

Sector	Energy sold (MWh)	No. of customer	Consumption per customer (kWh)
Residential	22,100	9,331	2,400
Commercial	9,900	1,597	6,200
Industrial	13,300	79	167,900
Flat-rate	300	340	900
Street lightings	1,200	62	19,700
Total	46,800	11,409	–

(2) Non-Utilities

In northern Negros are large sugar cane plantations which produce 65 percent of total sugar production in the Philippines. In the sugar cane fields, 15 sugar mills are in operation sporadically, and most of them are equipped with steam turbine generators that are using bagasse as fuel.

The total energy production of the 15 sugar mills was estimated to be 213 GWh, based on data made available by Central Azucarera de Bais and the total demand to be 30 MW. Bagasse being left over of sugar cane after juice has been taken out, the fuel cost is negligible at these power plants. Therefore, it is not expected for the sugar mills to be served by energy of utilities for sometime in the future.

Although data were not obtained, industrial power plants seem to be not existing except those of sugar mills in Negros.

(3) Electric Cooperative

Aside from V-M-C Rural Electric Service Cooperative, Inc. (VRESCO) which started operation in 1966, there are two electric cooperatives proposed

one each in two provinces.

Table 4-11 Electric Cooperatives in Negros

	VRESCO*	Negros Occidental		Negros Oriental	
		1st Year	10th Year	1st Year	10th Year
Installed capacity (kW)	5,200	6,000	15,000	4,500	10,500
Max. demand (kW)	2,500	3,930	11,650	2,510	8,560
Energy production (MWH)	5,968	9,063	46,151	5,779	33,882
No. of customers	1,292**	14,644	30,142	10,043	24,615

Note * Performance of VRESCO system in 1971

** 5,700 as of August 1972

4-3-4 Bohol

(1) Utilities

Different from the other islands described in the above, there is no power utility which has an installed capacity of over 10 MW in Bohol. In Tagbilaran City, the Capital of Bohol, power utility is run by the city purchasing power from Loboc Hydro Power Plant, 1,200 kW in installed capacity, of NPC. The peak load in Tagbilaran has been 915 kW since August 1972 due to the shortage in power supply capability, because, supplying to other utilities, such as, Loay, Alburquerque, Balcayon, etc. on the way to Tagbilaran, distributing about 50 kW to each, Loboc Hydro Power Plant does not have a capacity to increase supply to Tagbilaran. No connections have been made to new customers since August 1972. The population of Tagbilaran was 33 thousand in 1970. However, the area served by electricity is confined to the central part of the city, 2,940 in the number of customers served. In order to cope with the present situation, the city is going to install in early 1973 a 950 kW diesel driven unit which was previously owned and operated by NPC in Vigan City, Luzon. Aside from the utilities which are buying energy from NPC, there are only two private utilities, both with an installed capacity of less than 60 kW.

The purchase of energy and the energy sales by sector of Tagbilaran City in 1971 is as shown in Table 4-12.

(2) Non-Utilities

Although data were not made available, non-utility of a large scale is seen only at fish freezing plant in Tubigon.

Table 4-12 Purchased Energy and Consumption by Sector in 1971

Tagbilaran City, Bohol

Installed capacity	180*	kW
Max. demand	920	kW
Energy purchased	4,277	MWh

Sector	Energy sold (MWh)	No. of customer	Consumption per customer (kWh)
Residential	1,180	2,414	500
Commercial	1,291	515	2,500
Industrial	598	10	59,800
Street lighting	230	–	–
Total	3,299	2,939	–

Note * Out of service as of Dec. 1972

(3) Electric Cooperative

Along the west coast of Bohol, the establishment of a cooperative is on the way in order to supply energy to about 150 thousand people covering an area of about 65 thousand hectares. The definite design has been completed at the end of 1972, and four 750 kW diesel units are expected to arrive at from Okinawa in March, 1973. The load forecast prepared by NEA is shown below.

Year of operation	No. of customers	Demand (kW)
First year	10,600	2,350
Fifth year	16,500	5,130
Tenth year	24,600	8,580

4-3-5 Leyte

(1) Utilities

The island of Leyte was recently divided into two provinces, Leyte and Southern Leyte, the latter is somewhat retarded than the former in development. Major utilities are Tacloban Electric & Ice Plants Co., Inc. (TEIPCO) which is supplying power to Tacloban City and Ormoc Electric Company, Inc. extending services in and around Ormoc City. Other than the above two, there are 7 private utilities and 11 municipal utilities.

Tacloban City, a connecting point to Samar, was populated by 76.5 thousand

in 1970. As a part of Philippine-Japan Friendship Highway, a bridge is under construction to connect Leyte to Samar by the end of 1972. Power demand in Tacloban City comprises 72 percent of the island's total. The nominal installed capacity of Tacloban Electric & Ice Plants Co. is 4,200 kW. However, the actual output is around 2,500 kW due to lack of spare parts and frequent mechanical trouble; diesel units installed before 1957 comprising one quarter of the total installed capacity. On the other hand, peak demand in Tacloban amounts to 3,200 kW. Consequently, the load during peak lighting hours of 17:00 to 21:00 hours is restricted.

The total installed capacity of Ormoc Electric Company, Inc. is 1,000 kW against 2,070 customers. The energy production and energy sales by sector of Tacloban Electric in 1971 are shown in Table 4-13.

Table 4-13 Generated Energy and Consumption by Sector in 1971
Tacloban Electric Co., in Tacloban, Leyte

Installed capacity	4,200	kW
Max. demand	3,230	kW
Energy production	15,550	MWh

Sector	Energy sold (MWh)	No. of customer	Consumption per customer (kWh)
Residential	2,700	5,240	500
Commercial	3,100	1,230	2,500
Industrial	4,200	40	102,300
Street lightings	300	800	400
Others	100	290	200
Total	10,400	7,600	–

In order to lift the load restriction, Tacloban Electric & Ice Plants Co. is contemplating the installation of one 4 MW diesel unit in 1973.

(2) Non-Utilities

Data on industrial power plants were not obtainable, except those of INCO Mining Co., which, located 30 kilometers to the south of Tacloban City, is equipped with thirteen 200 kW diesel units for an annual magnetic sand production of 500 thousand tons. In view of the size of units, this company can be connected to a utility system in the future. No other information is available in connection with industrial power plant in Leyte.

(3) Electric Cooperative

Establishments of two electric cooperatives are making its head way.

One is in an area neighboring to the south of Tacloban with a proposed power plant site in Tolosa which is only 20 kilometers to Tacloban. The population in the cooperative area is about 200 thousand. The generator units have already been transported to the site for installation. The other cooperative is proposed in Southern Leyte covering 8 municipalities including Maasin, the capital, and a population of about 150 thousand. The load forecast prepared by NEA is as follows:

Year of operation	No. of customers		Demand (kW)	
	Leyte	Southern Leyte	Leyte*	Southern Leyte
First year	21,090	10,430	4,560	2,310
Fifth year	33,680	16,170	9,880	4,930
Tenth year	45,000	26,820	16,900	9,640

* estimated from energy production except for loads of INCO Mining and TEIPCO.

4-3-6 Samar

(1) Utilities

Samar which is almost the same as Negros in area was divided into three provinces in 1969. Statistics on Samar now on hand are mostly expressed on island basis. The natural conditions of the island, such as, narrow plain, hilly topography and frequenting typhoons are the holdback to the development. According to Provincial Profile, the agricultural products are only one third of those in Negros in value in 1960. Power utilities are also small. In Catbalogan, the largest municipality in Samar with a population of 49 thousand in 1970, the generating capacity is only 600 kW in total. The utility business of the town was transferred from the municipality to a private proprietor in July 1971. On this account, the past records were not obtainable. Table 4-14 gives the energy production and consumption in 1971.

(2) Non-Utilities

No data are available in connection with the industrial power plants. It is considered that there are no industries that should be taken into account in estimating the future load.

(3) Electric Cooperative

Although there are three provinces in Samar, cooperative is contemplated in Northern Samar only. Data on this cooperative were not obtained, but presumably, the design and scale are the same as other cooperatives in the Visayas.

Table 4-14 Generated Energy and Consumption per Customer
Catbalogan Electric Co., in Catbalogan, Samar

Installed capacity	600	kW
Max. demand	540	kW
Energy production	1,870	MWh

Sector	Energy sold (MWh)	No. of customer	Consumption per customer (kWh)
Residential, Commercial, Industrial	1,459	1,325	1,100
Street lightings	86	1	86,000
Total	1,545	1,326	–

(4) Philippine-Japan Friendship Highway

The Philippine-Japan Friendship Highway to connect Luzon with Mindanao is in part under construction in Samar and Leyte. The bridge accross the San Juanico Strait is near completion. When completed, the highway will give a great impact on the economy along the route. However, large in scale, requiring a huge amount of capital investment and labor force, the target date of completion which is presently set at 1975 will be deferred considerably. The construction work is still at the incipient stage. Therefore, in this report, the influence to be brought about by the highway was not considered.

Chapter 5 Basic Policy of Development

The Visayas consists of six major islands, in which the natural conditions, as well as, economic situations are largely variable from one island to another. Waters between the islands hinder the inter-island connection of power systems. Economy of scale is very hard to obtain. Yet, power demand on the islands are not large enough to justify the inter-island connections. For the time being, development of power industry should be contemplated on an intra-island basis. The prevailing conditions on the islands are not favorable to economical power development. Therefore, the power development program is required to be formulated in such a manner to eliminate all the possible uneconomical factors. For this purpose, a strategic approach was employed so as to comply with the government policy of nation wide electrification, as well as, to economize the development of power industry.

5-1 Strategy of Development

The followings are the strategy set up and recommended in developing power grids.

(1) Since inter-island connection of power grids will remain uneconomical for some time, the power development program has to be formulated independently

for the respective islands. The interconnection of islands will be contemplated separately when the demand of islands becomes large enough to economically justify the contruction of submarine cable.

(2) In accordance with the provisions of Presidential Decree No. 40 (See Appendix) dated November 1972, NPC will construct and operate central power plants and transmission lines to supply energy to electric cooperatives, private utilities and municipal utilities.

(3) Since NPC will not be engaged in power distribution, an island to be developed by NPC should have more than one major distribution network of either cooperatives or major utilities, or a combination of the two; any single network being small for the strategic establishment of NPC. An assignment to NPC is to interconnect these distribution networks with one another.

At the present time, one cooperative has been proposed in each province in principle. In the future, however, cooperatives are expected to be established successively in the Visayas, same as other regions, necessitating to revise the NPC's establishment program.

(4) Generating units will be centralized, and the grid will be expanded as the demand grows.

(5) Timing of strategic establishment of NPC on an island will not be before the prospected power sales revenue of NPC becomes on a par with the estimated running cost of NPC's establishment. In other words, NPC will not participate in power development of an island until demand of the island grows large enough to correspond to the fixed capital investment of NPC.

5-2 Strategic Considerations

Preparatory estimations for the strategy are as follows:

(1) To estimate power demand of respective cooperatives and major utilities for a period of 1973 to 1987.

(2) To estimate energy costs of NPC, cooperatives and major utilities.

(3) To determine the timing of NPC's establishment by comparing the NPC's energy cost with that of cooperatives and/or major utilities.

(4) To calculate fixed capital investment requirement of NPC including grid expansion up to 1987.

Table 5-1 Basic Figures of Various Power Plants

	NPC					Private utility	Cooperative
	Diesel			Steam		Diesel	Diesel
Plant capacity (MW)	6	10	20	70	100	10	7.5
Unit capacity x No. of unit (MW x No.)	3 x 2	5 x 2	10 x 2	35 x 2	50 x 2	5 x 2	1.5 x 5
Plant factor (%)	60	60	60	70	70	60	50
Annual energy production (million kWh)	31.5	52.6	105	429	614	52.6	32.9
Station service use (%)	3	3	2.5	7	7	3	3
Annual available energy (million kWh)	31	51	103	399	572	51	31.9
Thermal efficiency at sending end (%)	32	34	35	31	32	34	29
(BTU/kWh)	(10,720)	(10,120)	(9,840)	(11,100)	(10,760)	(10,120)	(11,840)
Annual fuel consumption (10^3 klit.)	8.3*	13.2*	25.6*	111.9	155.4	13.2*	10.5*
Unit construction cost (US$/kW)	210	195	190	210	195	232	250
Construction cost (thousand US$)	1,260	1,950	3,800	14,700	19,500	2,280	1,875
Foreign currency (%)	85	85	85	80	80	85	85
Domestic currency (%)	15	15	15	20	20	15	15
No. of persons for O&M	15	15	15	120	120	15	24
Service life	18	18	18	33	33	18	18

Note * : Lubricating oil is not included.

Table 5-2 Conditions for Energy Cost and Annual Cost Calculation of Power Plant

	NPC	Private utility	Cooperative
Interest Rate			
Foreign currency	3.5 %	12.0 %	2.0 %
Domestic	7.0 %	12.0 %	2.0 %
Import tax and duty	–	20 %	–
	(same conditions are applicable to all hereafter.)		
Depreciation			
Steam turbine	3.03%		
Diesel engine	5.55%		
Annual salary	US $ 1,200/person		
Rapair and maintenance cost	2 % of construction cost		
fixed cost	80 %		
variable cost	20 %		
Miscellaneous cost	0.2 % of construction cost		
Administration cost	8 % of operation and maintenance cost		
Fuel cost			
Bunker C	US $ 21.19/kiloliter.		
I. D. O.	US $ 30.75/kiloliter.		
Lubricating oil	US $ 320/metric ton		
Consumption per kWh	2g/kWh		

Table 5-3 Annual Cost and Energy Cost at Sending end

	NPC					Private utility	Cooperative
	Diesel			Steam		Diesel	Diesel
Plant cap. (MW)	6	10	20	70	100	10	7.5
Unit cap. x No. of unit (MW x No.)	3 x 2	5 x 2	10 x 2	35 x 2	50 x 2	5 x 2	1.5 x 5
Annual available energy (GWh)	31	51	103	399	572	51	31.9
Annual cost							
Fixed cost (US $ 1,000)	164	243	459	1,496	1,935	516	209
Variable cost (US $ 1,000)	203	318	627	2,441	3,386	318	354
Total (US $ 1,000)	367	561	1,086	3,937	5,321	834	563
Energy cost at sending end							
Fixed cost ($/kW)	27.30	24.30	22.95	21.37	19.35	51.60	27.87
Variable cost (mill/kWh)	6.64	6.24	6.09	6.12	5.92	6.24	11.10
Total (mill/kWh)	12.00	11.00	10.54	9.87	9.30	16.40	17.65

Table 5-4 Transmission and Distribution Facilities Unit Cost

(in thousand US dollars)

Item		FC	DC	Total
Transmission line*				
115 kV 336.4 MCM	single circuit per km.	3.7	5.8	9.5
69 kV 226.8 MCM	double " "	3.8	5.85	9.65
69 kV 226.8 MCM	single " "	2.4	4.65	7.05
13.8 kV 2/0 AWG	single " "	0.85	1.97	2.82
Substation**				
115 kV/69 kV	30 MVA Transformer	236	24	260
115 kV/69 kV	20 MVA "	131	13	144
115 kV/13.8 kV	10 MVA "	104	10	114
"	5 MVA "	71	7	78
69 kV/13.8 kV	10 MVA "	101	10	111
"	5 MVA "	68	7	75
115 kV line terminal		44	6	50
69 kV line terminal		41	6	47
13.8 kV "		5.4	0.6	6

Note: * All structures are of wood poles

** Construction cost of substation includes all necessary equipment and materials.

Table 5-5 Rate of Annual Cost for Transmission and Substation Facilities

	Interest	Depreciation	O & M	Total
Transmission line	5.81	3.33	3.0	12.14
Substation	3.85	3.33	2.5	9.68

5-3 Energy Cost of Utilities

5-3-1 Energy Cost of NPC

(1) Scale of NPC's First Establishment

The generating units to be installed first was assumed to be two 3 MW units on Bohol and Samar and two 5 MW units on the other islands in consideration of the sizes of demands on the respective islands. The transmission lines were first assumed to be 69 kV and 13.8 kV in view of the sizes of demands and with the purpose to determine the timing of NPC's establishment on each island. However, it has been concluded after detailed studies on the transmission voltage which are described in Chapter 6 that the transmission voltage of 69 kV should be raised to 115 kV on Panay and Negros.

(2) Energy Cost

The energy cost at receiving end of the 69 kV transmission line is shown in Fig. 5-1 for each island. In constructing a power plant, NPC is enjoying privileges of tax exemption and use of soft loans endorsed by the Government. Therefore, energy produced by NPC will be less expensive than those of utilities and cooperatives, and often times, the energy cost at receiving end of 69 kV transmission line which NPC will construct will be lower, depending upon the transmission distance and quantity of energy sale, than the energy cost of utilities or cooperatives.

5-3-2 Energy Cost of Cooperative

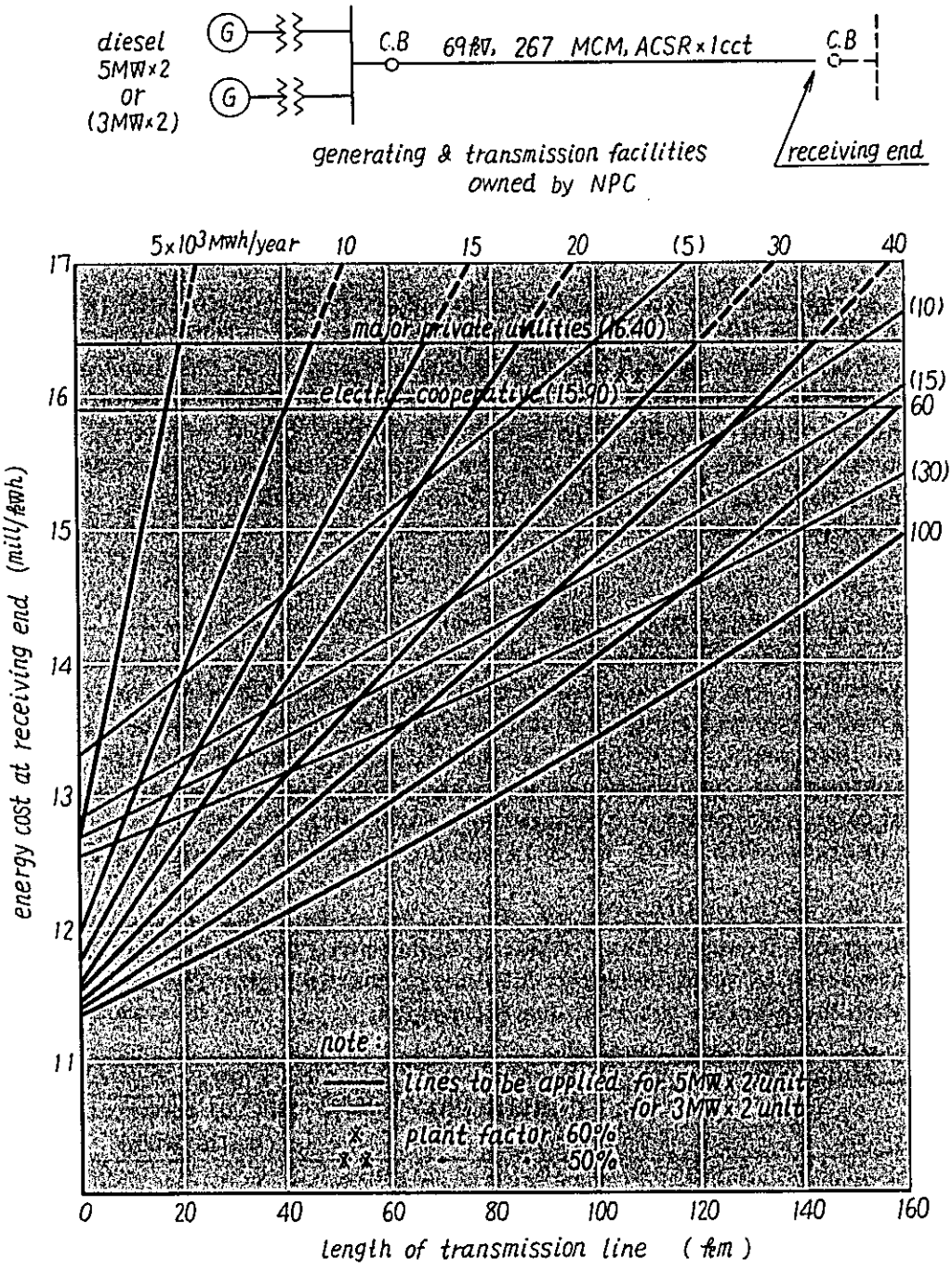
Cooperatives are privileged with funds of very soft loans. Besides, the generating units they are going to install are, according to their schedule, all 1,500 kW or less, and some of them are second hand units. Therefore, fixed capital investment of cooperatives is estimated very small, while annual cost is expected to go high because a generating unit of such a small capacity will have to be operated with I.D.O. which is much expensive as compared with Bunker C oil.

In the grids of cooperatives, lighting demand will be predominant and the plant factors are low. Consequently, the energy cost is high. The energy cost will vary with the plant factor as in the followings.

Plant factor (%)	Energy cost (mills/kWh)	Energy cost of NPC to cooperative (mills/kWh)
20	27.5	24.8
30	22.0	19.8
40	19.3	17.4
50	17.6	15.9

The above tendency is graphically shown in Fig. 5-2.

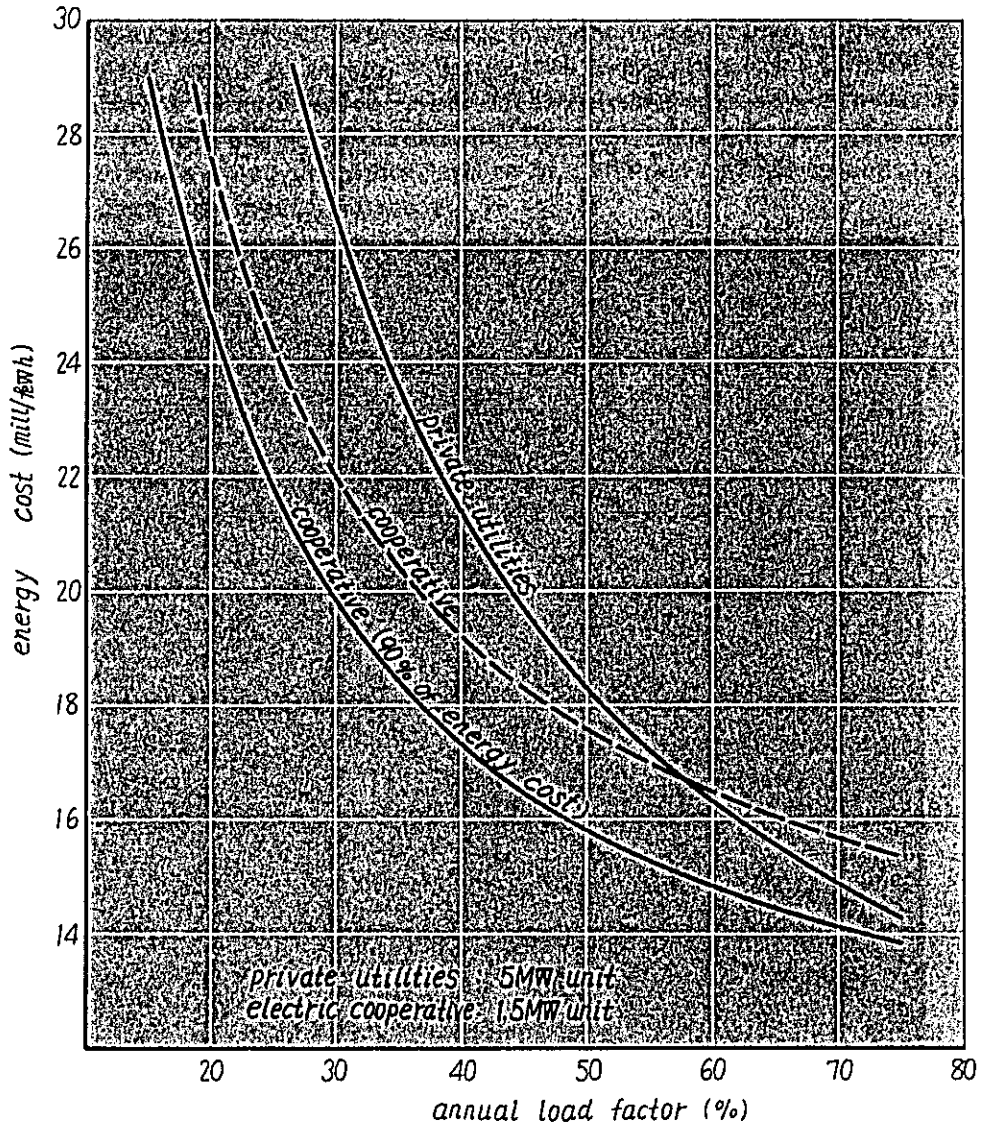
Fig. 5-1 Relation between Length of Transmission Line (69 kV x 1 cct.) and Energy Cost at Receiving End



5-3-3 Energy Cost of Private Utility

Private utilities are subject to import taxes of about 20 percent on the average of C.I.F. price and to property tax and educational tax of which total is about 3 percent of assets. Besides, private utilities are not in a position to be furnished with soft loans. Therefore, the energy cost of private utilities is higher than that of NPC by about 50 percent as shown in Table 5-3.

Fig. 5-2 Energy Cost of Private Utilities and Electric Cooperatives

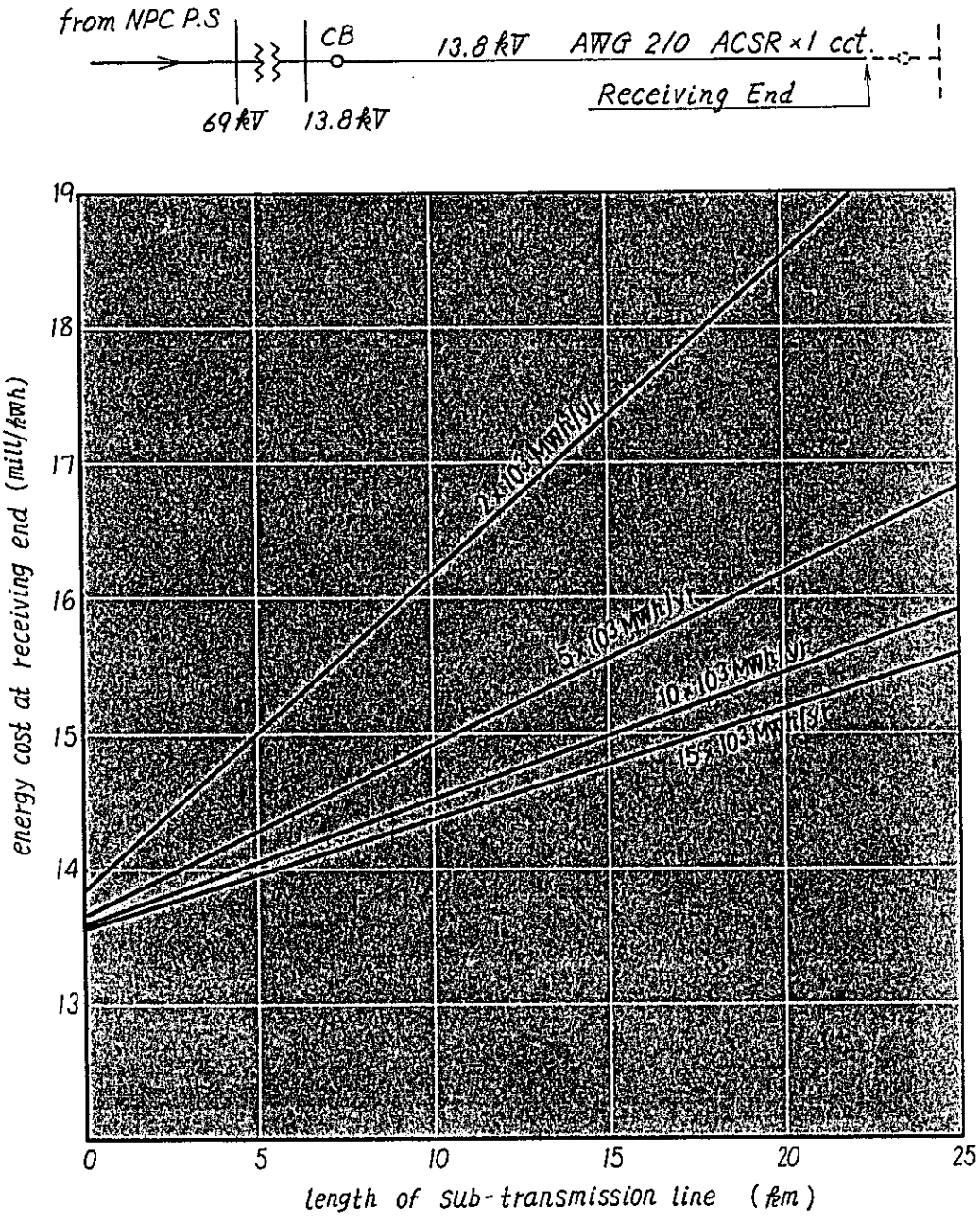


5-3-4 Method of Energy Cost Estimate

The conditions upon which energy cost was estimated are enumerated in Tables 5-1 through 5-5. The unit construction costs herein adopted were estima-

ted based on international bids. Service lives and depreciation periods are in accordance with the rules of NPC. Interest rates were set at what are available to the respective utilities and cooperatives today. The fuel cost was assumed to be the averaged price of Bunker C oil at which government agencies in Panay and Negros were purchasing in bulk in December 1972. The other figures and values were determined at an empirical discretion.

Fig. 5-3 Relation between Length of Sub-transmission Line (13.8 kV) and Energy Cost at Receiving End



5-4 Timing of NPC's Establishment

The timing of NPC's insular establishment was determined with use of charts shown in figures 5-1 through 5-3. The chart in Fig. 5-1 represents the energy cost at receiving end inclusive of transmission line only of a power plant with two 5 MW diesel units and two 3 MW diesel units with parameters of transmission distance and energy production. This chart gives an even point in the prospected energy costs of NPC, private utility and cooperative. The energy cost of cooperative drawn on the chart is 90 percent of the estimated cost. This even point will determine when NPC should establish its own plant and transmission line.

The insular strategy of NPC's establishment is described in the foregoing. On the other hand, areas to be embraced by the NPC grid were assumed to be electrified as much as economically practicable, contemporary with the establishment of NPC. A 13.8 KV subtransmission line, for instance, was assumed to pick up all the loads along the route, and to be extended to pick up nearby loads as long as it does not impair economy.

The insular strategy was applied to the respective islands taking into account their peculiar local conditions, i.e., existing system, load forecast of cooperative, place for NPC power plant, scale of grid, etc., with the results described in Chapter 6.

However, the strategy was not applied to Cebu where demand is far larger than the other islands, and therefore studied separately.

Chapter 6 Development Plan on Each Island

6-1 Cebu (Excerpt from Volume II)

6-1-1 Load Forecast

Most of the electric energy in Cebu is being produced by VECO. However, the size of its single system justifies the establishment of NPC on the island. The future load was forecasted on the assumption that the transmission lines will cover the entire island when the power plant of NPC is completed. Therefore, the whole island was considered in projecting the future demand.

Two approaches were employed in estimating the future demand in Cebu in the years of 1973 to 1990. One was macroscopic approach projecting the growth of energy consumption in relation to the development of national economy forecasted as a target in the Four Year Development Plan FY 1972-75; and the other was an analytical method which is based on detailed information of the present situation of sectorial as well as areal electricity demand.

The macro forecast was established based on the relation between per capita GDP's and per capita electricity productions of countries of the world. Based on the macro forecast, the future power demand of Cebu was projected

up to 1990. The projection gives an annual growth rate of 14 percent on the average up to 1980 and thereafter at 12 percent.

In the analytical method, Cebu was divided into two: one is Metropolitan Cebu and the other Rural Area. In the former, the future demand was estimated according to the sectors and based on the past growth of demand. The past records are shown in Table 6-1 together with the future projection.

Table 6-1 Figures Used for Load Forecast on VECO System

		1971	Past trend Rate of Growth '62- '69	Past trend Rate of Growth '62- '71	Forecast Rate of Growth '72- '80	Forecast Rate of Growth '81- '90
			%	%	%	%
(1)	No. of Customers	36,165	7.8	7.4	7.0	7.0
	Commercial	5,195	7.3	6.7	6.5	6.5
	Industrial	411	6.4	6.0	6.0	6.0
	Flat-rate	2,496	3.8	3.8	–	–
	Street lightings	16	8.1	8.1	7.0	7.0
	Gov't buildings	248	4.1	4.1		
(2)	Consumption per customer	(kWh)	%	%	%	%
	Residential	1,122	9.0	8.2	8.0	6.0
	Commercial	6,513	10.3	10.1	10.0	7.0
	Industrial	161,176	12.8	10.4	10.5	7.5
	Flat-rate	360	6.3	6.3	–	–
	Street lighting	106,844	0	0	0	0
	Gov't. buildings	16,817	5.7	10.9		

Studies by analytical method were performed on the assumption that the present electrification ratio of 5 percent in rural Cebu should be raised, in compliance with the target of electrification program of the government, to be the current electrification ratio of about 42 percent in Metropolitan Cebu, with the result shown in Table 6-2.

Table 6-2 Load Forecast of Cebu Power Grid

Year	Peak demand (MW)	Energy requirement (GWh)	Annual load factor (%)
1972	47.2	240.4	58.3
1974	63.1	316.7	57.5
1976	84.1	420.7	57.0
1978	110.8	554.7	57.0
1980	145.8	732.0	57.1
1985	272.9	1,380.6	57.8
1990	510.1	2,608.3	58.2
Growth rate (%)			
1972 - 1980	15.2	14.9	
1981 - 1990	14.2	14.2	

The forecast established in the study predicts that the electricity demand will grow at an annual rate of 15 percent till 1980 and thereafter at 14 percent up to 1990. In 1980, the load forecast is 146 MW in peak demand and 732 million kWh in annual energy production requirement which are over four times of 1970. In 1985, these figures will further increase to 273 MW and 1,380 million kWh.

6-1-2 Power Development Program

The power supply requirements obtained from the forecasted demand will increase by 125 MW by 1980 and by 260 MW by 1985, both including 10 percent reserve and after retirement of old facilities. It will be in 1974 that the demand in Metropolitan Cebu will exceed the power supply capability of VECO. However, it is virtually impossible to install generating facilities by 1974, therefore, the development program was formulated for the period of 1976 to 1987.

Five alternative plans were prepared all satisfying the requirement of the system, in order to arrive at the best combination of these generations. The sizes of generator units are 10 MW diesel units, 25 MW gas turbine units and 50 MW and 75 MW steam turbine units.

By any means, a steam turbine generator will not be able to be put in operation before 1978. Therefore, the combinations were confined to those of steam

turbine units with either diesel units or gas turbine units. The diesel and gas turbine units were considered to supplement the shortage in power supply capability in 1976 and 1977.

It is the conclusion arrived at in this report that the combination of 25 MW gas turbine generators and 50 MW and 75 MW steam turbine generators is the most effective from the economical as well as technical point of view. (See Fig. 6-1).

6-1-3 Transmission Lines and Substations

The proposed grid is shown in Fig. 6-2. The reliability of the grid is high in Metropolitan Cebu, the load center, and somewhat low in the rural areas where island wide electrification and economical power supply are the primary purposes.

Double circuit 115 kV line will be constructed to connect the thermal power plant with VECO system, while single circuit 69 kV lines will be extended into rural area. The lengths of transmission lines to be constructed by 1978 are 13 kilometers of double circuit 115 kV line, 265 kilometers of single circuit 69 kV lines and 250 kilometers of 13.8 kV lines. Seven 69 kV/13.8 kV substations, 35 MVA in total capacity, will be built.

In line with the operation of the second 50 MW steam turbine in 1980, the connection to VECO will be reinforced by adding a 115 kV line in order to increase transmission capacity and system reliability. To meet the load increase both in Toledo and Bogo areas, a 5 MVA transformer will be installed in each substation in 1985. Further, in 1986, a 230 kV transmission line will be constructed between Cebu City, the load center, and a power plant to be constructed to the south of Cebu City.

And the connections will also be made between the power plant and Sibonga and Toledo by a 69 kV line to lessen power flow on the 69 kV line from Naga to Liloan.

In Cebu, a total generating capacity of 375 MW will be installed together with the transmission lines by 1987 aiming at the electrification of entire Cebu. By the implementation of the project, the rural inhabitants will be served by electricity at a rate similar to that of Metropolitan Cebu, at the same time, VECO, the largest utility in Cebu, will be able to save the investment on generating facilities, thereby to expand and reinforce the distribution network with such savings.

6-1-4 Per Capita Consumption and Electrification Ratio

Population on Cebu is estimated to be about 2.3 million in 1987. Per capita energy consumption of 109 kWh in 1970 will grow to 360 kWh in 1980 and 770 kWh in 1987. Cebu power grid which will be completed in 1978 and distribution lines

into rural area will serve to heighten the electrification ratio of 19 percent in 1970 to 38 percent and 54 percent respectively in 1980 and 1987.

Fig. 6-1 Development Program in Cebu

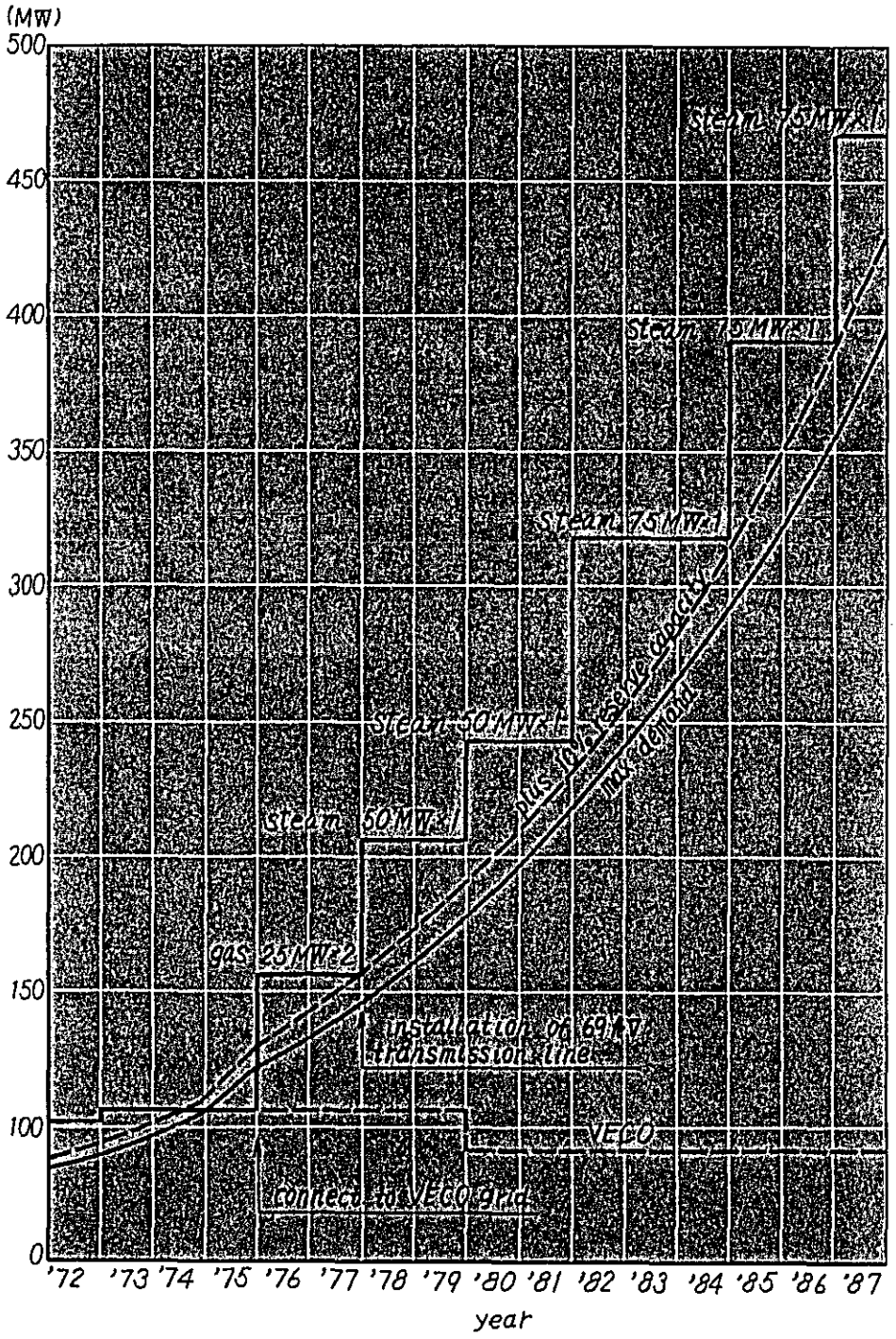
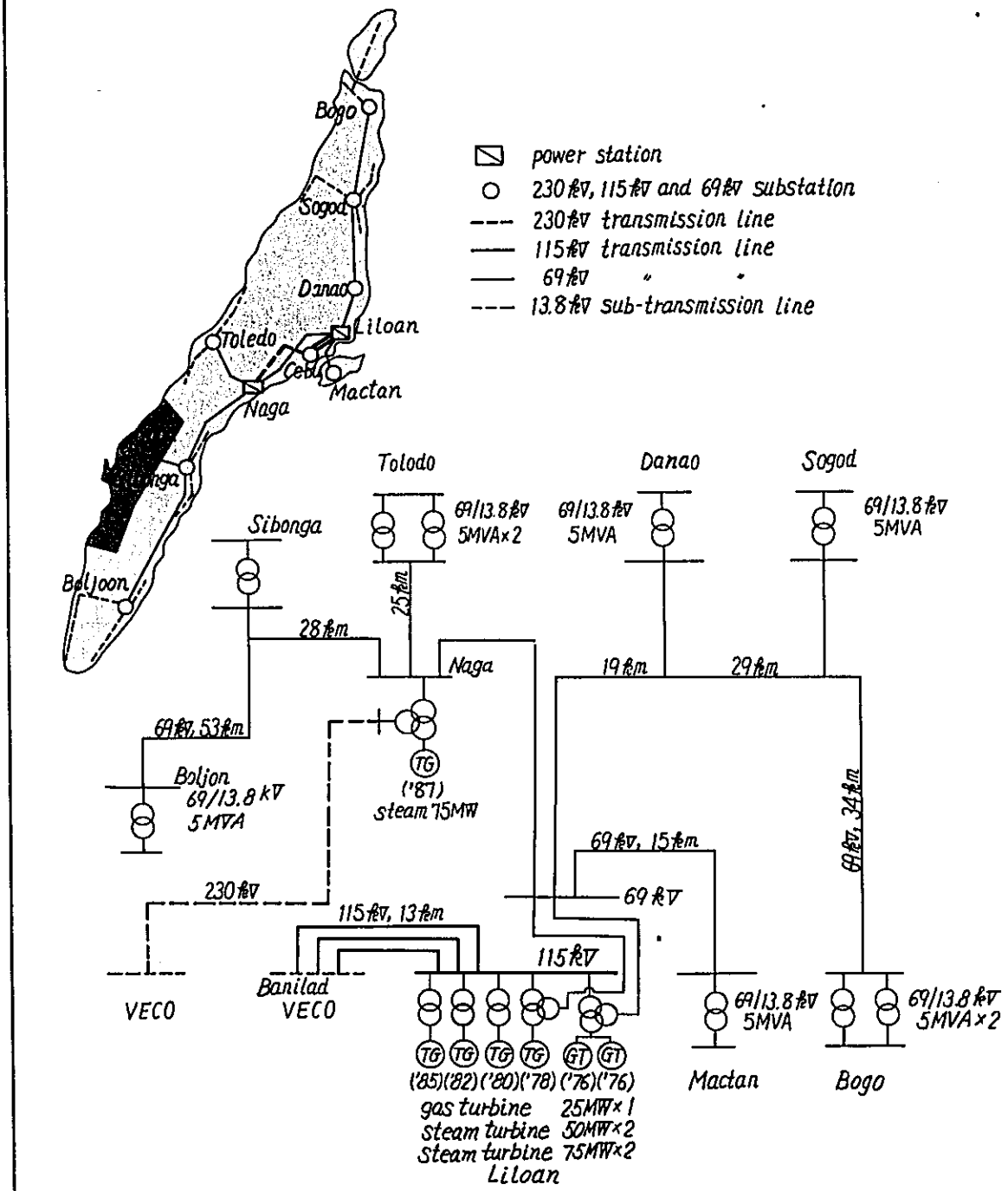


Fig. 6-2 Cebu Grid in 1987



6-2 Panay

6-2-1 Load Forecast

In projecting the future demand of electricity, the island was divided into 3 areas; one is civic area of Iloilo and Roxas where concentration of power demand is seen, and next is the area covered by electric cooperatives proposed one each in Iloilo, Antique, Aklan and Capiz provinces. The last is the remaining part of the island. Estimate of demand or potential demand is shown in Table 6-3.

In Iloilo City, which is the franchise area of PECO, power demand was projected based on the past records of PECO to grow at an annual rate of 9.3 percent with a load factor of 60 percent. (See Fig. 6-3) In Roxas, where power demand is suppressed due to shortage in power supply capability, a hypothetical assumption was set up. That is to say, the city will be served with sufficient energy from 1974. Then, the load would start increasing rapidly. It was assumed, taking into account the unserved population which is quite large today in the city, that the load will be doubled in three years and tripled within 6 years after 1974, then the increase will slow down to 9 percent in annual increase rate. Demand in the cooperative areas was taken from the schedule prepared by NEA. The cooperatives will become operational in 1974.

Fig. 6-3 Load Forecast for PECO

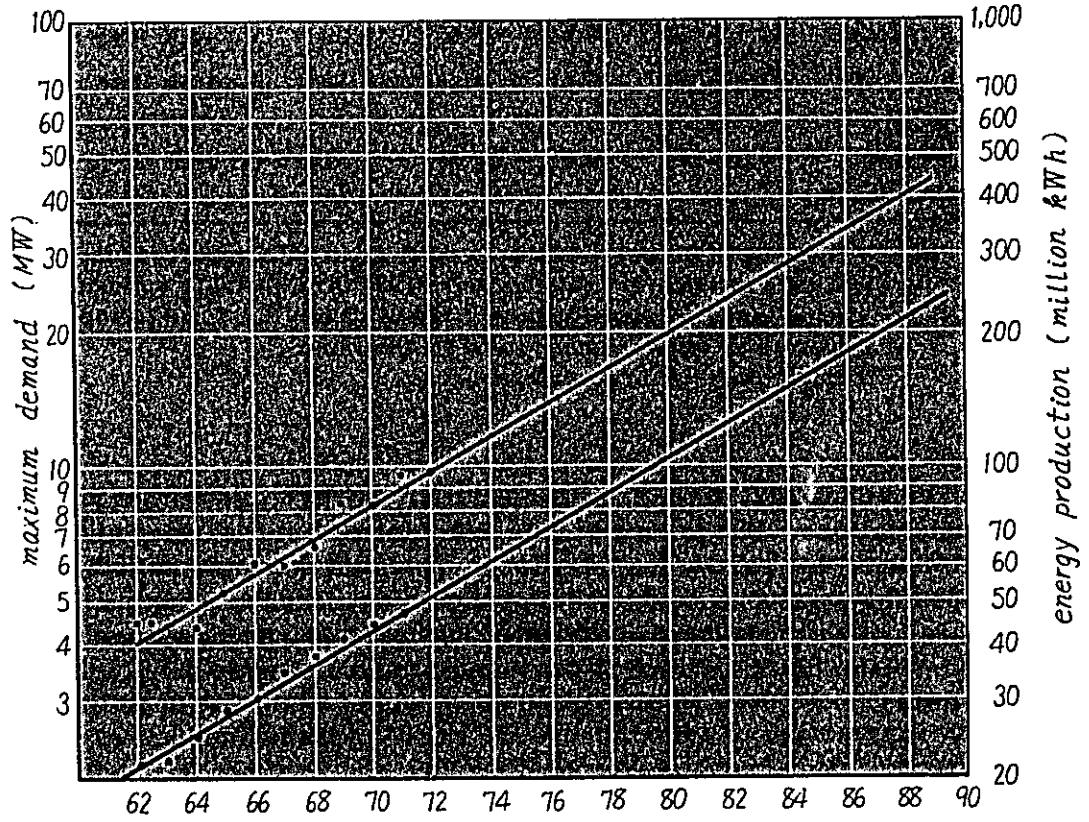


Table 6-3 Load Forecast in Panay

Year		PECO			Roxas Electric			Iloilo		
		Energy (GWh)	LF (%)	Demand (MW)	Energy (GWh)	LF (%)	Demand (MW)	Energy (GWh)	LF (%)	Demand (MW)
1	1972	52.0	60	9.9	4.2	40	1.2	–	–	–
2	73	56.9	60	10.8	4.2	40	1.2	–	–	–
3	74	62.2	60	11.8	5.5	41	1.5	7.4	27	3.2
4	75	67.9	60	12.9	7.1	42	1.9	9.8	28	4.0
5	76	74.3	60	14.1	8.5	43	2.3	12.6	30	4.8
6	77	81.2	60	15.4	10.2	44	2.6	15.3	32	5.6
7	78	88.7	60	16.9	11.2	46	2.8	18.2	33	6.3
8	79	97.0	60	18.5	12.4	48	2.9	20.8	36	6.7
9	80	106.0	60	20.2	13.5	50	3.1	23.8	38	7.2
10	81	115.8	60	22.0	14.7	52	3.2	26.8	41	7.6
11	82	126.6	60	24.1	16.0	53	3.4	30.3	43	8.1
12	83	138.4	60	26.3	17.5	54	3.7	34.1	46	8.6
13	84	151.2	60	28.8	19.0	55	3.9	38.2	46	9.5
14	85	165.3	60	31.4	20.1	55	4.3	42.4	46	10.6
15	86	180.7	60	34.4	22.6	55	4.7	46.6	46	11.6
16	87	197.5	60	37.6	24.6	55	5.1	50.8	46	12.7
Annual Increase rate (%)		9.3	–	9.3	12.5	–	10.2	16.0	–	11.2

Note: *Forecast of cooperatives were taken from NEA report for the years of 1974 to 1983, and for the years 1984 through 1987, estimate was made based on annual growth rates of 12 to 9 %. Load factors of co-operatives were assumed to be all the same.
**except cities and cooperative areas

In the remaining part of the island, electricity is served in the limited areas of municipalities. Due to lack of data and information regarding electric power generation in this part of the island, only potential demand was estimated. However, when they are connected to NPC grid, large demand is possible to sprout, depending on expansion of distribution networks of municipalities. In this report, municipalities' demand is considered to be picked up only in the vicinity of Iloilo City.

Electric cooperatives *						Total			Other area ** potential (MWh)
Antique		Aklan		Capiz					
Energy (GWh)	Demand (MW)	Energy (GWh)	Demand (MW)	Energy (GWh)	Demand (MW)	Energy (GWh)	LF (%)	Demand (MW)	
–	–	–	–	–	–	56.2	58	11.1	107
–	–	–	–	–	–	61.1	"	12.0	115
6.6	2.0	4.8	2.1	4.9	2.1	91.4	44	23.6	143
8.9	3.6	6.5	2.7	7.7	3.1	103.4	42	28.2	138
11.3	4.3	8.4	3.3	10.7	4.1	125.8	44	32.9	150
14.2	5.2	10.7	3.9	13.9	5.1	145.5	"	37.8	163
17.5	6.1	13.0	4.5	17.1	5.9	165.7	45	42.5	178
20.7	6.7	15.9	5.1	19.8	6.3	186.6	46	46.2	194
24.2	7.3	18.7	5.7	23.1	6.9	209.3	47	50.4	211
28.5	8.1	21.9	6.2	26.3	7.4	234.0	49	54.5	229
33.2	8.9	26.7	7.1	30.0	8.0	262.8	50	59.6	249
37.8	9.5	30.5	7.7	34.2	8.6	292.5	52	64.4	271
42.3	10.5	34.2	8.5	38.3	9.5	323.2	"	70.7	295
47.0	11.7	37.9	9.4	42.5	10.6	355.8	"	78.0	321
51.7	12.9	41.7	10.4	46.8	11.7	390.1	"	85.7	350
56.3	14.0	45.5	11.3	51.0	12.7	425.7	"	93.4	379
17.9	12.9	18.9	13.8	19.8	14.9	14.4	–	15.3	8.8

6-2-2 Power Supply Program

(1) Supply Area

The major distribution networks that can be connected to NPC's grid will be those of PECO, Roxas Electric and the four electric cooperatives. Besides, there will be minor distribution systems that can be connected at the time of or after the establishment of NPC's grid contributing to the electrification of entire island. In Iloilo province of which population comprises approximately 60 percent of the island's total, there is a densely populated but less electri-

fied district, and as much as about 70 percent of the less electrified population of the island is in this district in Iloilo. Therefore, a special consideration was given to electrify this district.

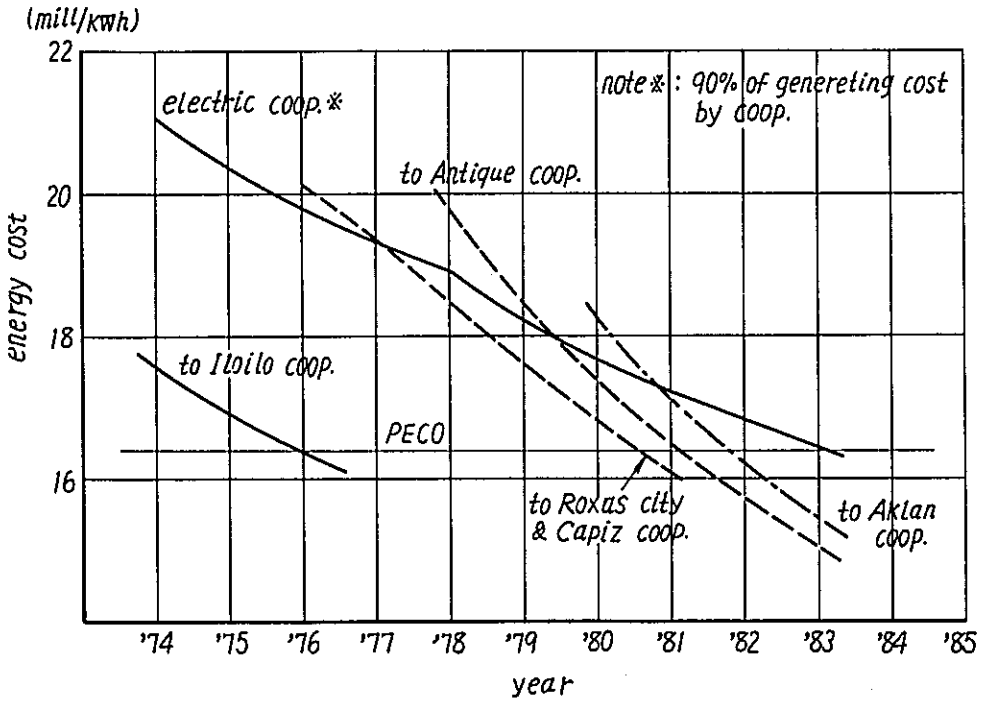
(2) Grid Structure and Timing of Power Supply

The first facilities of NPC are planned to be established at a place near Iloilo City, the load center of the island, to supply power to PECO, the electric cooperatives and unelectrified areas. In view of the size and distribution of demand, it is thought advantageous from the standpoint of transmission loss and grid reliability to add power plant at a place close to Roxas City. With the insular strategy applied to Panay, the timing of power supply from the power plant near Iloilo City to PECO and the cooperatives were studied with the results as shown in Fig. 6-4 and the table below.

	Calculated	Adjusted
To PECO	1974	1977
To Coop. in Iloilo	1974	1977
To Coop. in Antique	1980	1980
To Coop. in Capiz and Roxas City	1978 - 81	1980
To Coop. in Aklan	1981	1980

The year of 1974 is too soon to start power supply in consideration of the time required for financing and construction. Therefore, the start of power

Fig. 6-4 Energy Cost at Receiving End



supply to PECO and the cooperative in Iloilo was postponed till 1977. The extension of transmission lines to the cooperatives in Antique, Aklan and Capiz and Roxas City will be made, as stated later, in line with the operation of a 35 MW steam turbine in 1980.

(3) Generating Facilities

Concurrent with the power supply to the major distribution networks, 13.8 kV sub-transmission lines will be constructed to connect the municipalities around Iloilo City, so that the load of NPC grid will include those in the municipalities. The load forecast is shown in Fig. 6-5 and Table 6-4. Power supply to

Fig. 6-5 Development Program in Panay

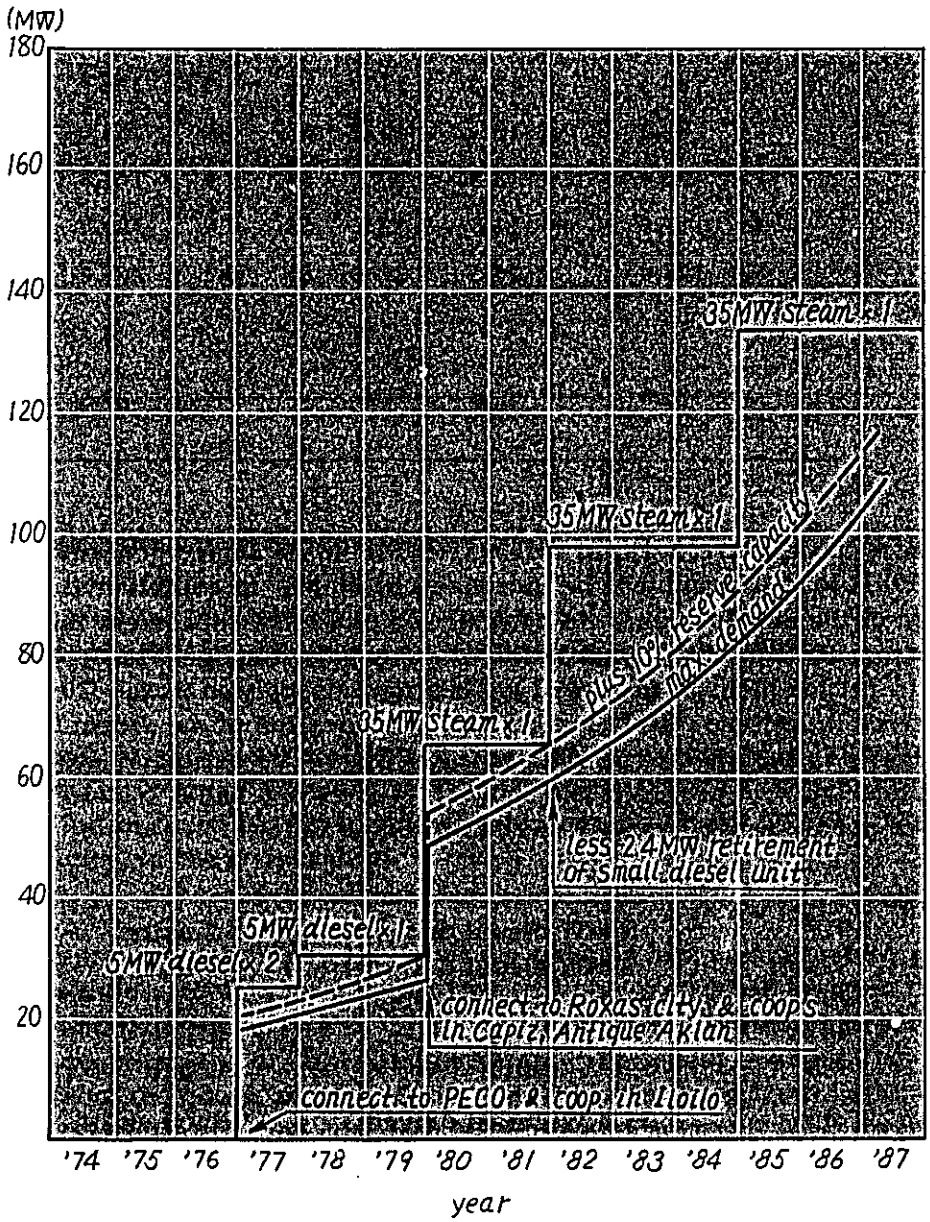


Table 6-4 Load Pick-up Forecast in Panay

	NPC supply								
	PECO			Roxas			Cooperatives		
	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
1977	12.3	60	2.3	–	–	–	15.3	32	5.6
78	19.8	"	3.8	–	–	–	18.2	33	6.3
79	28.1	"	5.4	–	–	–	20.8	36	6.7
80	37.1	"	7.1	13.5	51	3.1	89.8	38	27.1
81	46.9	"	8.9	14.7	52	3.2	103.5	41	29.3
82	57.7	"	11.0	16.0	53	3.4	120.2	43	32.1
83	69.5	"	13.2	17.5	54	3.7	136.6	46	34.4
84	82.3	"	15.7	19.0	55	3.9	153.0	46	38.0
85	96.4	"	18.3	20.7	55	4.3	169.8	46	42.3
86	111.8	"	21.3	22.6	55	4.7	186.8	46	46.6
87	128.6	"	24.5	24.6	55	5.1	203.6	46	50.7
Increase (%)	26.6	–	26.6	8.9	–	7.4	29.5	–	24.6

PECO and a cooperative in Iloilo will start with diesel engine generators. From 1979 to 1981, load demand will be increased by 30 MW in compliance with the expansion of the supply areas. In anticipation of 90 MW increment in load demand from 1979 to 1987, installation of a steam turbine generator was programed in 1980, which, in turn, will enable power supply to Roxas City and the cooperatives in Antique, Capiz and Aklan. The location of the steam turbine power plant was assumed to be near to Iloilo City. The estimated load of NPC grid and development program are shown in Tables 6-5 and 6-6 and Fig. 6-5. The power supply capability will be reinforced as follows:

1977	5 MW diesel driven	2 units
1978	5 MW diesel driven	1 unit
1980	35 MW steam turbine	1 unit
1982	ditto	1 unit
1985	ditto	1 unit
Total	15 MW diesel driven	by 3 units
	105 MW steam turbine	by 3 units

NPC supply						PECO Supply			Total in Panay Grid		
Other areas			Subtotal								
Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
2.1	24	1.0	29.7	38	8.9	68.9	60	13.1	98.6	51	22.0
2.3	24	1.1	40.3	41	11.2	"	"	"	109.2	51	24.3
5.0	26	2.2	53.9	43	14.3	"	"	"	122.8	51	27.4
9.8	27	4.2	150.2	41	41.5	"	"	"	219.1	46	54.6
11.9	28	4.9	177.0	44	46.3	"	"	"	245.9	47	59.4
17.1	29	7.1	211.8	45	53.6	"	"	"	280.7	48	66.7
24.9	29	9.7	248.5	47	61.0	"	"	"	317.4	49	74.1
32.9	30	12.4	287.2	47	70.0	"	"	"	356.1	49	83.1
42.2	31	15.5	329.1	47	80.4	"	"	"	398.0	49	93.5
53.1	32	19.0	374.3	47	91.6	"	"	"	443.2	49	104.7
65.1	33	22.6	421.9	47	102.9	"	"	"	490.8	49	116.0
41.0	–	36.6	30.4	–	27.7	–	–	–	7.4	–	18.1

(4) Transmission Lines and Substations

In line with the power supply program stated in the foregoing, the transmission networks will be expanded as described in the followings:

1977

Concomitant with the installation of the first two units near Iloilo City, 69 kV single circuit transmission lines will be constructed to connect to the cooperative in Iloilo and PECO, together with a substation, 69 kV/13.8 kV, 10 MVA in capacity, in the cooperative.

1980

Concomitant with the installation of the first 35 MW steam turbine generator, 115 kV single circuit transmission line will be constructed between the power plant and the cooperative in Capiz. A 69 kV line will also be erected between the cooperatives in Capiz and in Aklan. The length is about 110 kilometers from the power plant to Capiz, and 80 kilometers from Capiz to Aklan. The transmission line connecting Iloilo with Capiz will form an important trunk line running from south to north in the island. Its transmitting capacity should be big enough to carry the power flow of 30 to 40 MW anticipated

in 1987. It is thought advantageous to select 115 kV for the line voltage in view of transmission capacity and reliability. A substation, 115 kV/69kV/13.8 kV, 30 MVA will be built in the cooperative in Capiz to supply power to the cooperative as well as to Roxas City through two feeders of 13.8 kV lines. The substation in Aklan will be 69 kV/13.8 kV, 10 MVA in capacity.

On the way from Iloilo to Capiz, a substation, 115 kV/13.8 kV, 5 MVA, will be built at a place near Pototan in order to supply power to the less electrified area in Iloilo through three feeders of 13.8 kV lines, about 100 kilometers in total length.

A 69 kV single circuit transmission line, about 80 kilometers in length, will be constructed from the substation in the cooperative in Iloilo to the cooperative in Antique. At the receiving end in Antique, a substation, 69 kV/13.8 kV, 10 MVA x 2, will be built in the cooperative.

From the Iloilo cooperative, 13.8 kV feeders will be extended to Guimbal and Mingaro, the unelectrified areas to the west of Iloilo City.

By this year, a grid will be constituted by 115 kV and 69 kV transmission

Table 6-5 Transmission Expansion Program

Transmission line	Voltage (kV)	Length (km)	Date in service
P. P* - PECO	69	10	1977
P. P - Iloilo coop. **	69	10	1977
P.P - Pototan	115	30	1980
Pototan - Capiz coop.	115	80	1980
Capiz Coop. - Aklan coop.	69	80	1980
Iloilo coop. - Antique coop.	69	80	1980
P.P - Iloilo coop.	69	10	1984
P.P - PECO	69	10	1986
P.P - Rural Iloilo	13.8	20	1977
Iloilo coop. - Rural Iloilo	13.8	30	1980
Pototan - Rural Iloilo	13.8	100	1980
Capiz coop. - Roxas City	13.8	30	1980
Capiz coop. - Rural Capiz & Iloilo	13.8	20	1980
Total		510	

Note: * power plant
** electric cooperative

lines, respectively 110 and 180 kilometers in total length, five substations, 80 MVA in total capacity and a power plant accomodating a 35 MW steam turbine generator.

1983

A 10 MVA transformer will be added at the cooperative substation in Iloilo.

1984

In order to eliminate heavy loading due to increase in demand of the cooperatives in Iloilo and Antique, a 69 kV single circuit will be added between the power plant and the Iloilo cooperative. At the cooperative substation in Aklan, a 10 MVA transformer will be added to meet the load increase in the cooperative.

1986

To meet the load increase in PECO's system, another 69 kV single circuit line will be constructed.

During the eleven years from 1977 to 1987, 115 kV and 69 kV transmission lines will be constructed for a total distance of 110 and 200 kilometers respectively and 13.8 kV sub-transmission lines for a total of 200 kilometers. The total capacity of five substations will amount to 100 MVA. (See Fig. 6-6)

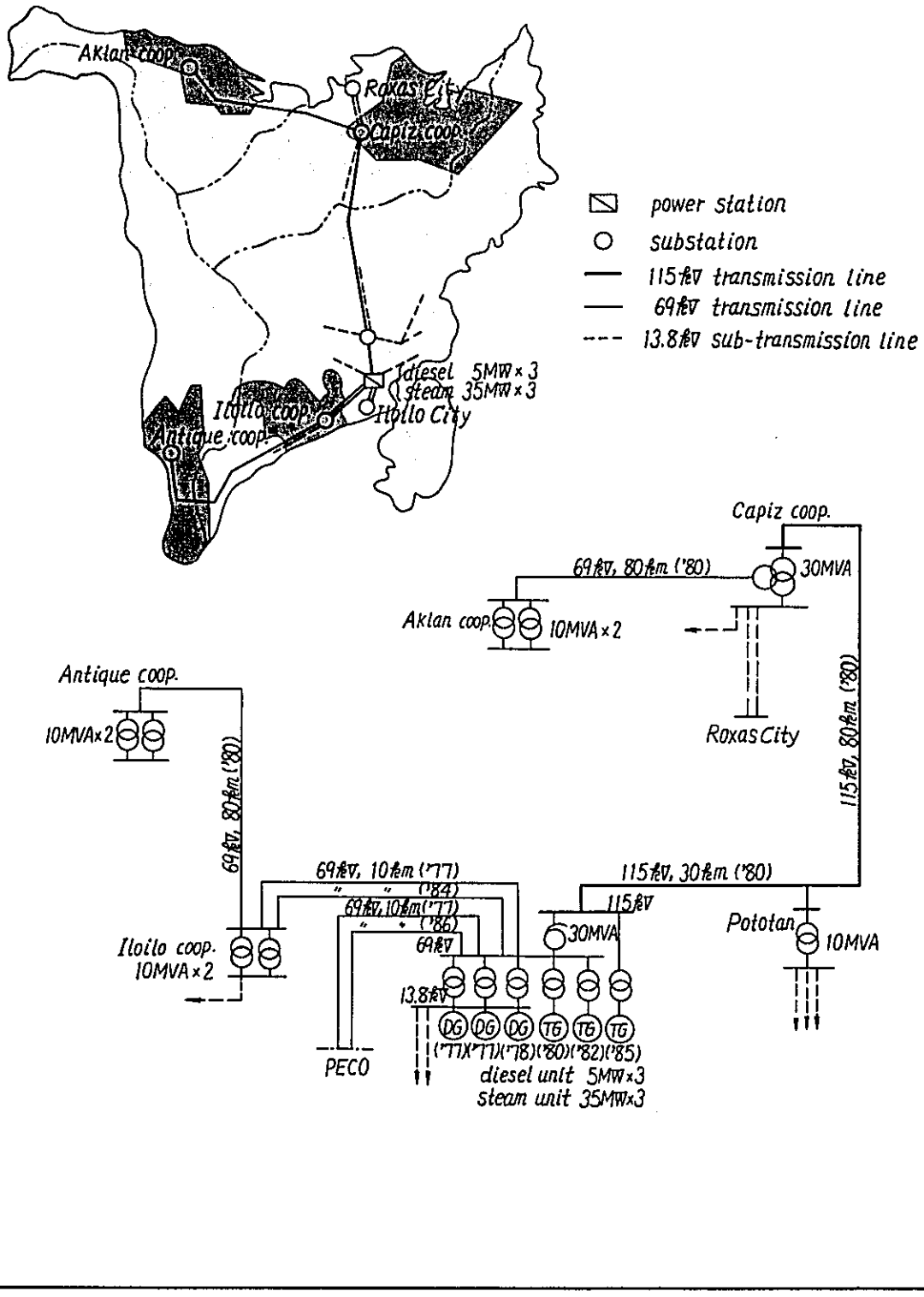
6-2-3 Per Capita Consumption and Electrification Ratio

With the program implemented the annual per capita energy consumption of 26 kWh in 1970 is expected to increase to about 160 kWh in 1987. Assuming the population distribution among the cities, the cooperatives and the remaining area to be 15, 28 and 57 percent respectively in 1987, the electrification ratio of the total island will be improved from 6 percent in 1970 to 40 percent in 1987;

Table 6-6 Transformer Expansion Program

Substation	Voltage (kV)	Capacity (kVA)	Date in service
Iloilo coop.	69/13.8	10	1977
Antique coop.	69/13.8	10 x 2	1980
Capiz coop.	115/69/13.8	30	1980
Aklan coop.	69/13.8	10	1980
Potatan	115/13.8	10	1980
Iloilo coop.	69/13.8	10	1983
Aklan coop.	69/13.8	10	1984
Total		100	

Fig. 6-6 Panay Grid in 1987



about 90 percent in the cooperatives according to NEA report and 17 percent in the remaining part. Since the population of Panay will be about three million in 1987, approximately one million persons will be served with electricity.

6-3 Negros

6-3-1 Load Forecast

In Negros, approximately 81 percent of energy is produced by Diaz Electric in Bacolod City and VECO in Dumaguete City. In projecting the future loads of these two utilities, their past growths were assumed to continue into the future with their respective growth rates in the past. Of the three cooperatives, VRESCO's load forecast prepared by NEA was adjusted taking into account their achievement. The load forecasts of the other two were taken from the feasibility reports of NEA. These are the loads of which magnitude determine the timing of NPC's establishment in Negros. Their total was 94.2 million kWh and 19.5 MW in 1972, which are expected to increase to 986 million kWh and 198 MW in 1987. In formulating power development program, Negros was divided into two, the two provinces, due to the topographical condition and size of demand. Therefore, load forecast was prepared for the two provinces separately, as shown in Tables 6-7 and 6-8.

(1) Negros Occidental

The major distribution networks that will be connected to NPC's grid are those of Diaz Electric, VRESCO and another cooperative in the making with target date in 1974. Demand of these networks is the determinant factor of the timing of NPC's establishment on the island. Other localized demands of minor utilities were considered to be incorporated in the grid of NPC insofar as economical. The future demand in Negros Occidental was estimated as shown in Table 6-7. The annual growth rate of Diaz Electric from 1965 up to 1971, which was about 16 percent, was assumed to be maintained in the future as shown in Figure 6-7.

Demand of VRESCO was assumed on the basis of the present situation to increase in 1973 by 35 percent over the estimated demand of 1972, and thereafter at annual rate gradually lowering from 35 to 10 percent until 1984, in consideration of the electrification to be promoted in the area which includes Cadiz City. After 1985, however, it will be maintained at 10 percent. Projection of NEA report was adopted to estimate the demand of the cooperative in the making. However, the projection after 1983 up until 1987 was estimated to be from 12 to 9 percent in annual growth rate.

(2) Negros Oriental

The major distribution networks to be connected to NPC grid are those of VECO in Dumaguete City, utilities in Bais City and Tanjay and a cooperative proposed.

Table 6-7 Load Forecast in Negros Occidental

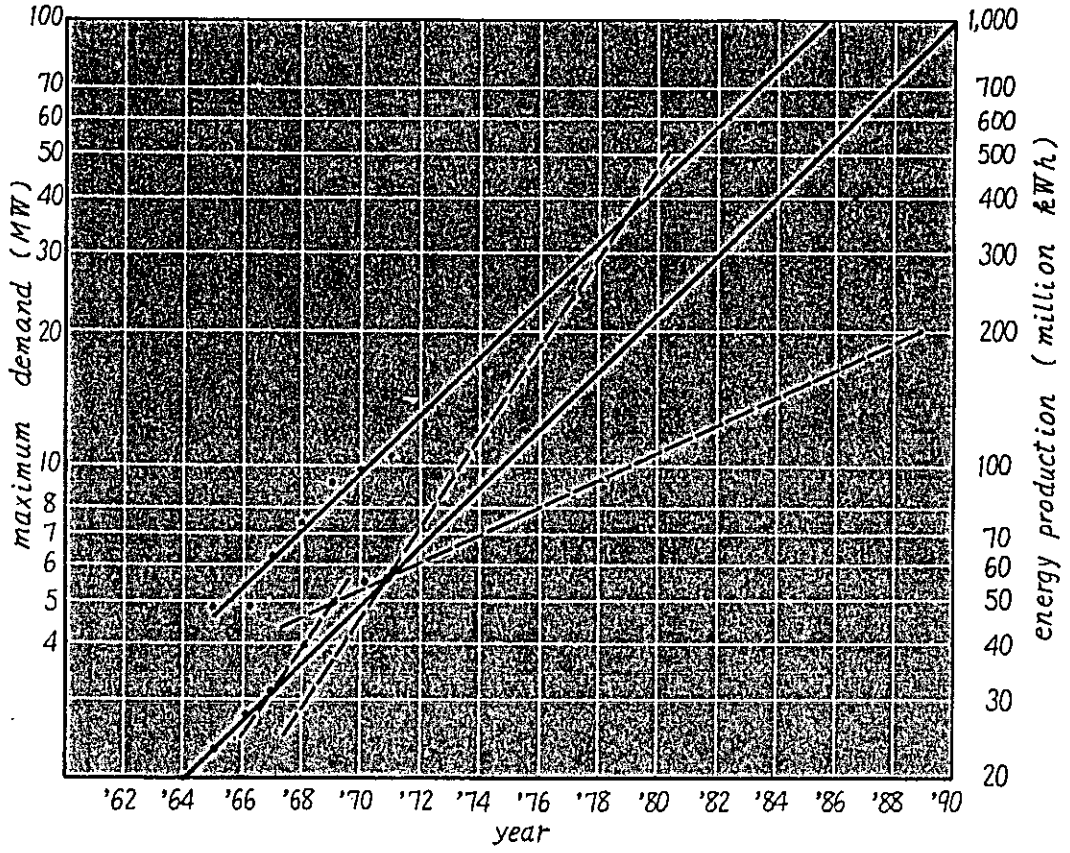
Year		Diaz Electric			Cooperative			VRESCO			Total		
		Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
1	1972	68.8	60	13.1	–	–	–	11.8	42	3.2	80.6	56	16.3
2	73	79.8	"	15.2	–	–	–	15.9	43	4.2	95.7	56	19.4
3	74	92.6	"	17.6	9.1	27	3.9	20.7	44	5.2	122.4	52	26.9
4	75	107.4	"	20.4	11.4	28	4.7	25.9	45	6.6	144.7	52	31.7
5	76	124.6	"	23.7	14.5	30	5.6	31.1	46	7.7	170.2	53	37.0
6	77	144.5	"	27.5	18.1	32	6.6	37.0	47	9.0	199.6	53	43.1
7	78	167.6	"	31.9	22.9	33	8.0	43.6	48	10.4	234.1	53	50.3
8	79	194.4	"	37.0	26.7	36	8.6	51.0	49	11.9	272.1	54	57.5
9	80	225.5	"	42.9	30.7	38	9.3	59.2	50	13.5	315.4	55	65.7
10	81	261.6	"	49.8	35.4	41	10.0	68.1	51	15.2	365.1	56	75.0
11	82	303.5	"	57.8	40.5	43	10.8	77.6	52	17.0	471.6	56	85.6
12	83	352.0	"	67.0	46.2	49	11.7	87.7	53	18.9	485.9	57	97.6
13	84	408.3	"	77.7	51.7	49	12.9	98.2	54	20.8	558.2	57	111.4
14	85	473.7	"	90.1	57.4	49	14.3	109.0	55	22.6	640.1	58	127.0
15	86	549.4	"	104.5	63.1	49	15.7	119.9	55	24.9	732.4	58	145.1
16	87	637.4	"	121.3	68.8	49	17.1	131.9	55	27.4	838.1	58	165.8
Increase (%)		16.0	–	16.0	16.8	–	12.3	17.4	–	15.4	16.9	–	16.7

Table 6-8 Load Forecast in Negros Oriental

Year		Dumaguete (VECO)			Bais & Tanjay *			Cooperative			Total		
		Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
1	1972	12.2	50	2.8	1.4	40	0.4	–	–	–	13.6	49	3.2
2	73	14.0	50	3.2	1.6	41	0.4	–	–	–	15.6	49	3.6
3	74	16.1	50	3.7	1.7	42	0.5	–	–	–	17.8	49	4.2
4	75	18.4	51	4.1	2.0	43	0.5	5.8	27	2.5	26.2	42	7.1
5	76	21.2	51	4.7	2.2	44	0.6	8.2	28	3.3	31.6	42	8.6
6	77	24.3	51	5.4	2.4	45	0.6	11.0	30	4.2	37.7	42	10.2
7	78	27.8	52	6.1	2.7	46	0.7	14.1	32	5.1	44.6	43	11.9
8	79	31.9	52	7.0	3.1	47	0.8	16.9	33	5.9	51.9	43	13.7
9	80	36.6	52	8.0	3.4	48	0.8	19.8	35	6.4	59.8	45	15.2
10	81	42.0	53	9.1	3.8	49	0.9	23.1	39	7.0	68.9	46	17.0
11	82	48.2	53	10.4	4.3	50	1.0	26.2	41	7.4	78.7	48	18.8
12	83	55.2	54	11.7	4.8	"	1.1	30.3	43	8.1	90.3	49	20.9
13	84	63.4	54	13.4	5.4	"	1.2	33.9	46	8.6	102.7	50	23.2
14	85	72.7	55	15.1	6.1	"	1.4	37.3	48	8.9	116.1	52	25.4
15	86	63.4	55	17.3	6.3	"	1.6	41.0	49	9.6	131.2	53	28.5
16	87	95.6	55	19.9	7.6	"	1.8	45.1	50	10.3	148.3	53	32.0
Increase (%)		14.7	–	13.9	12.0	–	10.6	18.7	–	12.5	–	–	–

Note: * includes Amlan municipality
LF: Load factor

Fig. 6-7 Load Forecast for Diaz Electric



Demand of VECO was assumed to increase in the future at 14.7 percent in the annual growth rate which was the averaged value of the past record. Demand of the utilities in Bais and Tanjay was assumed to grow at an annual rate of 12 percent over the demand in 1970. For the future demand of the proposed cooperative, estimate of NEA was adopted. However, judging from the present situation of the cooperative making, the date of operation was set in 1975. The load forecast is shown in Table 6-8.

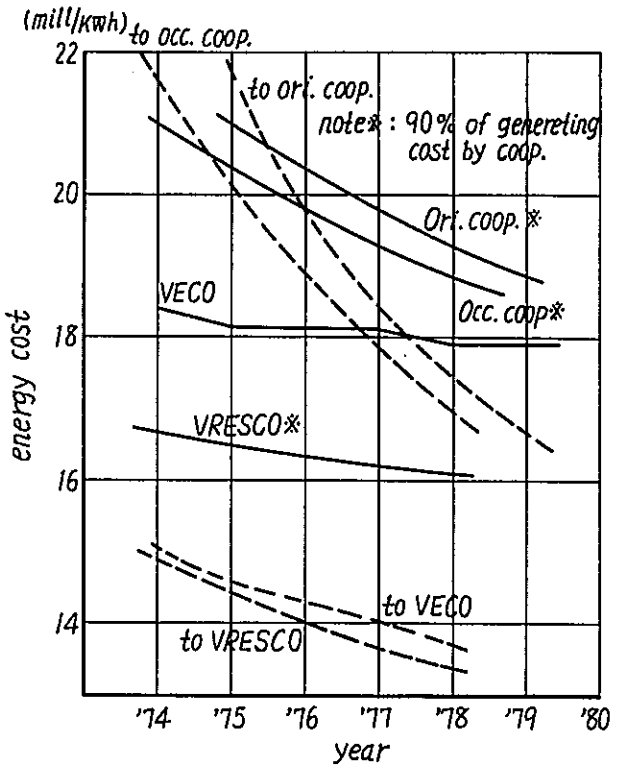
6-3-2 Development Program

(1) Timing of Establishment - Negros Occidental

If NPC is to supply energy for the future increment of demand of Diaz Electric, through a transmission line, about 10 kilometers in length, the energy cost of NPC to Diaz will become less expensive than that of Diaz when the increment reaches over about 3 million kWh. Such an increment is thought to be easily attained in view of the past increase of demand. The energy costs of VRESCO and the proposed cooperative were compared with that of NPC on the assumption that their generating facilities were all to be relocated for electrification of other rural areas. As a result, it was revealed that NPC could start

supplying energy to VRESCO at the present time, and to the proposed cooperative in 1975. (See Fig. 6-8)

Fig. 6-8 Energy Cost at Receiving End



However, in view of the time requirement for investigation, design, financing and construction, it is reasonable to schedule NPC's operation in 1977, supplying energy to cities of Cadiz and Silay and municipalities such as Talisay located near VRESCO and the proposed cooperative from the start of operation. The above schedule is summarized in the following:

	Timing of connection
Cooperative	1977
VRESCO	1977
Diaz Electric	1977
Small utilities	1977 and on

(2) Timing of Establishment - Negros Oriental

In consideration of the future interconnection with the grid in Negros Occidental, power plant site is desired to be at Bais. Assuming VECO and a cooperative will be receiving power from this power plant, timing or NPC's establishment in Negros Oriental was determined to be in 1977. (See Fig. 6-8.)

6-3-3 Development Program

From the load forecast and timing of power supply described in the foregoing, the power development program was formulated for the two provinces as shown in Fig. 6-9 and Fig. 6-10.

In Negros Occidental, NPC will start its operation in 1977 with three 19 MW diesel units, and increase its power supply capability after 1980 by introducing 35 MW steam turbine units corresponding to the increase in demand.

Fig. 6-9 Development Program in Negros Occidental

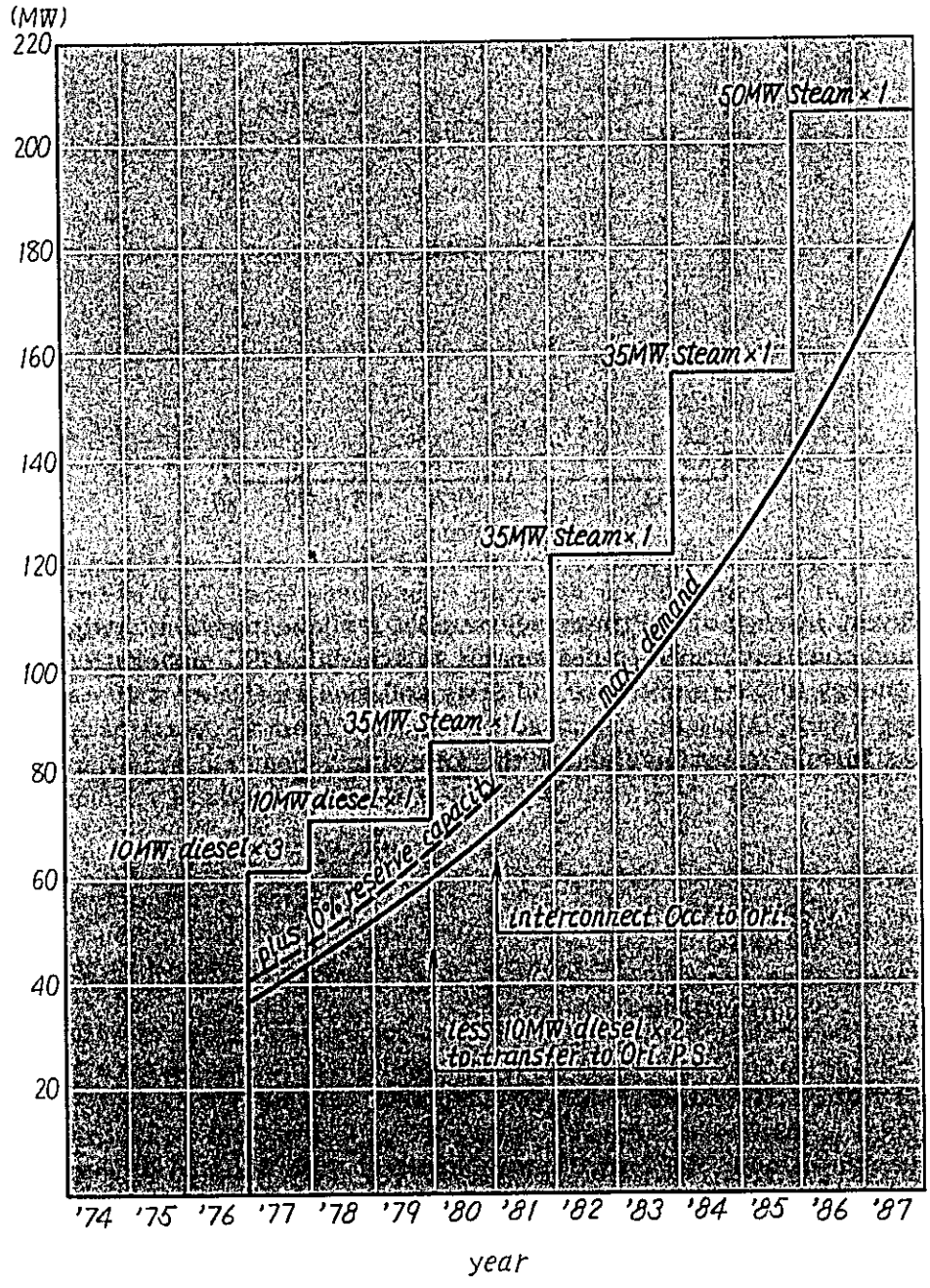
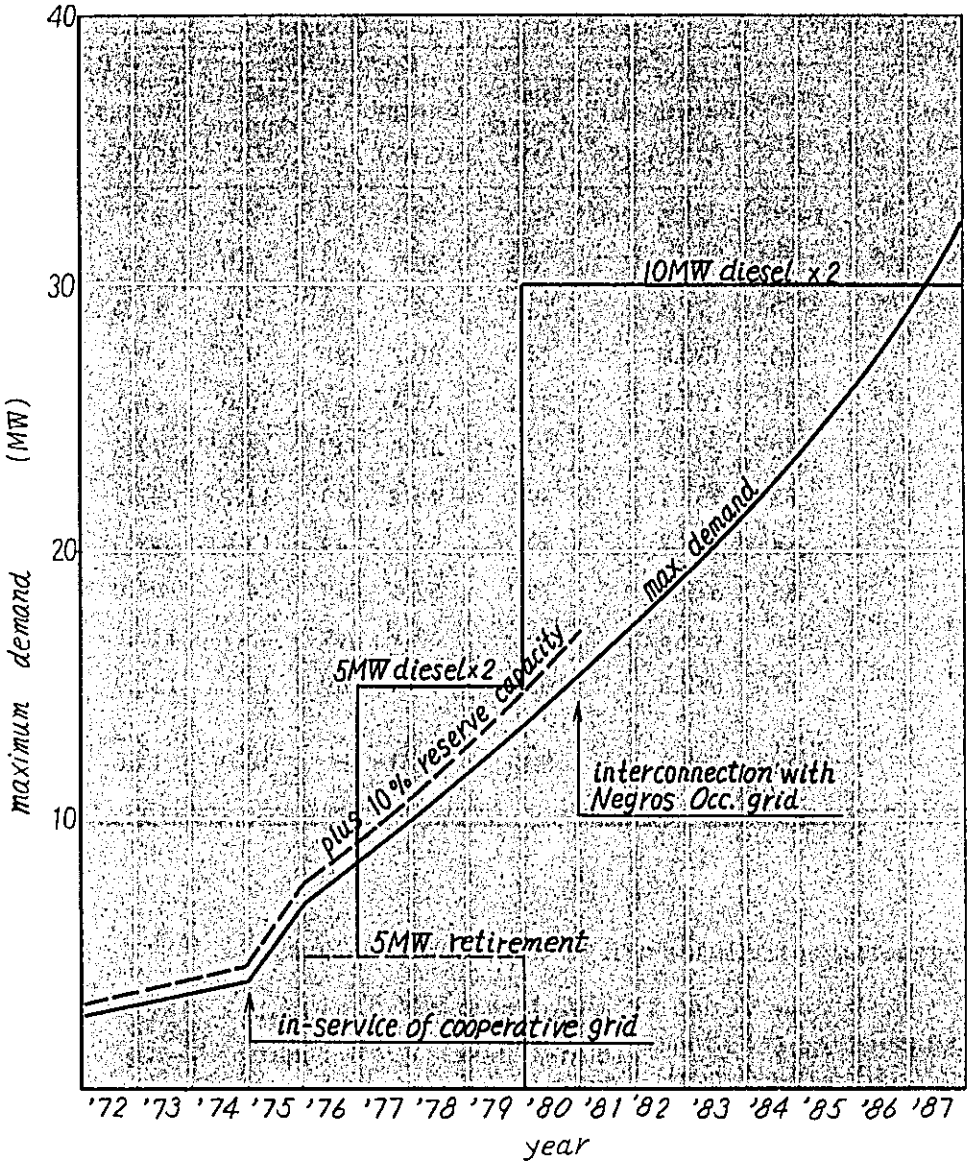


Fig. 6-10 Development Program in Negros Oriental



In Negros Oriental, NPC will be operational in 1977 with two 5 MW diesel units. In 1980, since this installed capacity will become short due to increasing demand, two 10 MW diesel units in Negros Occidental will be relocated to Negros Oriental. In 1981, the grid of Negros Occidental will be interconnected with that in Negro Oriental thereby to lessen the transmission loss, as well as, improve the reliability of supply. The combined development program for Negros Power Grid is shown in Fig. 6-11.

(1) Generating Facilities - Negros Occidental

Corresponding to the growth in demand as shown in Table 6-9 and Figure

Table 6-9 Load Pick-up Forecast in Negros Occidental

	NPC supply								
	Diaz			Cooperative			VRESCO		
	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
1977	21.5	60	4.1	18.1	32	6.6	37	47	9.0
78	44.6	"	8.5	22.9	33	8.0	43.6	48	10.4
79	71.4	"	13.6	26.7	36	8.6	51.0	49	11.9
80	130.9	"	24.9	30.7	38	9.3	59.2	50	13.5
81	167.0	"	31.8	35.4	41	10.0	68.1	51	15.2
82	208.9	"	39.8	40.5	43	10.8	77.6	52	17.0
83	257.4	"	49.0	46.2	49	11.7	87.7	53	18.9
84	313.7	"	59.7	51.7	49	12.9	98.2	54	20.8
85	379.1	"	72.1	57.4	49	14.3	109.0	55	22.6
86	454.8	"	86.5	63.1	49	15.7	119.9	55	24.9
87	542.8	"	103.3	68.8	49	17.1	131.9	55	27.4
Increase (%)	38.1	–	38.1	14.3	–	10.0	13.6	–	11.8

6-9, the generating facilities will be expanded as follows:

1977	10 MW diesel	3 units
1978	10 MW diesel	1 unit
1980	35 MW steam	1 unit
	(less 10 MW diesel	2 units to be relocated to Negros Oriental)
1982	35 MW steam	1 unit
1984	35 MW steam	1 unit
1986	50 MW steam	1 unit

In 1987, there will be three 35 MW steam turbine units, one 50 MW steam turbine unit and two 10 MW diesel units totaling 175 MW in capacity. The power plant will be located at a littoral site near Bacolod.

(2) Generating Facilities - Negros Oriental

Corresponding to the growth of demand as shown in Table 6-10 and Fig. 6-10, the generating facilities to be located in the vicinity of Bais will be

NPC supply						Diaz supply			Total in Negross Occ.		
Others			Subtotal								
Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
2.5	34	0.8	79.1	44	20.5	123.0	60	23.4	202.1	53	43.9
5.1	34	1.7	116.2	46	28.6	123.0	"	23.4	239.2	53	52.0
8.1	34	2.7	157.2	49	36.8	123.0	"	23.4	280.2	53	60.2
11.7	34	3.9	232.5	51	51.6	94.6	"	18.0	327.1	54	69.6
15.8	35	5.1	286.3	53	62.1	94.6	"	18.0	380.9	54	80.1
24.7	36	7.9	351.7	53	75.5	94.6	"	18.0	446.3	54	93.5
31.6	37	9.8	422.9	54	89.4	94.6	"	18.0	517.5	55	107.4
39.7	39	11.7	503.3	55	105.1	94.6	"	18.0	597.9	55	123.1
48.7	39	14.4	594.2	55	123.4	94.6	"	18.0	688.8	56	141.4
59.4	40	17.0	697.2	55	144.1	94.6	"	18.0	791.8	56	162.1
70.6	41	19.7	814.1	55	167.5	94.6	"	18.0	908.7	56	185.5
39.7	–	37.8	26.3	–	23.4	–	–	–	16.2	–	15.5

increased as follows:

1977	5 MW diesel	2 units
1980	10 MW diesel	2 units (to be relocated from Negros Occ.)

(3) Transmission Lines and Substations - Negros Occidental

1977

To supply power to Diaz, VRESCO and the proposed cooperative, 115 kV single circuit transmission lines will be constructed, respectively 10 kilometers, 36 kilometers and 37 kilometers in length. In transmitting power to Diaz and VRESCO, voltage was set at 115 kV in consideration of the size and growth rate of load. Also adopted was 115 kV for a transmission line to the cooperative in the south because it will become a part of the tie line with Negros Oriental.

Substations, 115kV/13.8kV, will be constructed in the proposed cooperative and at a place near to Bago City, with transformers of two 10 MVA and one 5 MVA respectively in order to extend 13.8 kV sub-transmission lines for a total distance of about 120 kilometers to supply power to such nearby cities and municipalities

that can economically be supplied at 13.8 kV.

1981

The interconnection will be made by a 115 kV single circuit line, 82 kilometers in length, between the cooperative in Negros Occidental and Bais City. A 5 MVA substation will be constructed at a place near to Kabankalan to start supplying power to an area in the south of Negros Occidental.

1985

The connection to Diaz will be reinforced by constructing a 115 kV circuit line. At Bago substation, an additional 5 MVA transformer will be

Fig. 6-11 Development Program in Negros

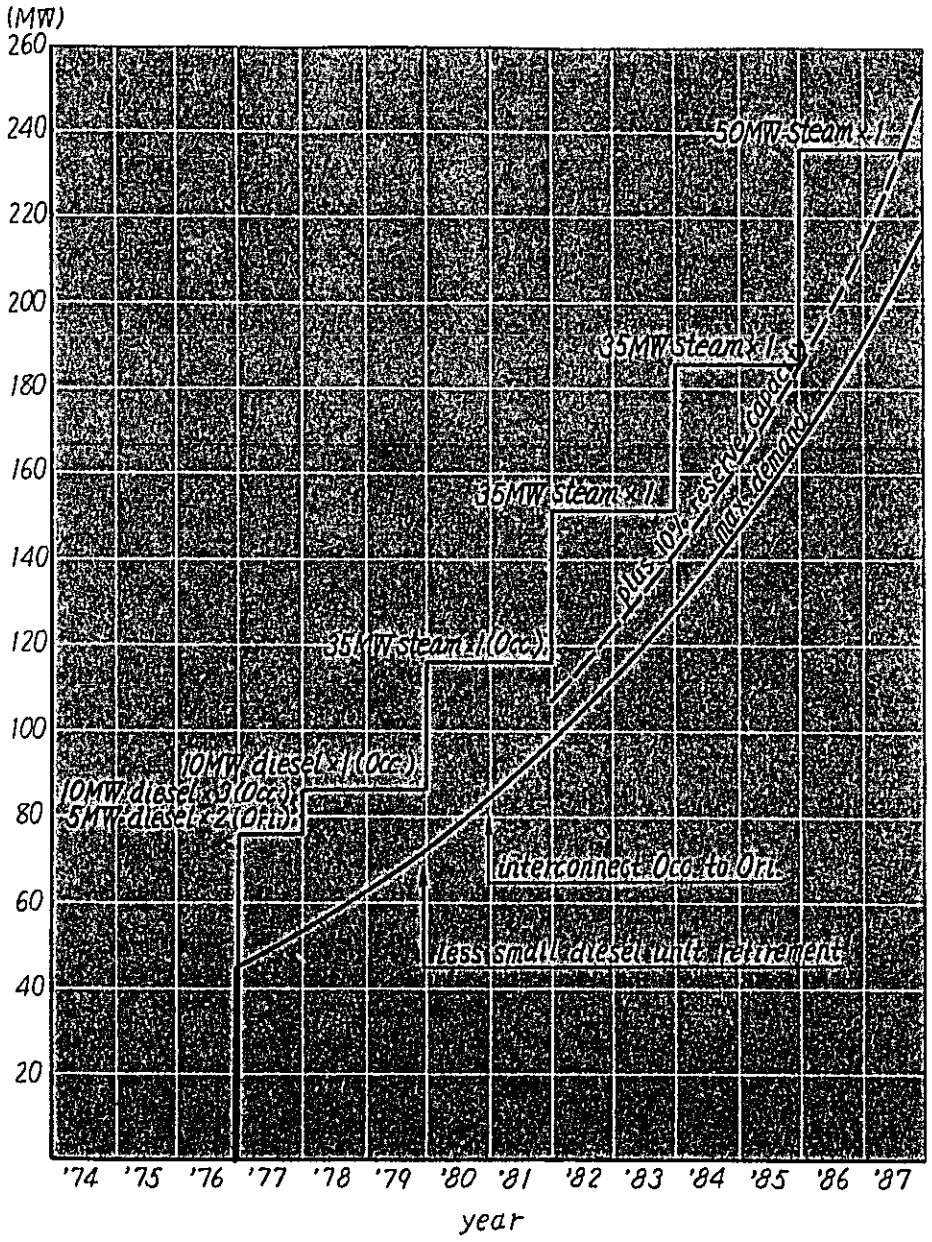


Table 6-10 Load Pick-up in Negros Oriental

Year		Dumaguete (VECO)			Bais & Tanjay*			Cooperative			Others**			Total			Total in Negros Grid		
		Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
1	1977	23.1	-	5.2	2.4	45	0.6	11.0	30	4.2	-	-	-	36.5	42	10.0	36.5	-	10.0
2	78	25.0	-	4.2	2.7	46	0.7	14.1	32	5.1	-	-	-	41.8	48	10.0	281.0	-	62.0
3	79	25.0	-	3.3	3.1	47	0.8	16.9	33	5.9	-	-	-	45.0	51	10.0	325.2	-	70.2
4***	80	36.6	52	8.0	3.4	48	0.8	19.8	35	6.4	1.6	40	0.5	61.4	45	15.7	388.5	52	85.3
5	81	42.0	53	9.1	3.8	49	0.9	23.1	39	7.0	1.8	40	0.5	70.7	46	17.5	451.6	53	97.6
6	82	48.2	53	10.4	4.3	50	1.0	26.2	41	7.4	1.9	41	0.5	80.6	48	19.3	526.9	53	112.8
7	83	55.2	54	11.7	4.8	"	1.1	30.0	43	8.1	2.1	41	0.6	92.4	49	21.5	609.9	54	128.9
8	84	63.4	54	13.4	5.4	"	1.2	33.9	46	8.6	2.3	42	0.6	105.0	50	23.8	702.9	55	146.9
9	85	72.7	55	15.1	6.1	"	1.4	37.3	48	8.9	2.6	42	0.7	118.7	52	26.1	807.5	55	167.5
10	86	83.4	55	17.3	6.8	"	1.6	41.0	49	9.6	2.8	43	0.7	134.0	52	29.2	925.8	55	190.0
11	87	95.6	55	19.9	7.6	"	1.8	45.1	50	10.3	3.1	43	0.8	151.4	53	32.8	1,060.1	55	218.3
Annual growth rate (%)		16.4	-	14.6	15.2	-	11.8	15.2	-	9.4	10.0	-	7.8	15.3	-	12.6	15.4 (1980-87)	-	14.4

Note: * Including Amlan municipality
** Zamboanguita and Siaton municipalities
*** Interconnection of Negros Occ. Grid and Negros Or. Grid is to be completed in 1980.

installed.

1987

To meet growth in demand a 10 MVA transformer will also be added at the cooperative substation.

(4) Transmission Lines and Substations - Negros Oriental

1977

To connect to the proposed cooperative and VECO, 69 kV single circuit transmission lines will be constructed, respectively 23 kilometers and 44 kilometers in length. Substations, 69kV/13.8 kV, will be built in the cooperative and Dumaguete, each with two 5 MVA transformers.

1980

Two 10 MW diesel units will be relocated from Negros Occidental. To supply power to municipalities to the south of Dumaguete, 13.8 kV sub-transmission lines will be extended for a distance of about 46 kilometers.

1981

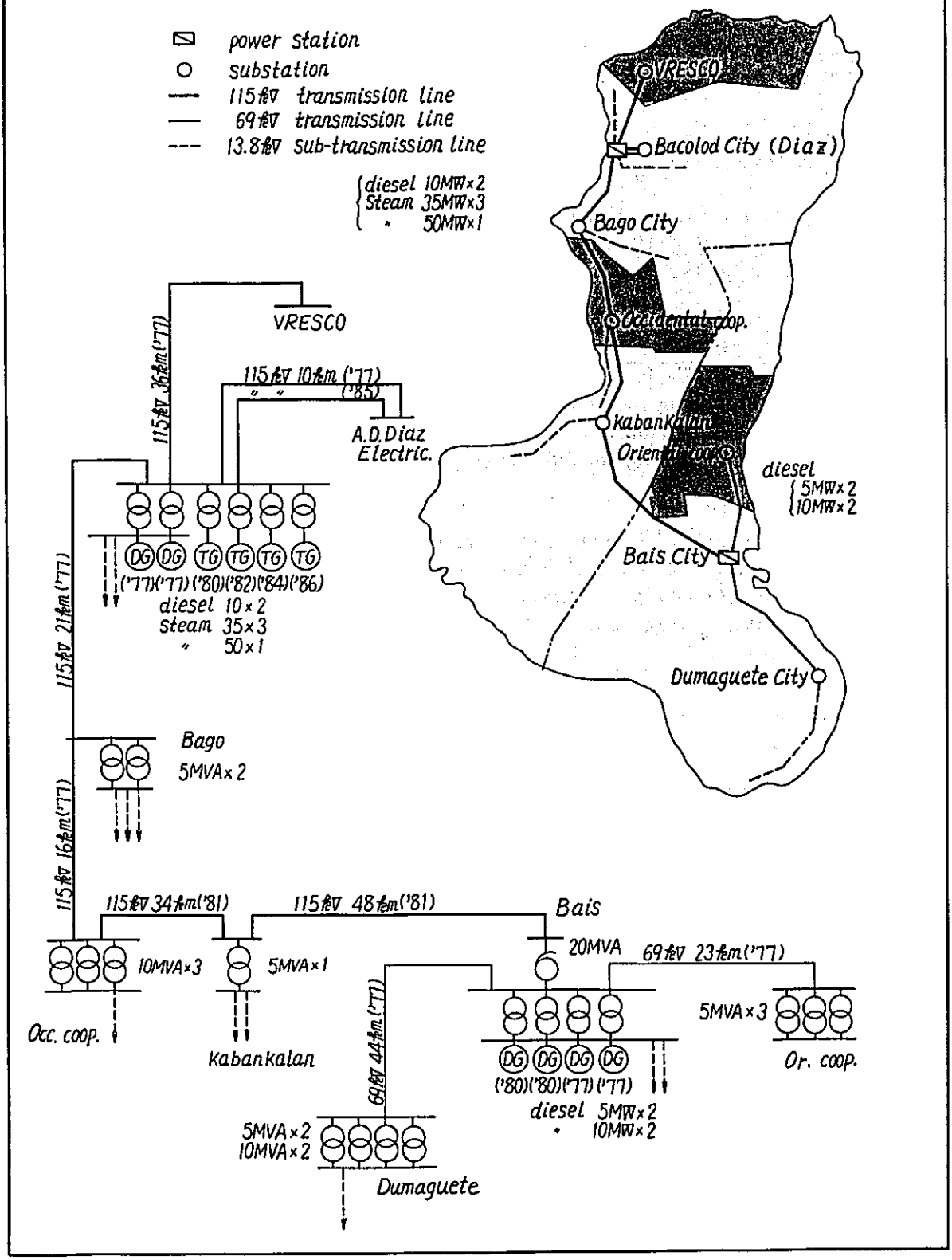
The grid will be interconnected to that in Negros Occidental by a 115 kV single circuit transmission line, 82 kilometers in length.

Table 6-11 Installations in Negros Power Grid as of 1987

	Negros Occidental	Negros Oriental	Total
Maximum demand (MW)	186	33	218
Generating facilities			
Diesel units (MW)	51*	30	81
Steam units (MW)	155	0	155
Total	206*	30	236
Transmission lines			
115 kV (km)	175	0	115
69 kV (km)	0	67	67
13.8 kV (km)	150	46	196
Substations			
Number	3	2	5
Capacity (MVA)	45	65	110

Note: * inclusive of 31 MW owned and operated by other utilities

Fig. 6-12 Negros Grid in 1987



1982
A 10 MVA transformer will be added at the substation in Dumaguete to meet the increase in demand around Dumaguete.

1986
Due to growth in demand of the cooperative, a 5 MVA transformer will be added at the cooperative substation.

1987
A 10 MVA transformer will be installed in Dumaguete substation.

The total of installations on the island of Negros as of 1987 are shown in Table 6-11. Figure 6-12 shows the general plan and transmission diagram of the proposed Negros Power Grid.

6-3-4 Per Capita Consumption and Electrification Ratio

Population on Negros is estimated to be about 2.8 million in 1987. Per capita power consumption of 37 kWh in 1970 will grow to 380 kWh in 1987; from 48 kWh to 400 kWh in Negros Occidental and from 16 kWh to 160 kWh in Negros Oriental.

In 1987, number of persons receiving energy produced by NPC will be 1,100 thousand approximately; 800 thousand in Negros Occidental and 300 thousand in Negros Oriental. Electrification ratio will be about 45 percent in Negros Oriental, averaging about 40 percent on the island of Negros.

6-4 Bohol

6-4-1 Load Forecast

Economy of Bohol does not show any omen of drastic change in the future. It is forecasted that the economic activities in Bohol will grow at a steady pace as has been observed in the past. Therefore, the past growth rate of power demand was assumed to be maintained in Tagbilaran and other municipalities that are served with energy produced by Loboc Hydro Power Plant of NPC.

Since a feasibility report has been completed by NEA on a cooperative located to the north of Tagbilaran, load forecast for the cooperative area was adopted from the report. After 1981 when, as stated in 6-4-2, a power plant will have been constructed by NPC, demand in the municipalities of Maribojoc, Cortes, Corella that are located near to Tagbilaran and populated by a total of 33 thousand approximately will be met by energy produced by NPC. The load forecast is shown in Table 6-12.

Table 6-12 Load Forecast in Bohol

		Tagbilaran			Electric Cooperative			Other *			Total		
		Energy (GWh)	LF (%)	Max. demand (kW)	Energy (GWh)	LF (%)	Max. demand (kW)	Energy (GWh)	LF (%)	Max. demand (kW)	Energy (GWh)	LF (%)	Max. demand (kW)
1	1972	6.3	42	1,700	–	–	–	–	–	–	6.3	42	1,700
2	73	6.9	42	1,900	–	–	–	–	–	–	6.9	42	1,900
3	74	7.5	"	2,000	–	–	–	–	–	–	7.5	42	2,000
4	75	8.2	"	2,200	5.4	26	2,400	–	–	–	13.6	34	4,600
5	76	9.0	"	2,400	7.8	28	3,200	–	–	–	16.8	34	5,600
6	77	9.9	"	2,700	9.1	30	3,500	–	–	–	19.0	35	6,200
7	78	10.8	43	2,900	12.2	31	4,500	–	–	–	23.0	36	7,400
8	79	11.8	44	3,100	14.8	33	5,100	–	–	–	26.6	37	8,200
9	80	13.0	45	3,200	17.3	35	5,600	–	–	–	30.3	39	8,800
10	81	14.2	46	3,500	20.1	36	6,400	5.6	33	1,900	39.9	42	10,800
11	82	15.5	47	3,800	24.0	38	7,200	6.2	35	2,000	45.7	43	12,100
12	83	17.0	48	4,100	27.4	40	7,800	6.8	37	2,100	51.2	44	13,300
13	84	18.6	49	4,400	30.9	41	8,600	7.5	39	2,200	57.0	45	14,400
14	85	20.4	50	4,700	34.0	42	9,200	8.3	41	2,300	62.7	47	15,400
15	86	22.4	"	5,100	37.4	43	9.800	9.1	42	2,500	68.9	48	16,500
16	87	24.5	"	5,600	41.1	44	10,600	10.0	43	2,600	75.6	48	17,900
Increase (%)		9.5	–	8.3	18.6	–	13.0	10.0	–	5.5	–	–	–

Note: * Demand of Maribojoc, Cortes, Corella and Sikatuna municipalities.
LF: Load factor

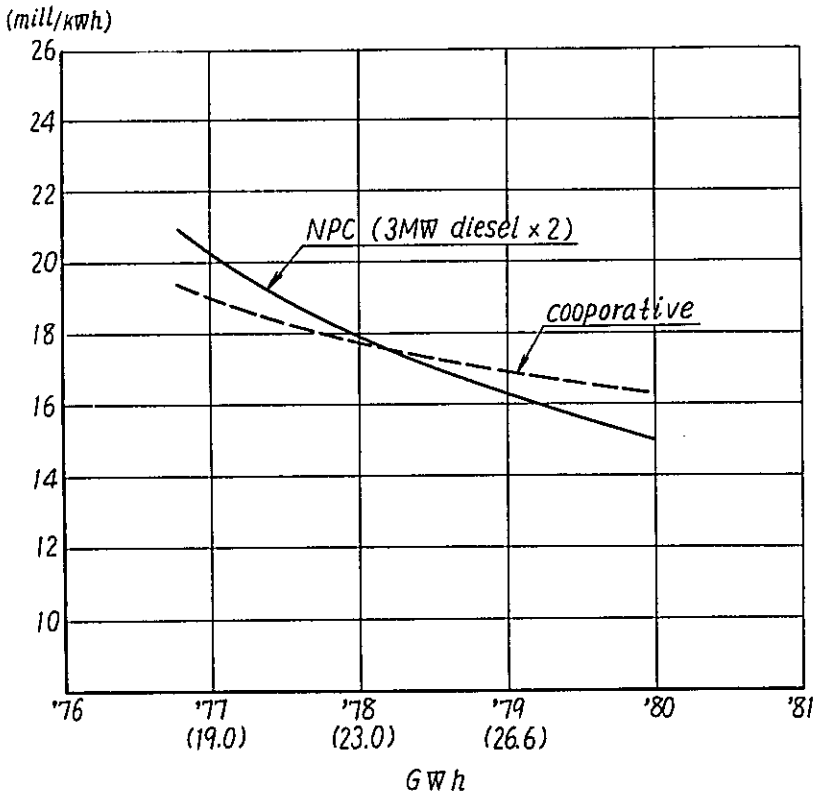
6-4-2 NPC's Establishment

Major power systems in Bohol in the future will be the one around Tagbilaran and the cooperative. In order to supply power from NPC's power plant to the load centers of these two systems, 69 kV transmission lines were considered. The initial installations of NPC are described as follows:

Power plant:	3 MW diesel unit x 2 at a place 2 km or less to Tagbilaran City center
Substation	
Tagbilaran substation:	5 MVA x 1
Tubigon substation:	5 MVA x 2
Transmission line:	69 kV, 1 cct., 42 km (NPC P.P. - Tubigon S.S.) 69 kV, 1 cct., 2 km (NPC P.P. - Tagbilaran S.S.)

The energy cost at receiving end of the above facilities will be variable with the energy production as shown below.

Fig. 6-13 Energy Cost at Receiving End



As can be seen from Fig. 6-13, the annual energy production of the two systems will have to grow up to about 25 million kWh in total before NPC comes to Bohol. That will be in 1979 as indicated in Table 6-12. Therefore, NPC's establishment in Bohol was scheduled in that year. After the establishment of NPC, the generating units of Tagbilaran will be all relocated to electrify rural areas, while three 1,500 kW units of the cooperative will be kept for two years as a reserve capacity.

In line with the NPC's establishment, distribution networks in municipalities around Tagbilaran will have to be expanded in 1980 by extending 13.8 kV subtransmission lines for a total distance of 27 kilometers. Furthermore, NPC's

Fig. 6-14 Development Program in Bohol

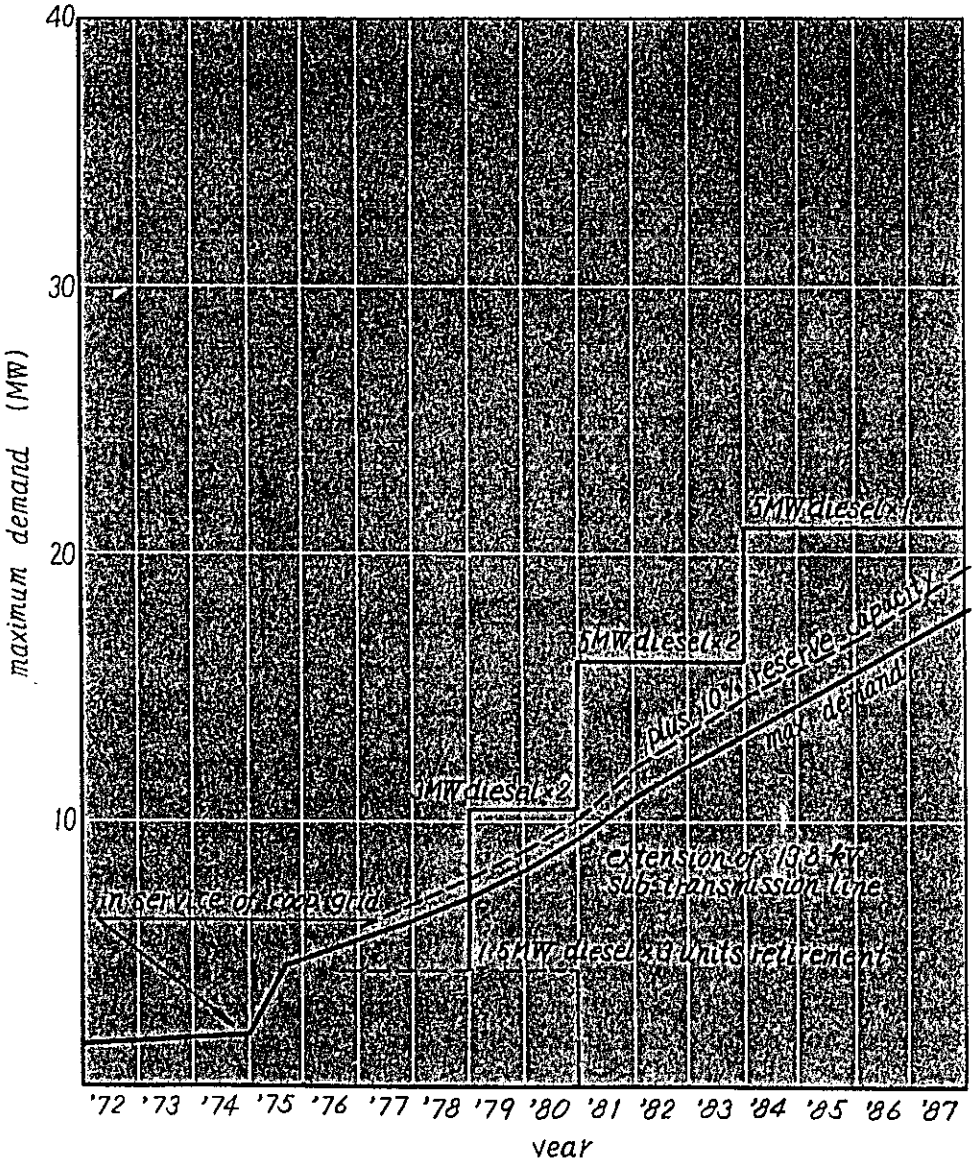
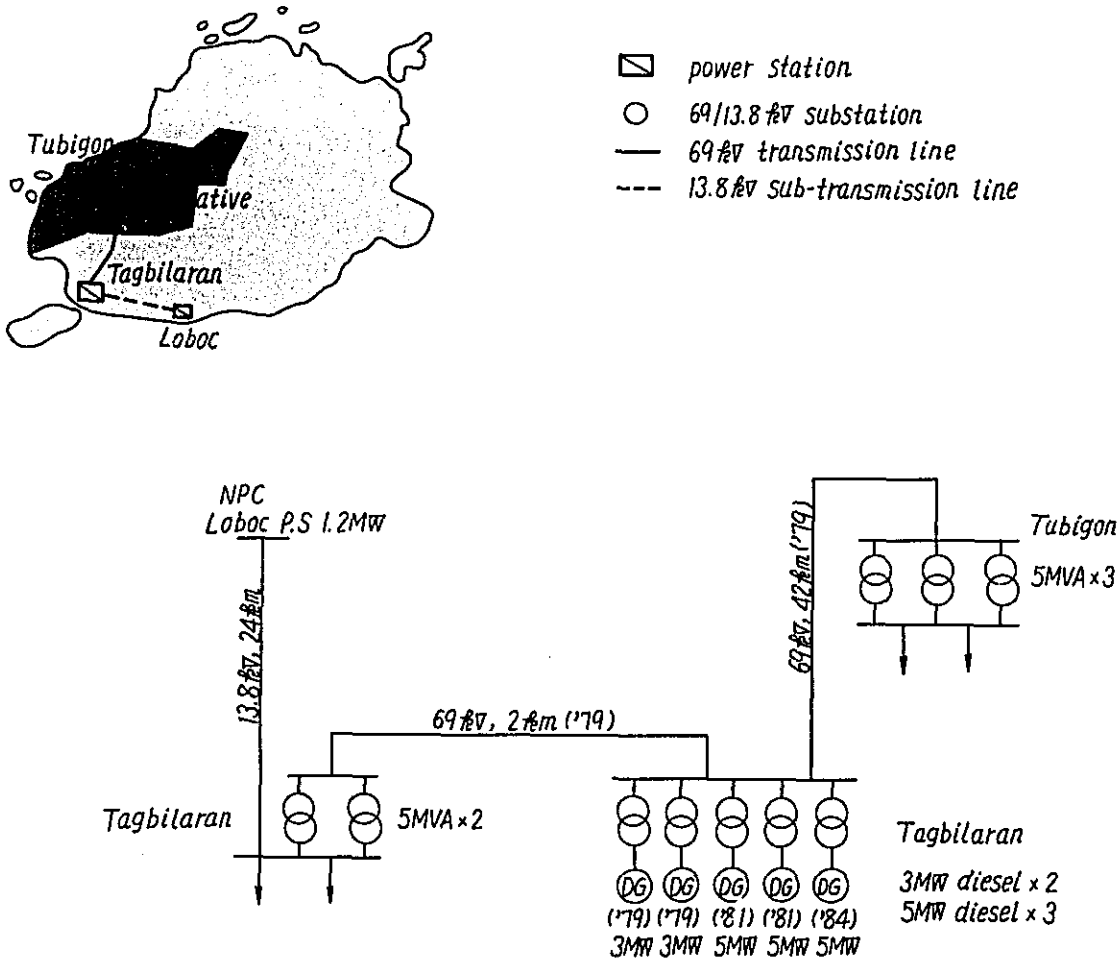


Fig. 6-15 Bohol Grid in 1987



facilities will have to be augmented to meet the growing demand after 1979 as follows:

	Generating unit	Substation	Transmission line
1979	3 MW x 2	5 MVA x 3	69 kV, 1 cct., 44 km
1980	-	-	-
1981	5 MW x 2	-	13.8 kV, 1 cct., 27 km
1982	-	-	-
1983	-	-	-
1984	5 MW x 1	5 MVA x 3	-
1985	-	-	-
1986	-	5 MVA x 1	-
1987	-	-	-
Total	3 MW x 2 5 MW x 3	5 MVA x 6	69 kV, 1 cct., 44 km 13.8 kV, 1 cct., 27 km

Figure 6-14 gives the development program, and Fig. 6-15 single line diagram of the grid.

6-4-3 Per Capita Consumption and Electrification Ratio

The population on Bohol is estimated to be about 865 thousand in 1987. Per capita energy consumption of 6 kWh in 1970 is expected to increase to approximately 87 kWh in 1987.

Based on the load forecast described in the foregoing and the distribution of population, the electrification ratio of 3 percent in 1970 was estimated to increase to 19 percent in 1979, and further in 1987 it will reach 30 percent.

6-5 Leyte

6-5-1 Load Forecast

As in the case of other islands, the load forecast of major utilities in Leyte was projected with use of the past trend in the load growth. They are the utilities in the cities of Tacloban and Ormoc. Two cooperatives in Leyte and Southern Leyte are now on the stage of definite design. The feasibility studies are complete by NEA, and the load forecasts of the report was borrowed. Table 6-13 gives the estimated load forecast. Of the major distribution networks, those in Ormoc and cooperative in Southern Leyte were, as stated later, considered to be connected after 1982. Therefore, timing of NPC's establishment in the island was determined by the future loads in Tacloban and the cooperative in Leyte.

Table 6-13 Load Forecast in Leyte

		TEIPCO			Ormoc Electric			Leyte Cooperative			S. Leyte Coop.			Total		
		Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWn)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
1	1972	17.6	53	3.8	3.4	41	1.0	–	–	–	–	–	–	21.0	50	4.8
2	73	19.9	"	4.3	3.9	41	1.1	–	–	–	–	–	–	23.8	50	5.4
3	74	22.5	"	4.8	4.6	42	1.2	21.1	47	5.3	–	–	–	48.2	49	11.2
4	75	25.4	"	5.5	5.3	42	1.4	27.1	47	6.6	5.3	26	2.3	63.1	46	15.8
5	76	28.8	"	6.2	6.1	43	1.6	32.8	48	7.8	7.0	28	2.8	74.7	46	18.4
6	77	32.5	"	7.0	7.1	44	1.8	38.5	48	9.2	9.3	30	3.6	87.4	46	21.6
7	78	36.8	"	7.9	8.2	45	2.1	44.0	48	10.5	11.8	31	4.3	100.8	46	24.8
8	79	41.6	"	9.0	9.5	46	2.4	51.3	49	12.0	14.2	33	4.9	116.6	47	28.3
9	80	47.1	"	10.1	10.9	47	2.7	58.6	49	13.7	17.8	33	6.2	134.4	47	32.7
10	81	53.2	"	11.5	12.7	48	3.0	65.6	50	15.0	21.3	34	7.2	152.8	48	36.7
11	82	60.2	"	13.0	14.6	49	3.4	72.4	50	16.5	25.3	34	8.5	172.5	48	41.4
12	83	68.1	"	14.6	16.9	50	3.9	79.1	51	17.5	29.9	35	9.6	194.0	49	45.6
13	84	77.0	"	16.6	19.6	50	4.5	86.2	51	19.3	34.7	36	11.0	217.5	49	51.4
14	85	87.1	"	18.7	22.7	50	5.2	94.0	51	21.0	38.2	37	11.8	242.0	49	56.7
15	86	98.5	"	21.2	26.2	50	6.0	102.4	51	22.9	42.0	38	12.6	269.1	49	62.7
16	87	111.4	"	24.0	30.4	50	7.9	111.6	51	25.0	46.2	39	13.5	299.6	49	70.4
Increase (%)		13.1	–	13.1	15.7	–	14.7	13.9	–	12.9	19.7	–	15.4	–	–	–

Note. LF : Load factor

(1) Interconnection with Ormoc and Southern Leyte Cooperative

Studies were made by preparing Fig. 5-1 with the results as follows:

Ormoc City

69 kV transmission line:	48 km 1 cct. (Dagami-Burauen-Ormoc)
Economical energy transmission:	more than 12.2 million kWh/year
Timing of interconnection:	1981

Note: It was assumed that NPC would supply all the energy requirement in Ormoc.

Cooperative in Southern Leyte

69 kV transmission line:	90 km (Tolosa-Bontoc)
Economical energy transmission:	more than 24.5 million kWh/year
Timing of interconnection:	1982

The both networks will be interconnected with NPC grid in the 1980's.

(2) Supply to Municipalities

NPC's establishment in Leyte will be in 1977 as stated in 6-5-2 Development Program. When established, NPC's grid will supply power to the following municipalities where economical transmission is possible through 13.8 kV sub-transmission lines.

Municipalities	Population in 1970
San Miguel	9,300
Tunga	3,900
Jaro	29,600
Alangalang	25,200
Total	68,000

The future demand in the areas to be served by NPC energy was estimated as shown in Table 6-13.

6-5-2 Development Program and Timing of Establishment

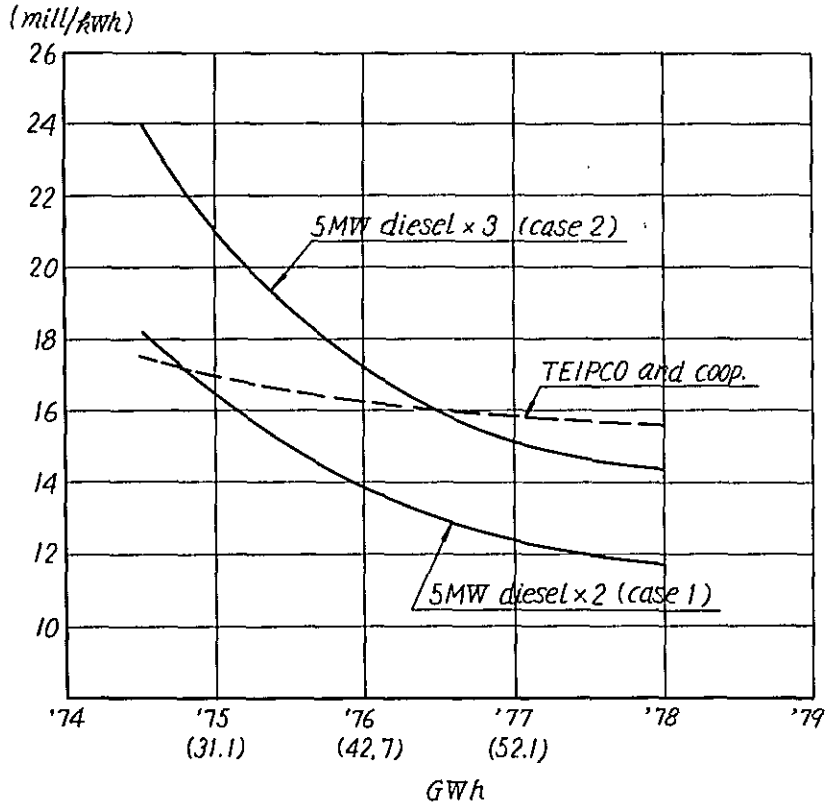
In view of the sizes of demands in Tacloban and the cooperative in Leyte, two different development programs were prepared in order to find out optimum scale of the initial development.

	Case-1	Case-2
Generating units	5 MW x 2	5 MW x 3
Transmission lines	69 kV, 1 cct., 2 km	69 kV, 2 ccts., 25 km
	69 kV, 2 ccts., 23 km	
Substation transformers	5 MVA x 1	5 MVA x 2

The power plant was supposed to be situated within a two kilometers distance from Tacloban. The energy costs at receiving end of the two cases were estimated as shown in Fig. 6-16.

As can be seen from the figure, the initial establishments of Case-1 and Case-2 would require the annual demand to grow respectively to 30 million kWh

Fig. 6-16 Energy Cost at Receiving End



and 50 million kWh which will be attained in 1975 and 1977 respectively as shown in Table 6-14.

According to Case-1, NPC may be established in 1975. However, the date of operation of the cooperative which is scheduled in 1974 is quite dubious in view of the present progress of cooperative making. A pragmatic judgment favours the NPC's establishment in 1977, which is Case-2.

The development program after 1977 up to 1987 is shown in Fig. 6-17, and the grid diagram in Fig. 6-18.

Fig. 6-17 Development Program in Leyte

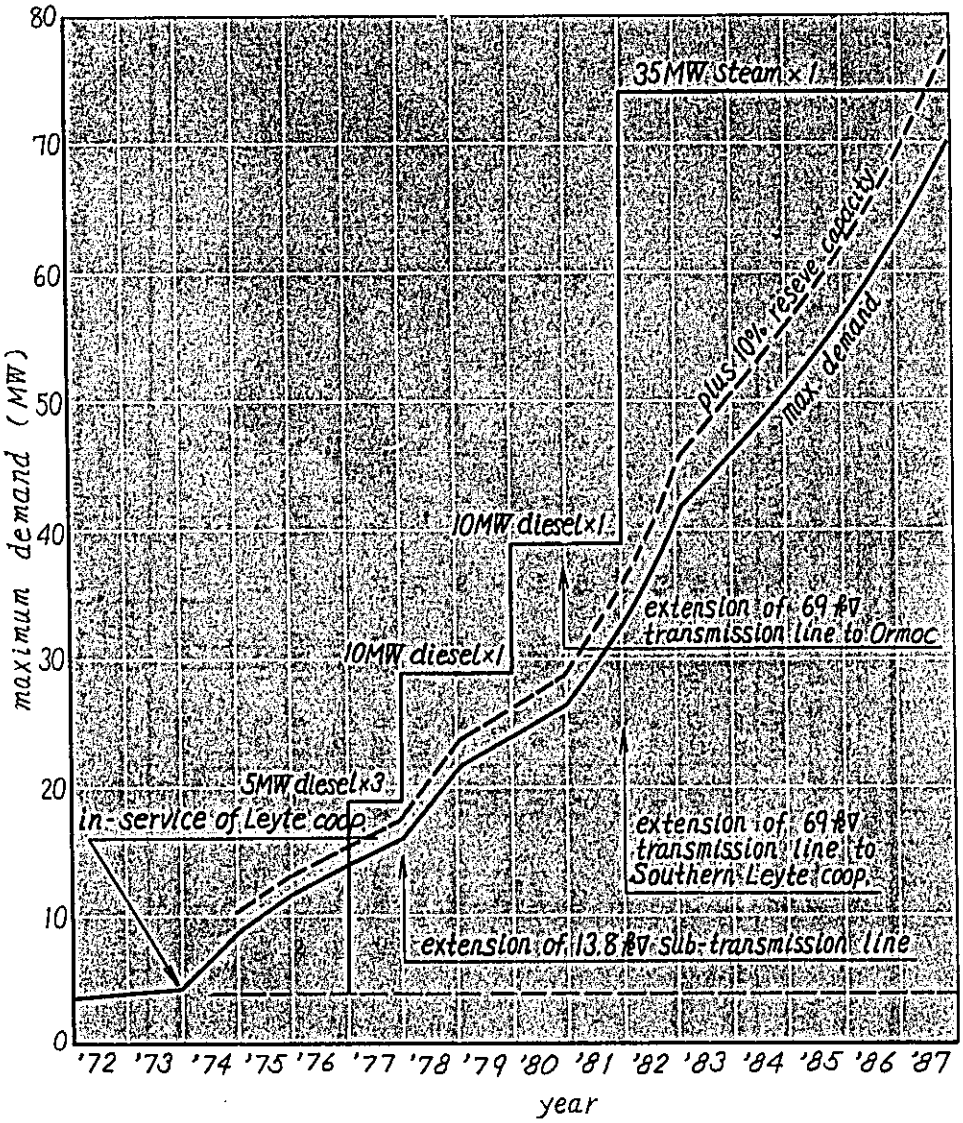


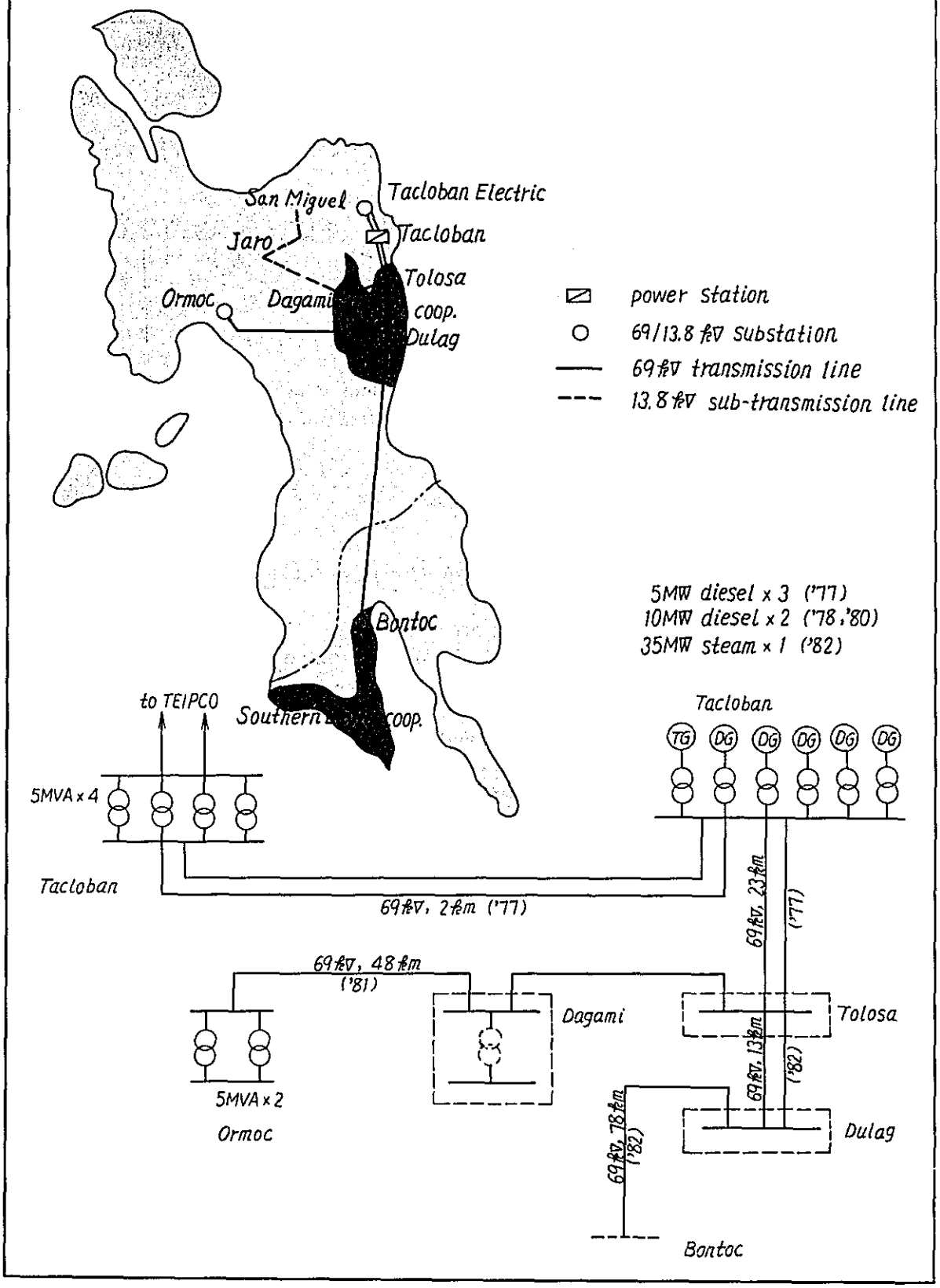
Table 6-14 Load Pick-up Forecast in Leyte

Year		* TEIPCO			Leyte Cooperative			** Others			Ormec Electric			S. Cooperative			Total		
		Energy (GWH)	L.F (%)	Max Demand (MW)	Energy (GWH)	L.F (%)	Max Demand (MW)	Energy (GWH)	L.F (%)	Max Demand (MW)	Energy (GWH)	L.F (%)	Max Demand (MW)	Energy (GWH)	L.F (%)	Max Demand (MW)	Energy (GWH)	L.F (%)	Max Demand (MW)
-1	1975	(4.5)	(27)	(1.9)	(27.1)	(47)	(6.6)	-	-	-	-	-	-	-	-	-	(31.6)	(43)	(8.5)
0	76	(9.9)	(44)	(2.6)	(32.8)	(48)	(7.8)	-	-	-	-	-	-	-	-	-	(42.7)	(47)	(10.4)
1	77	13.6	46	3.4	38.5	48	9.2	-	-	-	-	-	-	-	-	-	52.1	47	12.6
2	78	17.9	48	4.3	44.0	48	10.5	7.7	30	2.9	-	-	-	-	-	-	69.6	45	17.7
3	79	22.7	48	5.4	51.3	49	12.0	8.2	32	2.9	-	-	-	-	-	-	82.2	46	20.3
4	80	28.2	49	6.5	58.6	49	13.7	8.8	34	2.9	-	-	-	-	-	-	95.6	47	23.1
5	81	34.3	50	7.9	65.6	50	15.0	9.4	36	3.0	12.7	48	3.0	-	-	-	122.0	48	28.9
6	82	41.3	51	9.4	72.4	50	16.5	10.1	38	3.0	14.6	49	3.4	25.3	34	8.5	163.7	49	38.4
7	83	49.2	51	11.0	79.1	51	17.5	10.8	40	3.1	16.9	50	3.9	29.9	35	9.6	185.9	50	42.6
8	84	58.1	51	13.0	86.2	51	19.3	11.6	41	3.2	19.6	50	4.5	34.7	36	11.0	210.2	50	48.5
9	85	68.2	51	15.1	94.0	51	21.0	12.4	42	3.4	22.7	50	5.2	38.2	37	11.8	235.5	50	53.7
10	86	79.6	51	17.6	102.4	51	22.9	13.3	43	3.6	26.2	50	6.0	42.0	38	12.6	263.5	50	59.6
11	87	92.5	52	20.4	111.6	51	25.0	14.2	44	3.7	30.4	50	6.9	46.2	39	13.5	294.9	50	67.0
Increase (%)		21.1	-	19.8	11.3	-	10.6	7.0	-	2.8	15.7	-	15.0	11.3	-	8.9	-	-	-

Note * : excluding energy production of 4MW diesel Unit (18.9GWh/year)

** : Demand of San Miguel, Tunga, Jaro and Alangatang Municipalities

Fig. 6-18 Levte Grid in 1987



The future additions of facilities are as follows:

	Generating units	Substation transformers	Transmission lines
1977	5 MW x 3 diesel	5 MVA x 2	69 kV, 2 ccts., 25 km
78	10 MW x 1 diesel	-	13.8 kV, 1 cct., 47 km
79	-	-	-
80	10 MW x 1 diesel	-	-
81	-	5 MVA x 2	69 kV, 1 cct., 48 km
82	35 MW x 1 steam	5 MVA x 1	69 kV, 1 cct., 91 km
83	-	-	-
84	-	-	-
85	-	-	-
86	-	-	-
87	-	-	-
Total	70 MW	30 MVA	69 kV, 164 km 13.8 kV, 1 cct., 47 km

6-5-3 Per Capita Consumption and Electrification Ratio

The population on Leyte is estimated to be 1,754 thousand in 1987. Per capita energy consumption of 15 kWh in 1970 is expected to grow to 180 kWh in 1987.

Based on the load forecast described in the foregoing and the distribution of population, the electrification ratio of 5 percent in 1970 was estimated to increase to 20 percent in 1977, and further in 1987 it will reach 39 percent.

6-6 Samar

Electricity demand on Samar, the basis for the formulation of power development program, is very small when compared with those on the other Visayan islands. As compared with Negros which has almost the same area, Samar was only one tenth in peak demand and one twentieth in energy consumption in 1970. The only city on Samar, Calbayog, 94 thousand in 1970 population, and Catbalogan populated by 49 thousand in 1970, have a total installed capacity of 950 kW which comprises about 50 percent of the total on Samar. Under such circumstances, the strategic establishment of NPC should be deferred considerably. Besides, due to difficulty in obtaining data, it was necessary to set up several hypothetical assumptions in order to formulate a power development program.

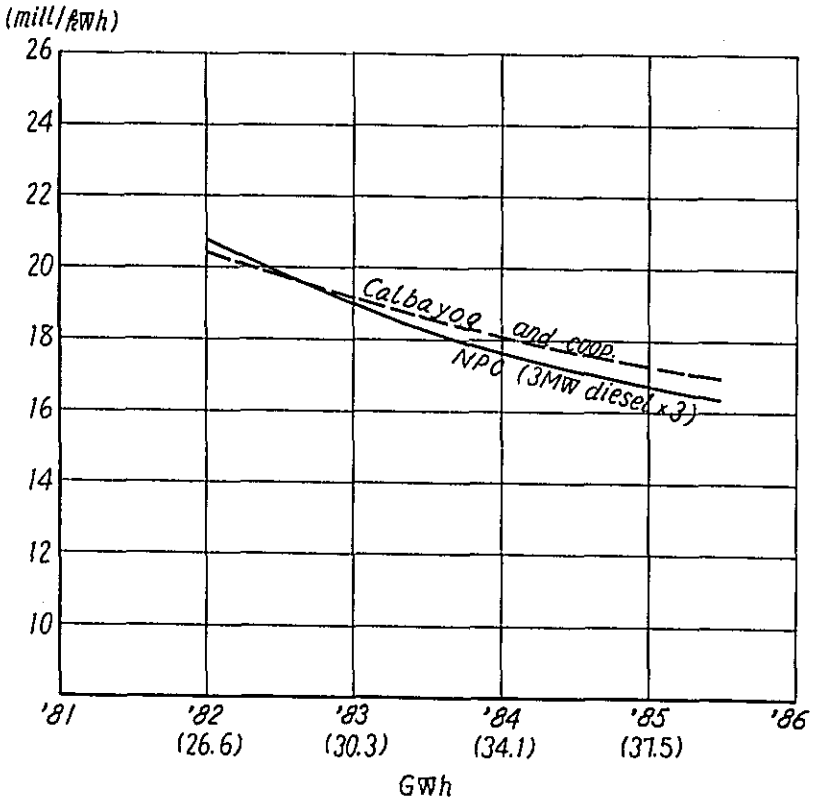
6-6-1 Load Forecast

The future demand of a cooperative proposed in Northern Samar was assumed to be identical with that of the cooperative in Bohol, since the capital investment for the two cooperatives are almost the same. Power demands in Calbayog and Catbalogan were assumed to grow at an annual rate of 10 percent from the recorded peak demands of Calbayog in 1970 and of Catbalogan in 1971. Demand forecasted in the report is shown in Table 6-15.

6-6-2 Development Program

There is a hydro power project proposed on the Ulot River flowing eastward in the mid part of the island. The project, 24 MW in proposed capacity, has been investigated by NPC since 1969. But, the study is on the preliminary stage, and the feasibility is still unknown. Therefore, the project was not considered in the development program. As in the case of the other Visayan islands, timing of NPC's establishment on the island was studied with the 3 MW diesel units as considered in Bohol Grid. The power plant site was scheduled in Calbayog in consideration of the interconnection with Catbalogan in the future when the demand in Catbalogan becomes large.

Fig. 6-19 Energy Cost at Receiving End



It may be noted from Fig. 6-19 and Table 6-16 that the establishment of NPC on Samar will be in 1983 at the earliest. From the estimated size of demand at that time, the initial installation was considered to be three 3 MW diesel units. Table 6-16 gives the demand which will be met by energy to be produced by NPC, and Fig. 6-20 shows development program to meet the demand.

There are two municipalities in southern Samar, Santa Rita and Basey. Population of the municipalities was respectively 21 thousand and 35 thousand in 1970. It will be possible to supply power to these municipalities from Tacloban in Leyte by way of San Juanico Bridge, but demand in the municipalities is, according to the estimate of NPC, 100 kW and 180 kW respectively. A 13.8 kV sub-transmission line is not economical for this purpose.

Fig. 6-20 Development Program in Samar

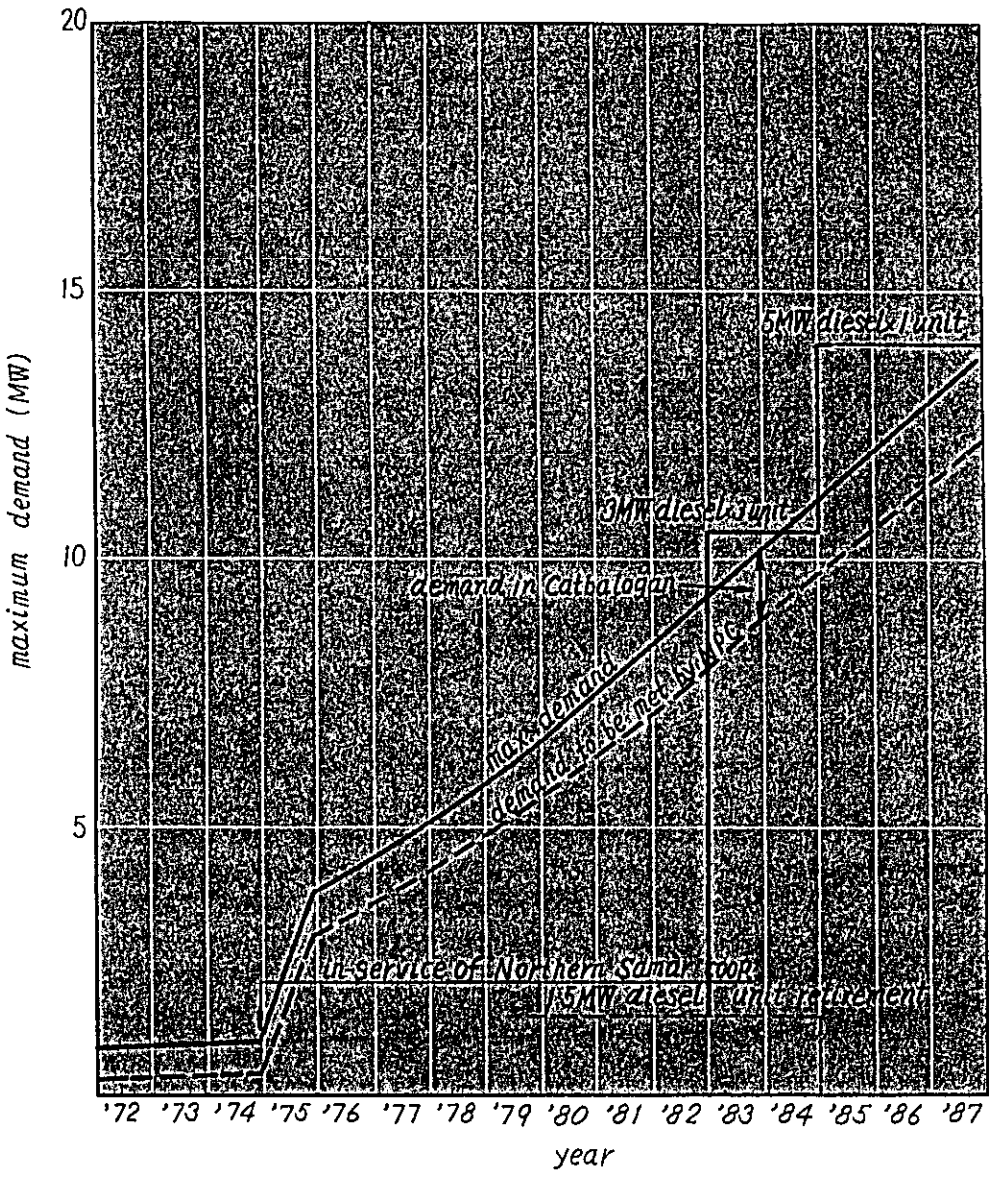


Table 6-15 Load Forecast in Samar

		Calbayog			Catbalogan			Cooperative			Total		
		Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
1	1972	1.0	39	0.3	2.1	40	0.6	–	–	–	3.1	39	0.9
2	73	1.1	40	0.3	2.3	40	0.7	–	–	–	3.4	39	1.0
3	74	1.2	41	0.3	2.5	41	0.7	–	–	–	3.7	42	1.0
4	75	1.3	41	0.4	2.7	41	0.8	5.4	26	2.4	9.4	30	3.6
5	76	1.5	42	0.4	3.0	42	0.8	7.8	28	3.2	12.3	32	4.4
6	77	1.6	42	0.4	3.3	42	0.9	9.1	30	3.5	14.0	33	4.8
7	78	1.8	43	0.5	3.7	43	1.0	12.2	31	4.5	17.7	34	6.0
8	79	2.0	43	0.5	4.0	43	1.2	14.8	33	5.1	20.8	35	6.8
9	80	2.2	44	0.6	4.4	44	1.2	17.3	35	5.6	23.9	37	7.4
10	81	2.4	44	0.6	4.9	44	1.3	20.1	36	6.4	27.4	38	8.3
11	82	2.6	44	0.7	5.4	44	1.4	24.0	38	7.2	32.0	39	9.3
12	83	2.9	45	0.7	5.9	45	1.5	27.4	40	7.8	36.2	41	10.0
13	84	3.2	45	0.8	6.5	45	1.7	30.9	41	8.6	40.6	42	11.1
14	85	3.5	46	0.9	7.1	46	1.8	34.0	42	9.2	44.6	43	11.9
15	86	3.8	46	0.9	7.8	46	1.9	37.4	43	9.8	49.0	44	13.7
16	87	4.2	47	1.0	8.6	47	2.1	41.1	44	10.6	53.9	46	13.7
Increase (%)		10	–	8.4	10	–	8.7	13.6	–	13.0	–	–	–

Note. LF: Load factor

Fig. 6-21 Samar Grid in 1987

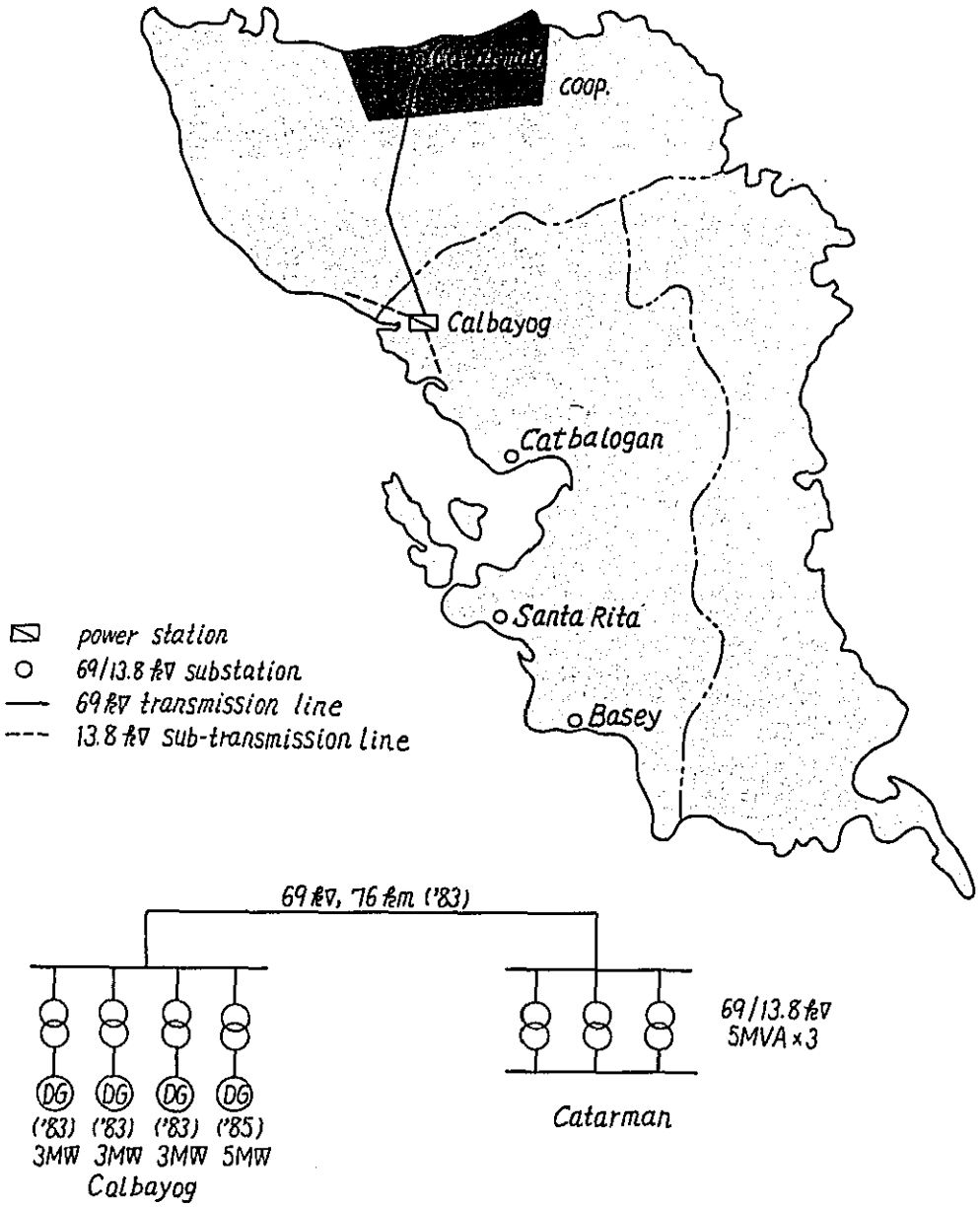


Table 6-16 Load Pick-Up Forecast in Samar

		Calbayog			Cooperative		
		Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
(-1)	1982	(2.6)	(44)	(0.7)	(24.0)	(38)	(7.2)
1	83	2.9	45	0.7	27.4	40	7.8
2	84	3.2	45	0.8	30.9	41	8.6
3	85	3.5	46	0.9	34.0	42	9.2
4	86	3.8	46	0.9	37.4	43	9.8
5	87	4.2	47	1.0	41.1	44	10.6
Increase (%)		10	–	7.7	10	–	7.2

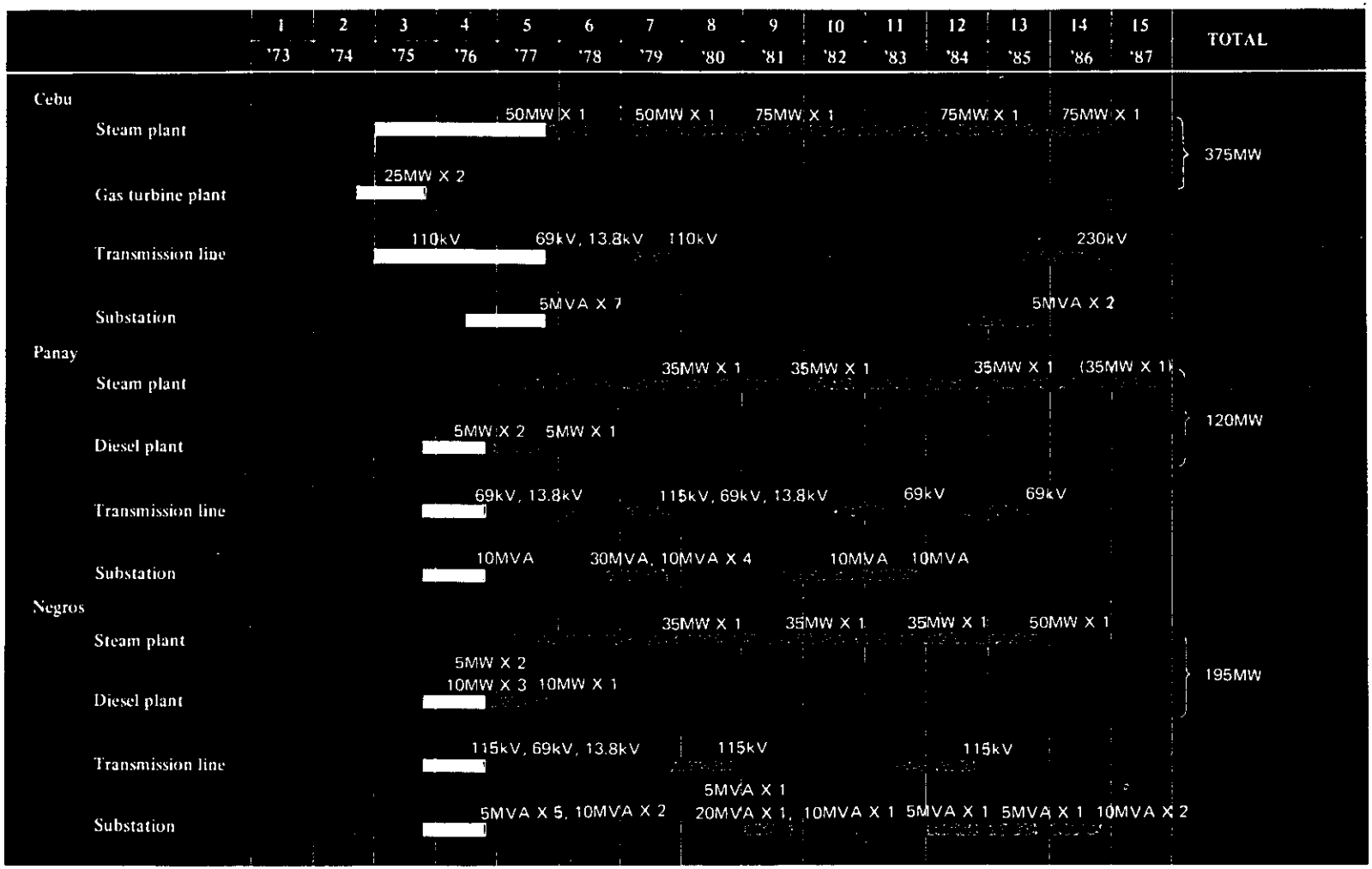
		Others *			Total		
		Energy (GWh)	LF (%)	Max. demand (MW)	Energy (GWh)	LF (%)	Max. demand (MW)
(-1)	1982	–	–	–	(26.6)	(39)	(7.9)
1	83	1.1	35	0.4	31.4	41	8.9
2	84	1.2	36	0.4	35.3	41	9.8
3	85	1.3	37	0.4	38.8	42	10.5
4	86	1.4	38	0.5	42.6	44	11.2
5	'87	1.6	40	0.5	46.9	44	12.1
Increase (%)		9.9	–	6.4	10.5	–	7.7

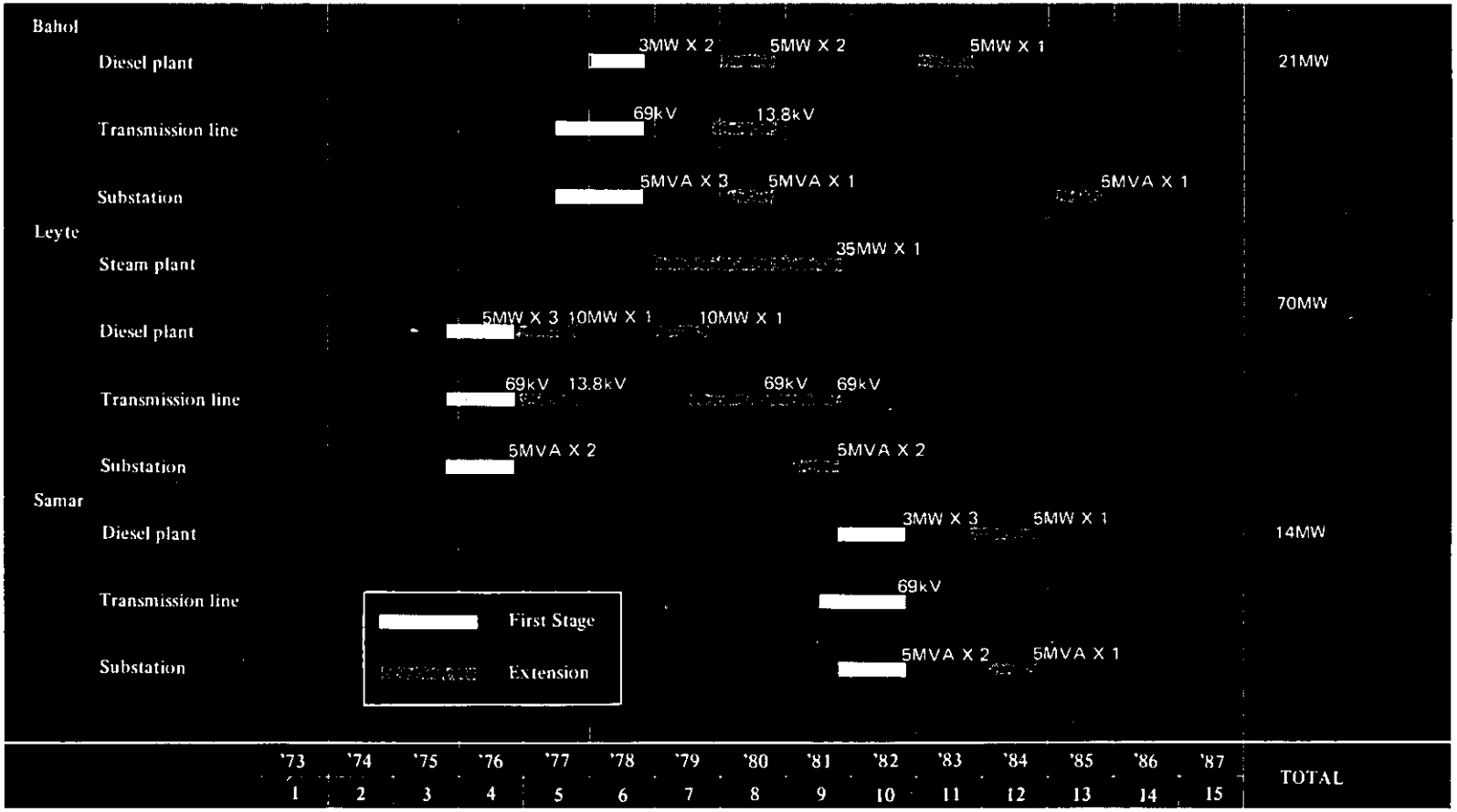
Note: * includes Oquendo, Santa Margarita, etc.
LF: Load factor

6-7 Construction Schedule

Fig. 6-22 gives the construction schedule of each island. The construction period of steam power plant was assumed to be three years, and those of diesel power plant and gas turbine power plant to be respectively two years and one and a half years. Two years were considered for the construction of a transmission line and a substation.

Fig. 6-22 Construction Schedule of Visayas Projects




Bahol
Diesel plant
3MW X 2
5MW X 2
5MW X 1
21MW
Transmission line
69kV
13.8kV
Substation
5MVA X 3
5MVA X 1
5MVA X 1
Leyte
Steam plant
35MW X 1
70MW
Diesel plant
5MW X 3
10MW X 1
10MW X 1
Transmission line
69kV
13.8kV
69kV
69kV
Substation
5MVA X 2
5MVA X 2
Samar
Diesel plant
3MW X 3
5MW X 1
14MW
Transmission line
69kV
Substation
5MVA X 2
5MVA X 1
First Stage
Extension
'73
'74
'75
'76
'77
'78
'79
'80
'81
'82
'83
'84
'85
'86
'87
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
TOTAL

6-8 Inter-island Transmission Line

Located close to one another, the islands of the Visayas have long been contemplated of their interconnection by transmission lines. Merits conceivable of the interconnection are as follows:

(a) Saving of reserve capacity

(b) Energy cost economized by installing large generating units

(c) Saving of peak supply capability due to difference in peak hours

(d) Improvement of grid reliability

Since the pattern of living and the climatic conditions are almost identical on all the islands except the seasonal precipitation, merit of (c) can not be expected in the Visayas. Merits of (a) and (b) might give a ground to justify inter-island connection. In the Visayas where power grids are all small, an interconnection of two grids might enable installation of generating units of twice as large capacity as the prevailing maximum unit capacity. On the other hand, inter-island connection will be conditional on the size of grids and economical transmission. Submarine cables, conceivable for inter-island connection of major Visayan islands, are expensive. Therefore, power flow on the submarine cables should be large enough to offset the expensive construction cost. Of the construction cost, cable laying cost comprises a large portion. Including charterage and outfit expenses of boat, the cable laying cost is not proportional to the size of the cable. Less the size becomes, per kVA unit cost will be higher. On the other hand, requirement of cable strength restricts the cable size, in case of 69 kV, to be approximately 3-core, AWG 4/0 (equivalent to about 100 square milimeters), 25 MVA in transmission capacity. Economical transmission is subject to the distance with which the construction cost and transmission loss will increase. Short spans where interconnection is conceivable in the Visayas are as follows:

(a) Between Iloilo City in Panay and Bacolod City in Negros Occidental.

(b) Between Dumaguete City in Negros Oriental and the southern tip of Cebu.

(c) Between Tacloban City in Leyte and Samar

Due to the short span interconnection between Tacloban and Samar will be made at very low cost. However, very small load on Samar at the present time will leave a problem unsolved.

The span between Cebu and Negros near Dumaguete is 5.5 kilometers only. But, the small load in Dumaguete, about 3 MW in 1970, and the long distance between Cebu City, or the power plant site at Liloan, and the point opposite Dumaguete, approximately 150 kilometers along transmission route, will give a negative ground for inter-island connection for some time in the future.

Iloilo City and Bacolod, the largest cities on the respective islands, are facing each other over a strait. Therefore, detailed analysis was performed on the interconnection of these cities.

Interconnection of Iloilo and Bacolod

The transmission line consists of 15 kilometers long submarine cable and 20 kilometers long overhead line on the island of Guimaras in addition to 25 kilometers distance on Negros island. Merits on inter-connection will be derived from the unity of two separate grids. However, the minimum size of submarine cable, stated in the foregoing, will not justify the interconnection before the operation of 35 MW steam turbine units in both grids, which will be in 1982.

(1) Comparative study

Assuming the interconnection to be made in 1982, the capital investment requirement for power development up to 1987 was calculated in terms of the present worth as of 1982 for two cases; one with interconnection line and the other without the line.

The power development programs with and without the interconnection line are shown in Table 6-17 and Fig. 6-23.

Table 6-17 Development Program

Year	Demand (MW)			Development program (MW)		
				Without interconnection		With interconnection
	Panay	Negros	Total	Panay	Negros	
1982	112.8	66.7	179.5	35 x 1	35 x 1	35 x 1
3	128.9	74.1	203.0	–	–	–
4	146.9	83.1	230.0	–	35 x 1	75 x 1
5	167.5	93.5	260.0	35 x 1	–	–
6	191.9	104.7	296.6	–	50 x 1	75 x 1
7	218.3	116.0	334.3	–	–	–

Note: Generators are all to be driven by steam turbines.

In order to raise the reliability, four single core submarine cables were considered, including one reserve, with the size of 494 MCM (about 250 square milimeters), 100 MVA in transmission capacity.

(2) Conclusion

The capital investment requirements were obtained based on the foregoing development program as follows:

	1982 price at 7% discount rate (in thousand US$)
Construction cost of interconnection line	4,718
Construction cost of power plants	
Without interconnection	39,750
With interconnection	34,562
Difference in power plant cost	5,188
Merit of interconnection	470

Table 6-18 Construction Cost of Interconnection of Panay with Negros

(in thousand US dollars)

		Length (km)	Cost
Submarine cable (115 kV)			3,370
Cable	O.F. cable x 4	15	(2,400)
Others	C.H., etc.		(190)
Installation			(780)
Overhead transmission line (115 kV)			890
Negros side 336.4 MCM lcct wood		21	(200)
Iloilo " 477 MCM lcct steel		2	(40)
Guimaras side 477 MCM lcct steel		20	(350)
Line terminal		6 *	(300)
Total			4,200

Note: * includes terminal at Jordan substation in Guimaras

As shown in the foregoing, the merit of interconnection in terms of saving in the capital investment which otherwise would be required for the expansion of power plant would be US$ 5, 188 thousand in 1982 price. Deducting from this the construction cost of interconnection line of US$ 4,718 thousand leaves US$ 470 thousand, which may be considered as the merit of the interconnection. Therefore, it is construed that the interconnection project is worth considera-tion with detailed analysis.

The water between Guimaras and Negros is shallow. Between Guimaras and Panay, marine traffic along the strait is heavy although water is deep. Therefore, some measures might have to be taken to protect the cables from demages to be caused by anchoring.

Fig. 6-23 Load Forecast and Development Program in Panay and Negros Grid

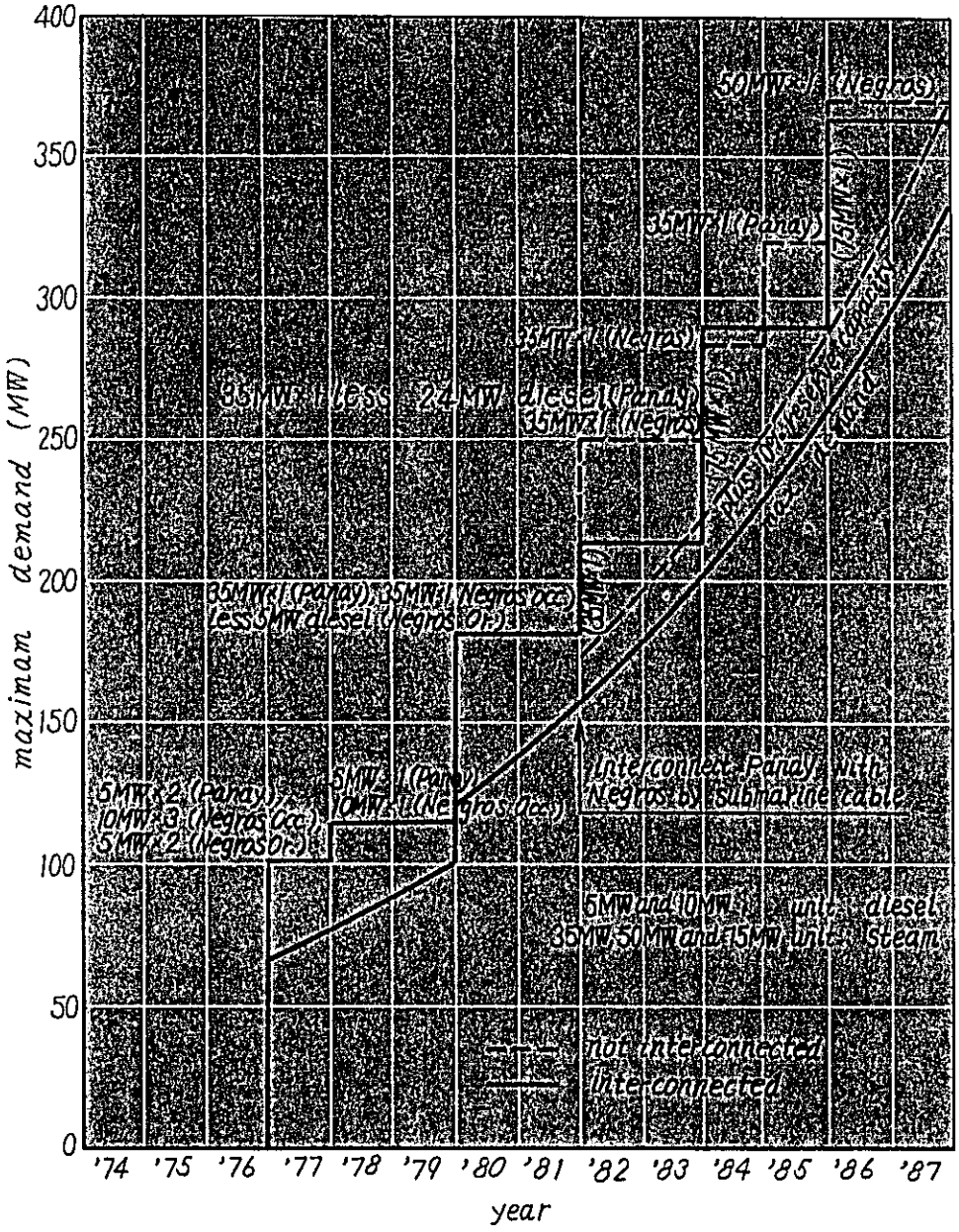


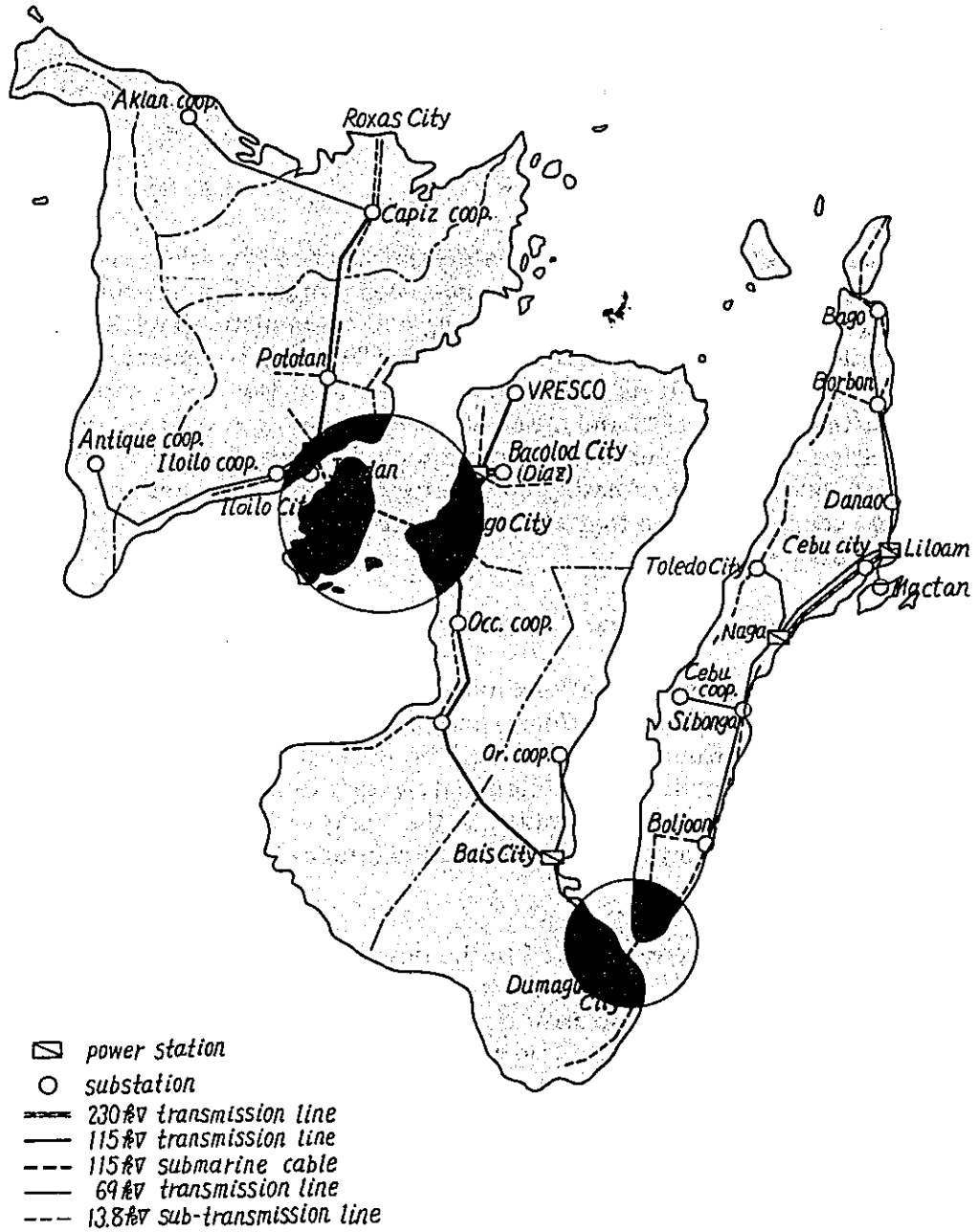
Table 6-19 Merit of Interconnection

(in thousand US dollars)

	Year of Competion	Total	1979	1980	1981	1982	1983	1984	1985	1986	1987
Construction cost of inter-connection line (See Table 5-23)	1981	4,260		2,130	2,130						
1982 present worth*		4,718		2,439	2,279						
Construction cost of power plant											
Without interconnection											
Steam 35 MW x 2	1981	14,700	3,675	8,085	2,940						
Steam 35 MW x 1	1983	7,350			1,838	4,042	1,470				
" 35 MW x 1	1984	7,350				1,838	4,042	1,470			
" 50 MW x 1	1985	9,750					2,438	5,362	1,950		
Total (190 MW)		39,150	3,675	8,085	4,778	5,890	7,950	6,832	1,950		
1982 present worth*		39,750	4,502	9,257	5,112	5,890	7,430	5,967	1,592		
With interconnection line											
Steam 35 MW x 1	1981	7,350	1,838	4,042	1,470						
Steam 75 MW x 1	1983	13,875			3,469	7,631	2,775				
" 75 MW x 1	1985	13,875					3,469	7,631	2,775		
Total (185 MW)		35,100	1,838	4,042	4,939	7,631	6,244	7,631	2,775		
1982 present worth*		34,562	2,252	4,628	5,285	7,631	5,836	6,665	2,265		
Difference in power plant cost		4,050									
1982 present worth*		5,188									
Merit of interconnection											
Construction cost		- 210									
1982 present worth*		470									

NOTE: * Discount rate: 7 %

Fig. 6-24 Panay, Negros and Cebu Grid



6-9 Recommendations on Project Implementation

This project consists of the establishment of insular power grids in the Visayas by constructing a centralized power plants on each island and transmission lines, aiming at the electrification of the entire Visayas on an area coverage basis by extending electric utility services with energy produced at a cost reasonably low. The National Power Corporation established the Visayas Regional Office, its first office in the Visayas, in Cebu in August 1972, and so far, does not have any generating or transmission facilities in the Visayas except a couple of small hydro power plants. In view of such circumstances in the Visayas, the followings are recommended in order to implement the project smoothly and efficiently.

(1) Power Grid Committee

Pursuant to the provisions of Presidential Decree No. 40 dated November 7, 1972, the National Power Corporation has been assigned to the construction and operation and maintenance of generating and transmitting facilities, and the distribution of electric power generated by NPC is to be undertaken by cooperatives, private utilities and municipal utilities. However, without amicable cooperation between NPC and other utilities including cooperatives, smooth implementation of the project can not be expected. Therefore, it is thought necessary to establish coordinating committees between NPC and the respective utilities and cooperatives so that close contacts can be kept in fulfilling the execution of the project.

(2) Organization and Training Program of NPC

In NPC, technical specifications and other documents for a project are prepared in the Engineering and Construction Department in the Head Office, Manila. The construction supervision and the operation and maintenance will be performed by the Construction Division and System Generation Division of the regional office. Although not organized in the Visayas Regional Office, these two divisions will have to be established and reinforced along with the progress of the project.

Having been primarily engaged in the development of hydro power resources, NPC has experienced staff in this field. However, Bataan Power Plant, 75 MW in installed capacity, is the first thermal power plant constructed by NPC in October, 1972. Although NPC is now successively engaged in the construction of No. 2 unit, 150 MW in capacity, the engineering staff seems to be lacking in experienced engineers in the field of steam power plant construction. Since the power plants to be constructed in the Visayas will be all thermal including internal combustion type, it will be necessary to train electrical and mechanical engineers in advance. Emphasis is put on the training of middle class engineers who will be the core in performing the construction and operation.

(3) Market Survey

As power development program is totally dependent on the estimate of

future demand, it is mandatory to make the estimate as accurate as possible. However, the past records of utilities are not complete, except those of major utilities, in the Visayas, and sometimes no records are kept. Therefore, it is a very hard task to seize the present situation of power industry. In addition, practically no data are available on the industrial power plants which, large in scale, are very influential on the estimate of future load.

Therefore, it is recommended that NPC be engaged in collection and classification of data as soon as practicable. Thorough research is required, e.g. on kind of fuel, fuel cost, plant factor, energy cost, and in case of utilities, load restriction. It is necessary to adjust and modify the power development program at least once a year based on the market survey stated in the above.

Chapter 7 Investment Program

7-1 Cost Estimate

7-1-1 Scope of Estimate

The estimate covers and includes the monetary requirement during the period of 1973 to 1987 for the construction of power plants, transmission lines and substations which will constitute the power grids described in Chapter 6. The power plants will accommodate diesel engine generators, gas turbine generators or steam turbine generators. The transmission lines and substations are to wholesale energy to utilities and cooperatives. Generally, they are 69 kV or 115 kV transmission lines. Wholesale to minor utilities will be made through 13.8 kV sub-transmission lines.

7-1-2 Conditions of Estimate

Supply of Materials

All the electrical and mechanical equipment and the materials of the power plants, substations, and transmission lines were assumed to be imported from abroad. The supporting structures of 115 kV lines will be steel towers, while

those for transmission lines of 69 kV and lower will be, following the practice of NPC, made of treated wooden poles available in the Philippines.

Prices of Equipment, Machineray and Materials

As stated in Chapter 1, the prices of equipment and machinery that are to be imported are the probable prices in the international tenders estimated taking into account the recent pruchase prices in the Philippines, as well as, ECAFE region. The construction cost of substations and transmission lines were based on data made available by NPC that are indicated in terms of unit prices per kilometer length and per kVA capacity.

Foreign Currency Requirement

The foreign currency requirement was assumed to be a sum of the amount of CIF prices of equipment and machinery and a part of installation cost, but excluding inland transportation cost and a major part of installation cost that will have to be covered by domestic currency. The construction cost for civil works of the power plant was considered in the domestic currency portion.

Taxes and Duties

As amended in the New Charter, NPC is exempted from all the taxes and duties, and therefore they were not considered.

Interest During Construction

The interest during construction was estimated for the period stipulated in Chapter 6 and with the interest rates of 3.5 percent for foreign currency portion and 7.0 percent for domestic currency portion.

Contingencies

The facilities programed to be installed in this report include power plants of steam turbine generators, diesel driven generators, and gas turbine generators, as well as, transmission lines and substations. In estimating the construction cost, a power plant with steam turbine units involves less unknown factors than a hydro power plant, and much less in the case of diesel driven units and gas turbine units. The transmission line routes were planned alongside highways, and no difficulties are expected to be encountered during the construction work. Upon these considerations, the contingencies were set at 8 percent for steam power plants and 5 percent for other power plants, as well as, transmission lines and substations.

Engineering Fee

The engineering fee including definite design, preparation of specifications and construction supervision, was assumed to be 5 percent.

Exchange Rate

All the costs are indicated in US dollars with an exchange rate of 1 dollar to 6.7 pesos.

7-1-3 Capital Investment Requirement

The capital investment requirement was calculated based on the development programs established for the respective islands and the conditions and assumptions described in 7-1-2. Disbursements for construction of respective plants were assumed as follows:

Plant	Construction period (year)	Disbursement 1st yr. (%)	2nd yr. (%)	3rd yr. (%)	Total (%)
Steam power plant	3	25	55	20	100
Diesel power plant	2	20	80	-	100
Gas turbine plant	1	100	-	-	100
Transmission plant	1	50	50	-	100

The result of the calculation is shown in Table 7-1 below and the summary of investment schedule by island is shown in Table 7-2.

Table 7-1 Total Investment

(in million US dollars)

	Foreign Currency	Domestic Currency	Total
Cebu	55.5	15.9	71.4
Panay	23.2	6.9	30.1
Negros	37.5	9.2	46.7
Bohol	4.6	0.9	5.5
Leyte	13.4	3.4	16.8
Samar	3.2	0.9	4.1
Total	137.4	37.2	174.6

The total capital investment requirement is US$ 175 million, US$ 138 million

Table 7-2 Summary of Investment Schedule

Island		1974	1975	1976	1977	1978	1979
Cebu	Total	200	7,350	7,440	6,390	5,510	5,560
	FC	80	6,270	5,240	4,400	4,360	4,400
	DC	120	1,080	2,200	1,990	1,150	1,160
Panay	Total		710	2,120	2,670	5,980	5,240
	FC		570	1,760	2,170	4,280	3,710
	DC		140	360	500	1,700	1,530
Negros	Total		3,150	8,180	3,440	4,120	4,590
	FC		2,340	6,610	2,830	3,270	3,200
	DC		810	1,570	610	850	1,340
Bohol	Total				700	1,460	560
	FC				540	1,190	465
	DC				160	270	95
Leyte	Total		1,100	3,360	1,660	2,290	5,910
	FC		895	2,790	1,385	1,855	4,755
	DC		205	570	275	435	1,155
Samar	Total						
	FC						
	DC						
Grand Total	Total	200	12,310	21,100	14,860	19,360	21,860
	FC	80	10,075	16,400	11,325	14,955	16,580
	DC	120	2,235	4,700	3,535	4,405	5,680

Note : FC : Foreign currency
DC : Domestic currency

(in thousand US dollars)

1980	1981	1982	1983	1984	1985	1986	1987	Total
7,600	2,700	3,500	7,600	6,240	8,110	3,170		71,370
6,080	2,160	2,800	6,080	4,990	6,290	2,340		55,490
1,520	540	700	1,520	1,250	1,820	830		15,880
4,050	1,510	2,050	4,190	1,510	70			30,100
3,240	1,230	1,640	3,350	1,210	40			23,200
810	280	410	840	300	30			6,900
4,750	3,360	4,050	4,010	5,500	2,100	110		47,360
3,640	2,710	3,240	3,330	4,660	1,790	100		37,770
1,110	610	810	680	840	310	10		9,590
1,730		200	780	40	40			5,510
1,455		170	660	35	35			4,550
275		30	120	5	5			960
2,120	400							16,840
1,530	190							13,400
590	210							3,440
	940	2,070	200	865				4,075
	660	1,620	170	735				3,185
	280	450	30	130				890
20,250	8,910	11,870	16,780	14,155	10,320	3,280		175,255
15,945	6,950	9,470	13,590	11,630	8,155	2,440		137,595
4,305	1,960	2,400	3,190	2,525	2,165	840		37,660

in foreign currency and US$ 37 million in domestic currency. Reflecting the economic activities of island, Cebu requires 41 percent of the total, followed by Negros and Panay, and then Leyte, Bohol and Samar in the order. Not including the cost of a 35 MW steam turbine unit to be operational in 1988, the investment requirement on Panay is not so different from that of Negros as what is indicated in the table. If averaged over the years of disbursement, 1974 to 1986, the annual investment requirement is US$ 13,400 thousand.

First Stage Construction Cost

Of the long-range power development program, the first establishment of NPC's plant on each island has been designated as the first stage construction. Fig. 6-22 shows the scope of the first stage on the respective islands. The first stage includes the construction of power plants accommodating diesel driven units and pertinent transmission and transformation plants except in Cebu where the power plant will have gas turbine generators and a steam turbine generator in the first stage since the gas turbine generators will be economical only when they are operated in combination with a steam turbine unit.

The aggregate capital investment requirement for the first stage will be US$ 42.7 million; foreign currency comprising 76 percent and domestic currency 24 percent. If the requirement on Cebu is considered separately, the total will be reduced to US$ 22.6 million.

Appropriateness of Investment Requirement in the Visayas

Four-Year Development Plan 1971-1974 published by the Philippine Government appropriated US$ 168 million equivalent in total for investment in the field of power industry. Of this total, US$ 137 million will be for the construction of power generation and transmission facilities, the remaining for the implementation of rural electrification program. If averaged over the four years, this would be US$ 34 million annually. However, this amount has been counted for the investment in Luzon and Mindanao only. In consideration of that the Visayas population comprises one fourth of the Philippines' total, US$ 11 million which corresponds to one third of the investment in Luzon and Mindanao, may be expected to be invested in the Visayas annually. Four-Year Development Plan estimates the Philippine economy will grow at an annual rate of about 7 percent. If this estimate comes to be true, capital investment in the power industry will have to be increased considerably in the future. Therefore, an average of US$ 13 million which is the annual requirement estimated in this report for the implementation of the power development program for the years of 1974 to 1984, is an expectable amount to be invested in the Visayas. To date, no capital investment has been made by the Government to the power industry in the Visayas.

The breakdown of the construction costs by island is described into details in the followings:

(1) Cebu (See Table A2-1)

Following the first operation of two 25 MW diesel units in 1976, two 50 MW and three 75 MW steam turbine units, totaling 375 MW, will be installed by 1987. A transmission line will be constructed to connect to VECO grid by the end of 1975. The island wide grid will be constructed by 1978. In 1987, when No. 3 unit of 75 MW steam turbine generator will be put in operation at a power plant south of Cebu, a 230 kV line will be completed between the power plant and Cebu.

Total capital investment requirement during the years of 1974 to 1987 is US$ 72 million, US$ 56 million in foreign currency and US$ 16 million in domestic currency. Of the total, 90 percent is required by generating facilities and 10 percent by transmission lines and substations.

(2) Panay (See Table A2-2)

The initial operation of two 5 MW diesel units in 1977 will be followed by the installation of three 5 MW diesel units and three 35 MW steam turbine units, totaling 120 MW in capacity, during the ten years up to 1986. The installation of the first steam unit will make it practicable to construct an interconnection line between Capiz and Iloilo.

The total capital investment requirement in the years of 1975 to 1985 will be US$ 30.1 million, US$ 25.2 million for generating facilities and US$ 4.8 million for transmission lines and substations. The domestic currency requirement will be US$ 6.9 million, and the foreign currency requirement US$ 23.2 million; the ratio being 26:74. The initial capital investment to constitute a grid by 1980 will be US$ 14.9 million.

(3) Negros (See Table A2-3)

The total copital investment requirement on Negros is US$ 47.4 million which is the second largest following Cebu. Of this, US$ 37.8 million will be required in foreign currency, and US$ 9.6 million in domestic currency. Provincial distribution of the investment is US$ 41.2 million in Negros Occidental and US$ 6.2 million in Negros Oriental.

In Negros Occidental, NPC's power plant will be completed in 1977 to supply power to Bacolod and other major distribution networks. Approximately US$ 10.9 million will be required for the start of operation. In 1980, a 35 MW steam turbine generator will start operation. In the following 1981, a transmission line will be extended to the south of Negros Occidental and further to Negros Oriental to constitute a single grid on the island of Negros.

In Negros Oriental, power supply by NPC will start in the same year of 1977 to an area around Bais City and Dumaguete City. In 1980 when the 35 MW steam turbine generator will be installed in Negros Occidental, a 10 MW diesel unit in Negros Occidental will be relocated to Negros Oriental.

(4) Bohol (See Table A2-4)

The capital investment requirement in the years up to 1987 will be US$ 5.5 million. Of the total, 76 percent will be disbursed for the installation of diesel driven generators. The construction of transmission lines and substations will require a total investment of US$ 1.3 million. The capital investment of the first establishment of NPC will be US$ 2.2 million, US$ 1.7 million in foreign currency and US$ 0.4 million for domestic currency.

(5) Leyte (See Table A2-5)

The total capital investment requirement up to 1987 will be US$ 16.8 million, US$ 4 million for the initial establishment of grid around Tacloban in 1977, US$ 3.8 million for additional diesel generators, US$ 0.7 million for the interconnection with Ormoc and local expansion in 1981 and US$ 8 million for the installation of a steam turbine generator and interconnection with a cooperative in Southern Leyte in 1982.

(6) Samar (See Table A2-6)

The total capital investment will be US$ 4.1 million, US$ 3 million for the installation of three 3 MW diesel units and 69 kV transmission line between Calbayog and a cooperative in Northern Samar, US$ 1.1 million for an additinal 5 MW diesel unit.

7-2 Energy Cost

The cost of energy to be produced by the development program proposed in Chapter 6 was calculated. The energy cost will rise after investment of fixed capital and tend to lower with the increase in energy sales. Annual fluctuations will be seen. However, it will tend to be astringed although gradually to a certain level.

The energy cost obtained herein is based on energy to be sold after losses in transmission and transformation and includes all the costs for generation, transmission and transformation. Therefore, it will be possible to estimate the paying point of power rate schedule. And if the power rate schedule is compared with the prevailing energy cost of diesel power plant or steam power plant, economical judgement of the development program may be done.

7-2-1 Bases for Energy Cost

The bases, upon which energy cost was calculated, is transcribed from Chapter 5 in the followings:

(1) Service Life and Depreciation (in accordance with the rules of NPC)

Not stipulated in NPC rules, the service life and rate of depreciation of a gas turbine power plant were taken to be the same as those of a steam power plant as it is a general practice in Japan.

Plant	Service life (year)	Annual rate of depreciation (%)
Power plant with		
Steam turbine generators	33	3.03
Diesel Driven generators	18	5.55
Gas turbine generators	33	3.03
Transmission plant	30	3.33

(2) Interest Rate

Foreign currency portion	3.5 %
Domestic currency portion	7.0 %

(3) Operation and Maintenance Cost and Others

Wage and salary were estimated on the basis of US$ 1,200 per person per year. Repair cost and miscellaneous expenses of power plant were assumed to be respectively 2 percent and 0.2 percent of the construction cost. Overhead cost was assumed to be 8 percent of the operation and maintenance cost. Operation and maintenance cost of transmission line was assumed to be 3.0 percent of the construction cost, and it is 2.5 percent for substation.

(4) Fuel cost

Fuel cost of Bunker C oil was set at US$ 21.19 per kiloliter which is the averaged price at which the government agencies in Panay and Negros are purchasing in bulk in December 1972. Lubricating oil cost was separately assumed to be US$ 320 per metric ton.

7-2-2 Result of Calculation

Fig. 7-1 gives the annual energy cost by island. In Cebu, due to the introduction of large capacity steam turbine unit, the energy cost is the lowest and will go down steadily, and in 1986 it will decrease to less than 10 mills per kWh. In the figure, Cebu is followed by Negros, and then, by Leyte, Panay and Samar in the order. It may be noticed that the energy cost, although rising immediately after investment of fixed capital, generally tends to go down as the grid grows large.

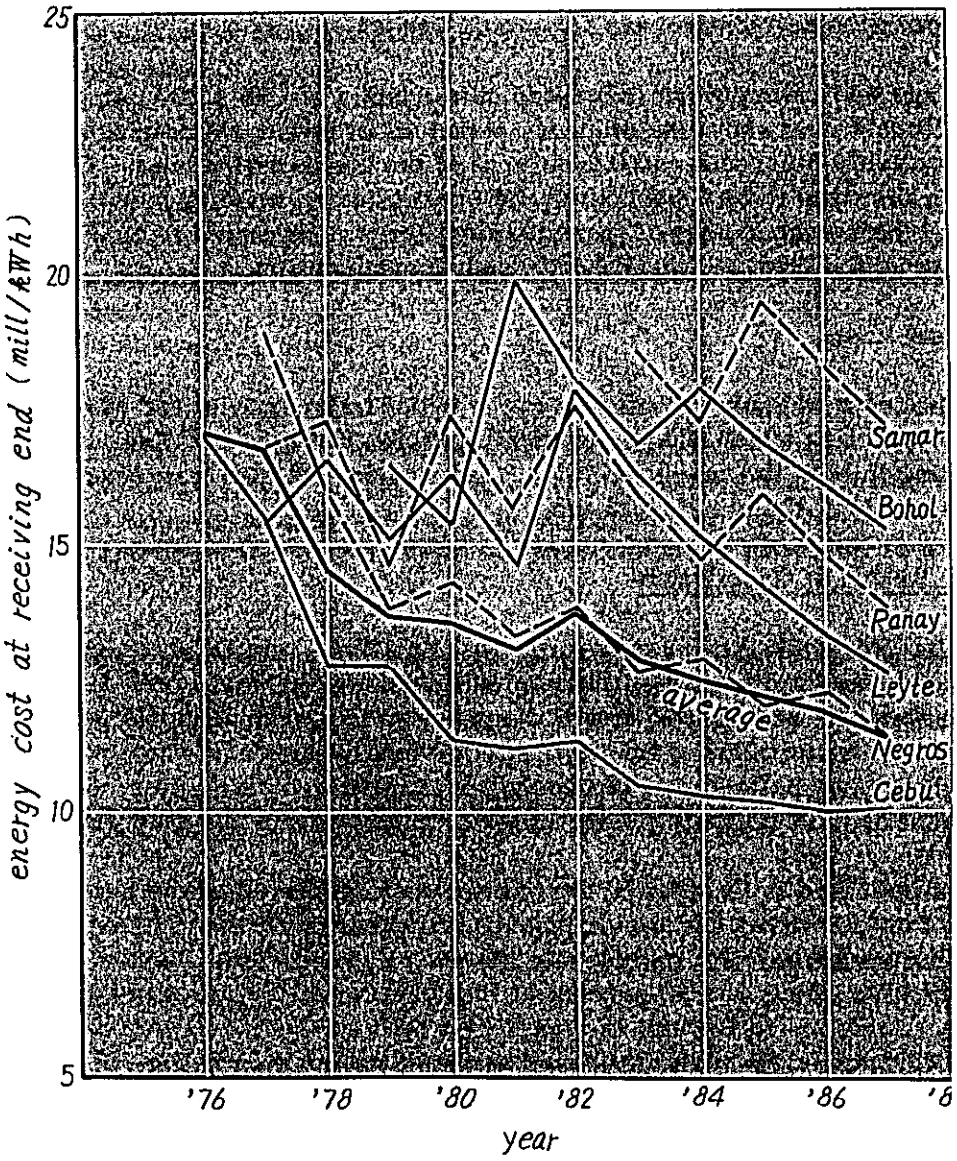
As indicated in Chapter 5, the energy costs expected of the future installations of cooperatives and major private utilities are estimated respectively at 17.7 mills per kWh, (NPC's wholesale price was assumed in Chapter 5 to be 15.9 mills per kWh which was 90 percent of this cost) and 16.4 mills per kWh.

If 15.5 mills per kWh which was assumed as the energy cost of cooperatives and utilities is to be the wholesale price of NPC, energy cost of each island, excepting those in Cebu and Negros, will be higher than the wholesale price even when viewed from the long term basis of up to 1987. This is attributable to the burden of transmission line construction and to the low load factor. However,

the averaged energy cost in the entire Visayas will go down below the wholesale price of 15.5 mills per kWh, and the rate of return will exceed 10 percent after 1983. The power rate will have to be lowered accordingly.

Power supply by NPC will enable utilities and cooperatives to save investment on their generating facilities, and such savings may be utilized for expansion of distribution networks. This is considered as one of the largest merits of NPC's establishment in the Visayas.

Fig. 7-1 Energy Cost at Receiving End



7-3 Rate of Return

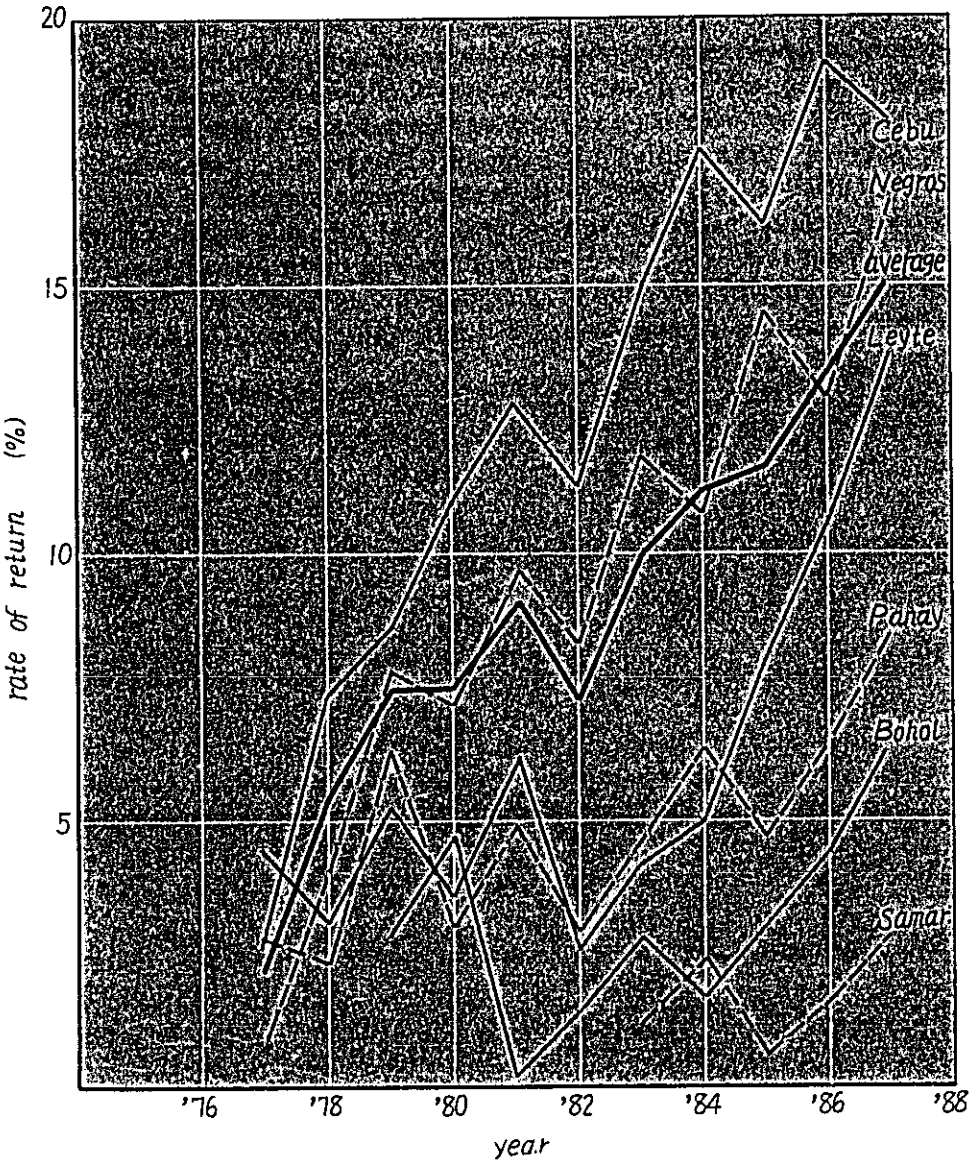
For the comparative purpose, the rate of return was obtained from the rate base for each insular develpment program. In the Philippines, the power rates are determined on the cost which is expressed in terms of rate base. The rate base is a sum of operating net assets, operating capital equivalent to two months operating expense and non-cash items such as deferred assets. The rate of return is a percentage of the operating income to the rate base, and is not acceptable to the Public Service Commission if it exceeds 12 percent. However, the maximum rate of return allowable for NPC is stipulated by its charter as 10 percent reflecting the non-profit seeking nature. In computing the rate of return, capital cost is not considered. That is to say, interest on loans and other liabilities are not included in the expense. For the purpose of comparison, energy cost of private utilities and cooperatives was supposed to be 15.5 mills per kWh uniformly. The result of calculation is given in Fig. 7-2.

A return is expected in Cebu, exceeding the 8 percent level in 1979. Negros is following Cebu with an almost identical trend, then comes Leyte. Due to low increase rate of demand and relatively advanced installation of 35 MW steam turbine unit, Panay will mark only 8.5 percent of return even in 1987, ten years after the date of operation, which is quite different from Negros. Then, comes Bohol and Samar in the order.

As stated in the foregoing, the energy cost and rate of return vary greatly from one island to another. However, it is considered desirable to have a uniform power rate schedule in the Visayas. With the uniform rate schedule, the rate of return in the Visayas as a whole would be more than 8 percent after 1980 and go over 10 percent in 1983, attributable to large weight in demand of Cebu and Negros respectively about one half and one fourth of the Visayan total. Consequently, the rate schedule may be predicted to be lowered after 1983.

In calculating the above rate of return, the power rate was set uniformly at 15.5 mills per kWh which is the rate proposed for the operation in Cebu where the first NPC's grid will be established in the Visayas.
This power rate will be applicable to all the islands in the Visayas until 1982, and thereafter, a lower rate may be adopted. Therefore, on the islands other than Cebu, energy will be supplied at a considerably low rate in relation to the energy cost.

Fig. 7-2 Rate of Return in Visayan Grids



Chapter 8 Consideration on Socio-Economic Effects of Power Development

8-1 Economic Growth and Power Development

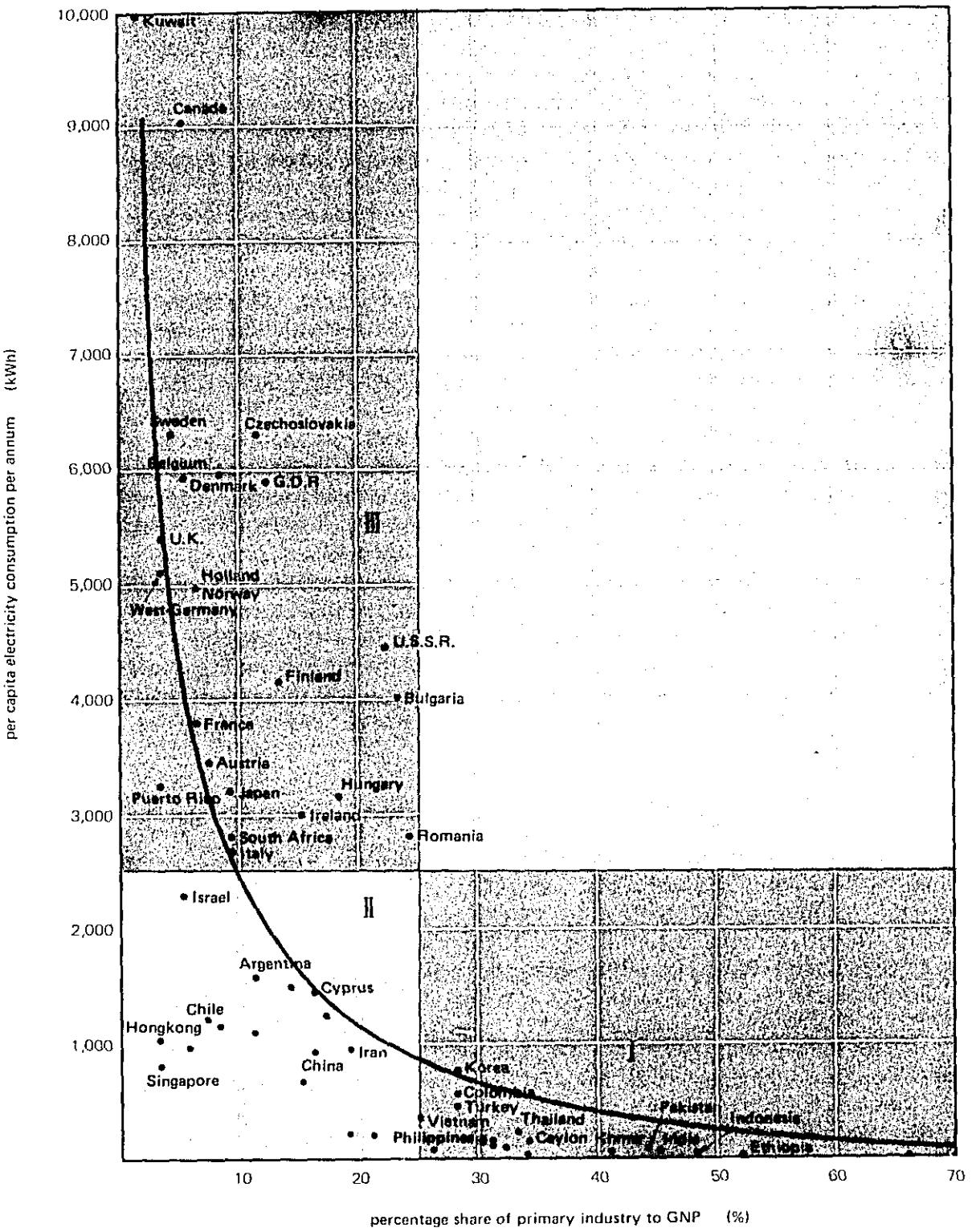
No such words are necessary as to describe the utility of electric power which is sustaining the modern life of the people as well as contributing to the economy as an important energy source. The demand for this electric power is very closely correlated with the economic growth. The fact that the demand for power increases at a higher rate than the economic growth rate when the economy is in a boom and that the demand does not decrease when in a recession elucidates the significant role played by power. The correlation between power-consumption and economic structure of a country has an interesting one which can be stated as follows: "the lower is the share of primary industry's value-added to the GNP of a country, the more the country consumer the power". On the figure 8-1, most of the South-east Asian countries are located in the region-I and the so-called developed countries are in the region III. The economic development studies show that the high share of the primary industry to GNP is, except some special cases, a trait of developing economy whose economic stage in a sense of development is still expecting the take-off. The share will decrease when industry dispersal and rural industrialization get under way. The countries in the region-I are generally characterized by the dominant traditional agricultural society, where the power consumption is quite small. The take-off of these economies requires not only the power development but the de-

velopment of various infrastructures as well as many other social conditions and environments. Among many conditions, the power development which is needed both for the consumption and production activity is very conducive to the improvement and stability of the people's life and for the completion of the infrastructures.

From the standpoint of Visayas in the Philippines, where industrialization and development are rather retarded compared with Luzon —— especially greater Manila area —— and Mindanao, the equity of the people which is one of the main objectives of economic policy will not be attained if these regional unblance is kept untouched or enlarged further. The unbalance may also cause the problem of over-density or excessive sparsity of population and economy. Economic development may accompany regional or sectoral unbalance in development or be the result of full utilization of the merit brought by the leading sector or region. However, there are many demerits of over-concentration and, in some examples, what is counted merits turns out to be demerits. Therefore, balanced growth and development is the desirable one. In this sense, Visayas development is very significant for the entire Philippines. The region is, as stated earlier, known as agricultural society and the main economic activity is the production and export of primary products. Therefore the economic connection and industrial linkage with other regions are weak. In other words, the region is relatively noninfluential and passive in economic activity. The population growth of the region will explain the state, which is 1.56 percent while the national average is 3 percent. Moreover, sugar and mining products, which are the staples of the region, are directly exported to the overseas demander as raw materials without being processed by domestic transactors. (They play, of course, an important role as dollar earners.) For the purpose of stepping out of the present situations for the region to the vigorous and influential regional economy as well as levelling the regional unbalance from national point of view requires investment in infrastructure.

Above all, power supply in the region depending on small private utilities is retarded in comparison with the other region and has to be improved. As for entire Philippines in 1961, electric charge shared 0.60 percent, 0.93 percent and 0.70 percent of the activity levels of household, commercial sector and industiral sector respectively. These ratios are thought to have increased during these ten years by the active power development by NPC, thus indicating the tendency of power consuming. Whereas in the Visayas the ratios at present are estimated to be a little less than, or almost equivalent to, the 1961 level of the whole Philippines. (The estimate is made from the sales data obtained from the utilities in Visayas.) In consideration of that power development and generation were executed by NPC through 1960's and that the industrialization in Mindanao is remarkably promoted by the full use of cheap and dependable power generated from Maria Cristina dam, Visayas industrialization as well as its social and economic activities may, to some extent, be stimulated and encouraged by exploring the power resources. The BOI's industry dispersal policy together with the above-mentioned power development are indispensable for the development of the region and therefore be materialized as soon as possible.

Fig. 8-1 Correlation between Percentage Share of Primary Industry to GNP and Per Capita Electricity Consumption per Annum



8-2 Socio-economic Effects of Power Development

If the recommendations given by the survey team are put into practice, the proposed socio-economic effects will be followings, which are divided into (1) direct effects brought by construction of the project and (2) indirect effects resulting from the completion of the project. Various data or conditions are required to make full analysis and quantification of these effects such as inter-industry table on regional basis and shadow price system prepared for all inputs necessary for the project. Since the data and materials obtained are not available for these quantitative analysis, the consideration is confined to qualitative evaluation and analysis.

(1) Direct effects brought by construction of the project

The direct effects will emerge from the year 1974 when, according to the proposed schedule, the construction of the project starts. As shown in Table 7-2 Vol. I, the investment schedule totals to US$ 37.7 million (252.2 million pesos) by 1987 which is to be spent on purchase, transportation and installation of equipments and on civil works for the construction of thermal plants. This will flow into the economic circulation. Whereas foreign currency expenditures which share 77 percent of the total project cost will be for purchasing the overseas-made equipments, whose socio-economic effects on Philippine economy as well as Visayas regional economy are not known without above-mentioned economic model. However, this expenditures of domestic currency will result in the increase of income and employment opportunity. In addition, the increase in income will be absorbed by the lower income class since it is generated by the expenditures on construction work, thus bringing about the better income distribution. The wage-earners in the Visayas, whose wage rates in terms of the opportunity cost are very low or sometimes almost zero, will have chance to increase the consumption if the they are employed in construction work. Consequently their participation in Visayas economy will further increase the income and from the national or

Table 8-1 Estimated Employment Creative (man-month)

Year	Cebu	Visayas
1975	2,100	3,100
76	4,900	9,900
77	2,700	4,600
78	2,400	7,300
79	1,700	8,800
80	2,400	14,400
81	1,000	8,200
82	600	6,200
83	2,400	6,700
84	1,800	5,400
85	3,400	5,200
86	2,900	5,900
87	-	1,000
Total	28,300	86,700

regional point of view, may mitigate the critical income inequity issue. NEC announces that GNP of the Philippines in 1970 was 26,053 million pesos, of which the Visayas seemingly shared 16 percent or 4,060 million pesos. The domestic currency planned in the project cost is 250 million pesos. Since there is no remarkable public investment in the Visayas, this project will expectedly generate the income creation effects as well as employment creation effects.

(2) Indirect effects resulting from the completion of the project

The indirect effects can be summarized into two categories, namely (i) promotion of electrification and (ii) long-run stability or decrease of electric rate. The rural electrification, as described in the earlier chapter, is one of the main national objectives and is to be promoted through NPC coupled with NEA policy. The project aims at increasing the present electrified ratio to as high as 40 percent or approximately 4.6 million of 11.93 million Visayas inhabitants. This will result in enhancement of people's living standard and rural modernization. As for the second category, although there included a big unknown factor of the price of petroleum, the electric rate is considered to be lowered in the long-run, judged from the financial analysis of the project. This may also bring about the industrial development and the tilt of power consumption.

The example of MORESCO, an electric cooperative which uses power generated in Maria Cristina dam illustrates that the investment of 1 peso in electricity resulted in 5 pesos increase of electric appliance sales, 0.05 pesos increase of petroleum products sales and 5 pesos increase of manufactured products sales respectively. Moreover, if the project is executed, those existing private utilities will be relieved of power generation and will afford to promote the distribution of electricity. Eventually the rural electrification will conceivably be promoted by private utilities.

(i) Effects of electrification

Annual electrification ratio is scheduled as Table 8-3, which enables the present 7 percent to go high up. The example of MORESCO also shows that electrification will serve to mechanization of agriculture (use of irrigation pump, electric tiller etc.), popularization of electric appliances, improvement of sanitary conditions, building of new residences and creation of employment opportunity. (The milling plants, wood product manufacturing, welding shops and radio-TVrepair shops are reported to have newly set up in MORESCO's case). Those new equipments and facilities necessary for the modern life are not popular in the Visayas and are only seen in cities and its vicinities where electric power is supplied.

Moreover, as rural electrification gets under way, cultural and educational effects can be expected. Illiteracy in rural area will decrease and modern culture will be introduced to the area through popularization of radio and TV, thus serving to the one of the national objectives, decrease of population growth. The introduction of modern culture will also be beneficial in facilitating the inhabitants to understand the value system of modern society. The agricultural society of the Philippines are said to be very conservative and traditional, but those traditional ways of living and thinking are expected to be modernized in some respects by virtue of agricultural land reform now under way and of electrification. As one of

the criteria for the economic development, the gap between the rich and the poor is sometimes used. Interpretation of this gap is whether or not the middle class of the society exists. In the Philippines, the growth of the new middle class which has political, economic and cultural power is awaited not only for solving the gap problem but for its active role played to be the step for country's take-off. For this purpose, as well as many policies, the increase of agricultural productivity and modernization of agricultural society through electrification are necessarily promoted.

In these senses, the completion of power projects in rural area will give rise to the social and economic development.

(ii) Effects of long-run stability or decrease of electric rate

As far as the financial analysis of the project is concerned, the electric rate will be stabilized or decreased in the long-run. What is here referred is, of course, the whole sale price which will emerge between NPC and utilities and the retail price to the final demanders, which should be treated as an internal politic problem, is not known clearly. However long-run stability of rate will have the effects of stimulating enterprises, industries and industrial complexes which are operating under full employment of their capacities due to the bottle-neck caused by power supply. The economic activities of these industries especially labor-intensive and export-oriented industries will be activated. Moreover those industries which are using the costly power generated by their own facilities —— most of the industries in the region including Atlas mining are those type —— will be able to push their cost down by obtaining the cheap and dependable power supplied by NPC. The price of 15.5 mills/kWh (10.2 centavos/kWh) under which the a-

Table 8-3 Population Projection and Proposed Served Population

Year	Cebue			Panay			Negros			
	Pop.	Served	%	Pop.	Served	%	Pop.	Served	%	Pop.
1976	1,852	564	30.4	2,367			2,412			743
1977	1,890	611	32.4	2,412	481	19.9	2,446	467	19.1	753
1978	1,930	661	34.2	2,458	542	22.1	2,480	563	22.7	764
1979	1,970	716	36.4	2,505	602	24.0	2,515	613	24.4	774
1980	2,012	773	38.4	2,552	670	26.3	2,550	714	28.0	785
1981	2,054	833	40.6	2,601	738	28.4	2,586	770	29.8	796
1982	2,097	896	42.7	2,650	820	30.9	2,622	829	31.6	807
1983	2,141	963	45.0	2,701	904	33.5	2,659	882	33.2	819
1984	2,186	1,032	47.3	2,752	964	35.0	2,696	944	35.1	830
1985	2,231	1,105	49.5	2,804	1,033	36.8	2,734	1,010	37.0	842
1986	2,279	1,178	51.7	2,858	1,099	38.5	2,772	1,062	38.3	854
1987	2,327	1,253	53.9	2,912	1,166	40.0	2,811	1,117	39.7	865

nalysis is made in the report is the average value of all whole prices from NPC to utilities in the Visayas and can possibly be decreased by 1987 to the value to about 75% of the above price, provided the conditions remain as they are. In the other regions of the Visayas, the same can be expected because economy of scale will arise, which will be followed by the long-run stability and decrease of electric rate. This will clearly stimulate the activities of the enterprises in the Visayas.

Table 8-2 Expected Electric Rate*

(centavos/kWh)

	Cebu	Visayas Average
1976	11.66	11.46
77	10.59	10.45
78	8.78	9.85
79	8.78	9.38
80	7.77	8.31
81	7.70	8.58
82	7.84	9.18
83	7.24	8.38
84	7.10	8.24
85	7.04	8.04
86	6.83	7.84
87	6.77	7.57

* genrating cost of NPC at receiving end

(in thousand unit)

Bohol		Leyte			Samar			Total		
Served	%	Pop.	Served	%	Pop.	Served	%	Pop.	Served	%
		1,489			1,122			8,863	1,434	16.7
		1,512	281	19.6	1,139			10,152	1,840	18.1
		1,534	339	22.1	1,157			10,323	2,105	20.4
143	18.5	1,557	386	24.6	1,176			10,497	2,460	23.4
166	21.1	1,581	429	27.1	1,195			10,675	2,752	25.8
197	24.7	1,604	478	29.8	1,214			10,855	3,016	27.8
207	25.6	1,628	529	32.5	1,233			11,037	3,281	29.7
214	26.1	1,653	562	34.0	1,253	163	13.0	11,226	3,688	32.8
222	26.7	1,678	594	35.4	1,273	171	13.4	11,415	3,927	34.4
232	275.	1,703	625	36.7	1,293	179	13.8	11,607	4,184	36.0
243	28.4	1,728	656	38.0	1,314	189	14.4	11,805	4,427	37.5
256	29.5	1,754	688	39.2	1,335	199	14.9	12,004	4,679	39.0

The proposed electric charge share to the 1987 activity levels of household, commercial sector and industrial sector is safely said to be low in consideration of high electrification ratio and mass-power consuming tendency. If the retail price of electricity to the final demanders are kept at present level.

Table 8-4 Electric Charge Share

	1970			1987		
	Activity level (million pesos)	Electric charge (million pesos)	%	Activity level (million pesos)	Electric charge (million pesos)	%
Household expenditure	6,100	15.5	0.25	15,700	247	1.57
Commercial sector	1,740	9.0	0.51	3,850	132	3.42
Industrial sector	2,330	13.4	0.57	6,830	187	2.73

Table 8-4 explains the relative low share of the electric charge, in view of the example of Japan where the charge shares 2 percent of household expenditures in 1970

In addition, this rate decrease will enable the final demanders to have savings resulting from resorting their energy to NPC. The value of this savings are not measurable from the data now available. Qualitative examples of such savings are such that will be brought by abandoning the cattle forces employed in agricultural sector and the generation by their own facilities now used in commercial and industrial sectors in cities. The quantitative measurement is as difficult as that of consumers' surplus between NPC and utilities in view of the data scarcity but there definitely exists, which should be counted as social economic benefits.

These effects are supposed to emerge from, according to the proposed schedule of the project, 1975. The promotion and fostering of export-oriented light industries, one of the main national objectives of the Philippines, are to be facilitated through electrification and power development as well as many policies concerning infrastructures. The completion of the project would be highly contributing to give rise to the social benefit exceeding the project cost.

APPENDIX

Appendix 1

PRESIDENTIAL DECREE NO. 40

ESTABLISHING BASIC POLICIES FOR THE ELECTRIC POWER INDUSTRY

WHEREAS, one of the primary concerns of the government in promoting the economic welfare of the people is to hasten the electrification of the entire country, more particularly the rural areas; and

WHEREAS, it is necessary to establish certain basic policies for the attainment of said objective;

NOW, THEREFORE, I, FERDINAND E. MARCOS, President of the Philippines, by virtue of the powers vested in me by the Constitution as Commander-in-Chief of all the Armed Forces of the Philippines, and pursuant to Proclamation No. 1081 dated September 21, 1972, and General Order No. 1 dated September 22, 1972, do hereby order and decree, as part of the law of the land, the following basic policies for the electric power industry.

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

a) The setting up of island grids with central/linked-up generation facilities.

b) The setting up of cooperatives for distribution of power.

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

a) Plant additions necessary to meet the increase in power demand of the area embraced by any grid set up by the NPC shall be constructed and owned by the NPC.

b) In areas not embraced by the NPC grid, the State shall permit cooperatives, private utilities and local governments to own and operate isolated grids and generation facilities, subject to State regulation.

3. The distribution of electric power generated by the NPC shall be undertaken by:

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

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

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

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

Done in the City of Manila, this 7th day of November, in the year of Our Lord, nineteen hundred and seventy-two.

(SGD) FERDINAND E. MARCOS
President

By the President:
(SGD) ALEJANDRO MELCHOR
Executive Secretary

Appendix 2 Investment Schedule of Each Island

Table A2-1 Investment Schedule of Cebu Power Grid

(in thousand US dollars)

Plant	Year of completion		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
Generating plant																
Gas turbine																
25 MW No. 1 &	1975	Total		4,750												4,750
No. 2		FC		4,270												4,270
		DC		480												480
Steam turbine																
50 MW No. 1	1977	Total		2,400	5,400	1,950										9,750
		FC		1,920	4,320	1,560										7,800
		DC		480	1,080	390										1,950
No. 2	1979	Total				2,400	5,400	1,950								9,750
		FC				1,920	4,320	1,560								7,800
		DC				480	1,080	390								1,950
75 MW No. 1	1981	Total						3,500	7,600	2,700						13,800
		FC						2,800	6,080	2,160						11,040
		DC						700	1,520	540						2,760
No. 2	1984	Total									3,500	7,600	2,700			13,800
		FC									2,800	6,080	2,160			11,040
		DC									700	1,520	540			2,760
No. 3	1986	Total											3,500	7,600	2,700	13,800
		FC											2,800	6,080	2,160	11,040
		DC											700	1,520	540	2,760
Transmission plant	1975	Total	200	200	2,040	2,040	110	110					40	510	470	5,720
	-86	FC	80	80	920	920	40	40					30	210	180	2,500
		DC	120	120	1,120	1,120	70	70					10	300	290	3,220
Total		Total	200	7,350	7,440	6,390	5,510	5,560	7,600	2,700	3,500	7,600	6,240	8,110	3,170	71,370
		FC	80	6,270	5,240	4,400	4,360	4,400	6,080	2,160	2,800	6,080	4,990	6,290	2,340	55,490
		DC	120	1,080	2,200	1,990	1,150	1,160	1,520	540	700	1,520	1,250	1,820	830	15,880

Note: FC: Foreign currency
DC: Domestic currency

Table A2-2 Investment Schedule of Panay Grid

(in thousand US dollars)

	Year of completion		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total
Generating plant															
Diesel 5MW No.1 & No.2	1976	Total	390	1,560											1,950
		FC	330	1,320											1,650
		DC	60	240											300
" No.3	1977	Total		200	780										980
		FC		170	660										830
		DC		30	120										150
Steam 35MW No.1	1979	Total			1,850	4,050	1,450								7,350
		FC			1,480	3,240	1,180								5,900
		DC			370	810	270								1,450
" No.2	1981	Total					1,850	4,050	1,450						7,350
		FC					1,480	3,240	1,180						5,900
		DC					370	810	270						1,450
" No.3	1984	Total								1,850	4,050	1,450			7,350
		FC								1,480	3,240	1,180			5,900
		DC								370	810	270			1,450
Transmission plant															
Transmission line	1976	Total	100	100		1,340	1,340			40	40	40	40		3,040
	1986	FC	40	40		510	510			20	20	20	20		1,180
		DC	60	60		830	830			20	20	20	20		1,860
Substation	1976	Total	220	260	40	590	600		60	160	100	20	30		2,080
	1986	FC	200	230	30	530	540		50	140	90	10	20		1,840
		DC	20	30	10	60	60		10	20	10	10	10		240
Total		Total	710	2,120	2,670	5,980	5,240	4,050	1,510	2,050	4,190	1,510	70		30,100
		FC	570	1,760	2,170	4,280	3,710	3,240	1,230	1,640	3,350	1,210	40		23,200
		DC	140	360	500	1,700	1,530	810	280	410	840	300	30		6,900

Note: FC: Foreign currency
DC: Domestic currency

Table A2-3 Investment Schedule of Negross Power Grid

(in thousand US dollars)

		Year of completion		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Tatal
Generating plant																
Diesel 5MW	No.1 & No2	1976	Total	390	1,560											1,950
			FC	330	1,320											1,650
			DC	60	240											300
" 10MW	No1,2 & No3	1976	Total	1,140	4,560			570								6,270
			FC	970	3,880			200								5,050
			DC	170	680			370								1,220
" 10MW	No4	1977	Total		380	1,520										1,900
			FC		320	1,290										1,610
			DC		60	230										290
Steam 35MW	No1	1979	Total			1,850	4,050	1,450								7,350
			FC			1,480	3,240	1,180								5,900
			DC			370	810	270								1,450
"	No2	1981	Total					1,850	4,050	1,450						7,350
			FC					1,480	3,240	1,180						5,900
			DC					370	810	270						1,450
"	No3	1983	Total							1,850	4,050	1,450				7,350
			FC							1,480	3,240	1,180				5,900
			DC							370	810	270				1,450
50MW	No1	1985	Total									2,450	5,350	1,950		9,750
			FC									2,080	4,550	1,660		8,290
			DC									370	800	290		1,460
Transmission plant																
Transmission line		1976	Total	800	800		70	500	430			50	50			2,700
		~86	FC	300	300		30	190	160			20	20			1,020
			DC	500	500		40	310	270			30	30			1,680
Substaion		1976	Total	820	880	70		220	270	60		60	100	150	110	2,740
		~86	FC	740	790	60		200	240	50		50	90	130	100	2,450
			DC	80	90	10		20	30	10		10	10	20	10	290
Total			Total	3,150	8,180	3,440	4,120	4,590	4,750	3,360	4,050	4,010	5,500	2,100	110	47,360
			FC	2,340	6,610	2,830	3,270	3,200	3,640	2,710	3,240	3,330	4,660	1,790	100	37,770
			DC	810	1,570	610	850	1,340	1,110	650	810	680	840	310	10	9,590

Note: FC: Foreign currency
DC: Domestic currency

Table A2-4 Investment Schedule of Bohol Power Grid

(in thousand US dollars)

Plant	Year of completion		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Total
Generating plant														
Diesel 3MW														
No1 & No2	1978	Total	250	1,010										1,260
		FC	210	860										1,070
		DC	40	150										190
Diesel 5MW														
No3,No4 & No5	1980,1983	Total			390	1,560		200	780					2,930
		FC			330	1,320		170	660					2,480
		DC			60	240		30	120					450
Transmission plant														
Transmission line	1978 '80	Total	150	150	40	40								380
		FC	60	60	15	15								150
		DC	90	90	25	25								230
Substation	1978 '85	Total	300	300	130	130				40	40			940
		FC	270	270	120	120				35	35			850
		DC	30	30	10	10				5	5			90
Total		Total	700	1,460	560	1,730		200	780	40	40			5,510
		FC	540	1,190	465	1,455		170	660	35	35			4,550
		DC	160	270	95	275		30	120	5	5			960

Note : FC : Foreign currency
DC : Domestic currency

Table A2-5 Investment Schedule of Leyte Power Grid

(thousand US dollars)

	Year of completion		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Total
Generating plant																
Diesel 5MW																
No1, 2 & No3	1976	Total	590	2,340												2,930
		FC	500	1,990												2,490
		DC	90	350												440
Diesel 10MW No1	1977	Total		380	1,520											1,900
		FC		320	1,300											1,620
		DC		60	220											280
10MW No2	1979	Total				380	1,520									1,900
		FC				320	1,300									1,620
		DC				60	220									280
Steam 35MW, No1	1981	Total				1,850	4,050	1,450								7,350
		FC				1,480	3,240	1,180								5,900
		DC				370	810	270								1,450
Transmission plant																
Transmission line	1976	Total	120	190	70		170	490	330							1,370
	~'81	FC	45	75	25		65	190	120							520
		DC	75	115	45		105	300	210							850
Substation	1976	Total	390	450	70	60	170	180	70							1,390
	~'81	FC	350	405	60	55	150	160	70							1,250
		DC	40	45	10	5	20	20								140
Total		Total	1,100	3,360	1,660	2,290	5,910	2,120	400							16,840
		FC	895	2,790	1,385	1,855	4,755	1,530	190							13,400
		DC	205	570	275	435	1,155	590	210							3,440

Note : FC : Freign currency
DC : Domestic currency

Table A2-6 Investment Schedule of Samar Power Grid

(in thousand US dollars)

	Year of completion		1981	1982	1983	1984	1985	1986	1987	Total
Generating plant										
Diesel 3MW										
No1, No2 & No3	1982	Total	380	1,510						1,890
		FC	320	1,280						1,600
		DC	60	230						290
Diesel 5MW										
No4	1984	Total			200	780				980
		FC			170	660				830
		DC			30	120				150
Transmission plant										
Transmission line	1982	Total	325	325						650
		FC	130	130						260
		DC	195	195						390
Substation	1982 '84	Total	235	235		85				555
		FC	210	210		75				495
		DC	25	25		10				60
Total		Total	940	2,070	200	865				4,075
		FC	660	1,620	170	735				3,185
		DC	280	450	30	130				890

Note : FC : Foreign currency
DC : Domestic currency

Appendix 3 Daily Load Curves of Major Utilities

Fig. A3-1 Daily Load Curves of VECO System

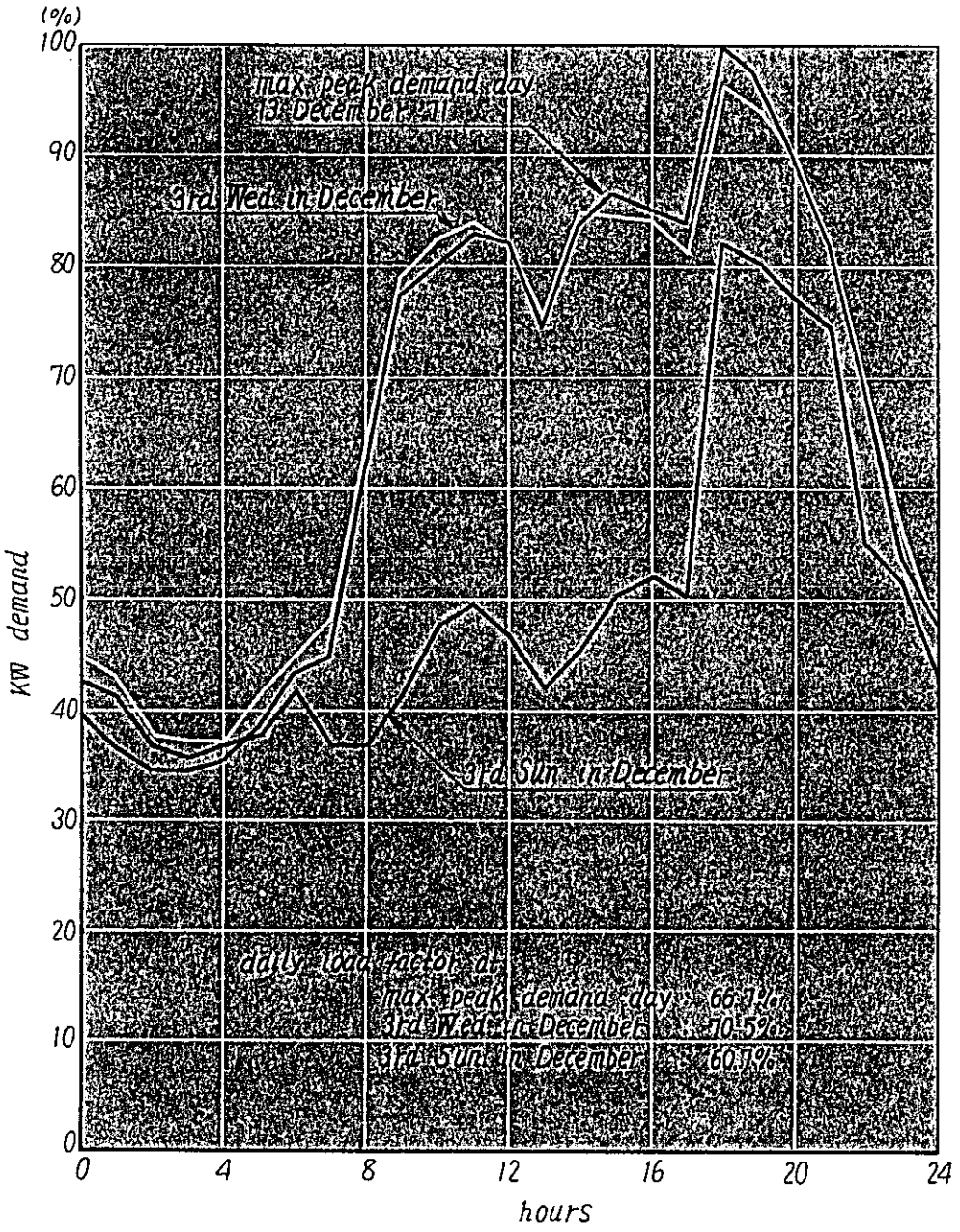


Fig. A3-2 Daily Load Curves of PECO System

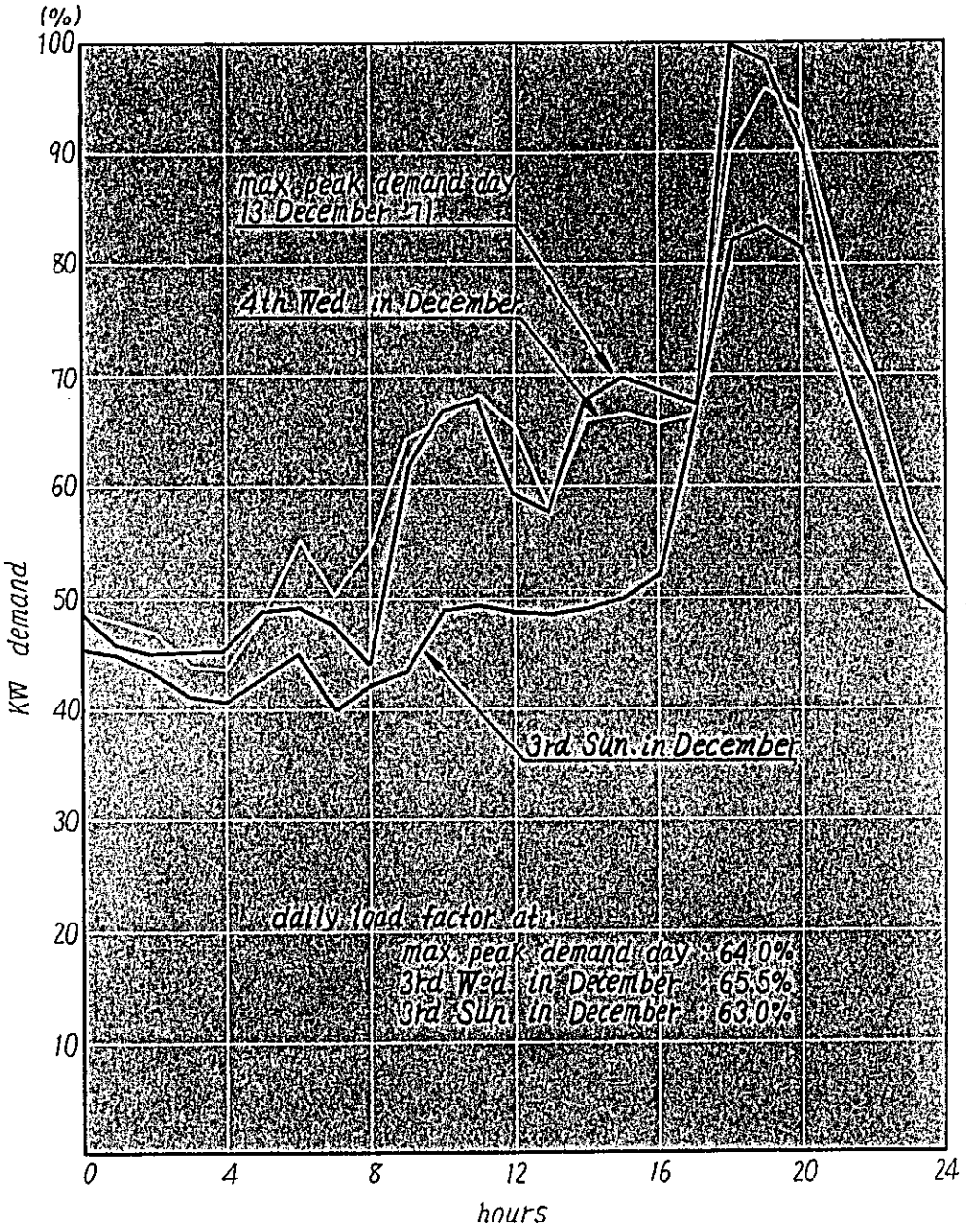


Fig. A3-3 Daily Load Curve in 1971 (A. S. Diaz Electric)

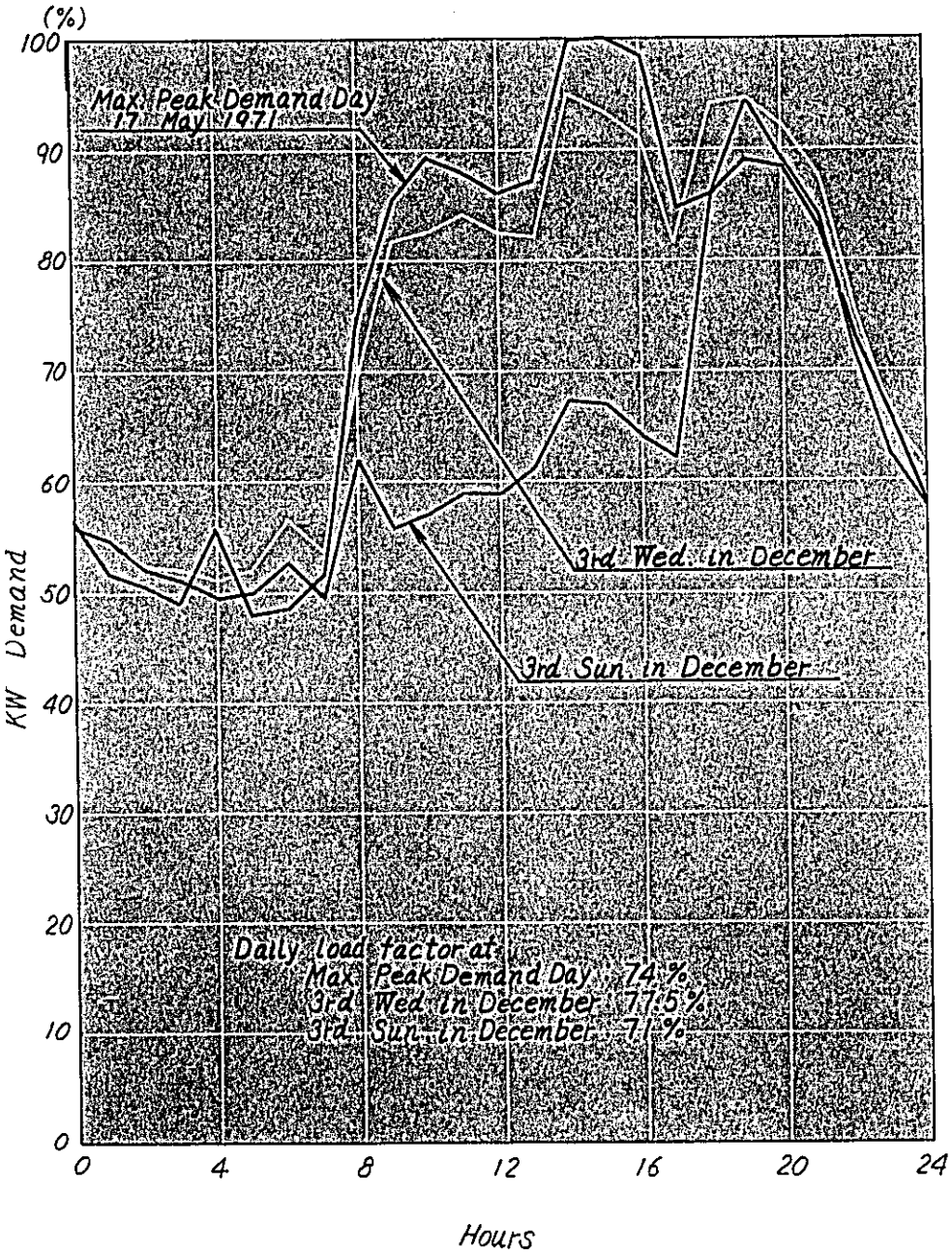


Fig. A3-4 Daily Load Curves of Tacloban Electric System