THE REPUBLIC OF THE PHILIPPINES

REPORT
ON
ELECTRIC DISTRIBUTION SYSTEM PROJECT
IN
CAGAYAN VALLEY (REGION II)

FOR

NATIONAL ELECTRIFICATION ADMINISTRATION

September, 1977

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

The Government of Japan, in response to the request of the Government of the Republic of the Philippines, decided to carry out the feasibility study on the Cagayan Valley Distribution Project and 230 KV Transmission System Expansion Project, and entrusted this task to the Japan International Cooperation Agency.

The Japan International Cooperation Agency, organized a study team comprising 7 members headed by Mr. Yutaka Matsumoto, of West Japan Engineering Consultants, Inc., and dispatched the team to the Philippines for 55 days from January 25, 1977.

The team made survey on the electric power demand, projected substation sites, transmission line and distribution line routes, and other items necessary for the design in the Cagayan Valley Area and collected the necessary data.

After returning to Japan, the team made the demand forecast, formulation of the development plan, preliminary design, estimation of construction cost, financial plan and economic evaluation, etc. and the results were compiled into the present report for presentation.

We sincerely hope that this report will contribute to the promotion of electrification of the Cagayan Valley Area and at the same time to furthering of goodwill between our two countries.

Finally, we wish to take this opportunity to express our sincere appreciation and gratitude to the Government of the Republic of the Philippines and other Authorities concerned, the Ministry of Foreign Affairs and the Ministry of International Trade and Industry of Japan and West Japan Engineering Consultants, Inc. for their generous cooperation and assistance extended to the team during the execution of the study.

September 1977

Shinsaku Hogen
Director General
Japan International
Cooperation Agency
Tokyo, Japan

Letter of Transmittal

September 1977

Mr. Shinsaku Hogen
Director General
Japan International
Cooperation Agency
Tokyo, Japan

Dear Sir:

We are pleased to submit this report of the feasibility study on the Cagayan Valley Distribution Project and 230 KV Transmission System Expansion Program in the Republic of the Philippines, which was entrusted to West Japan Engineering Consultants, Inc.

West Japan Engineering Consultants, Inc. dispatched the Study Team comprising 7 specialists (including one member from Planning Division, Public Utilities Department, Natural Resources and Energy Agency, Ministry of International Trade and Industry, and one member from Japan International Cooperation Agency) to the Philippines for this feasibility study.

The Study Team made surveys on the electric power demand, selection of transmission and distribution line routes and substation sites and other necessary items for design and gathered related materials and data in the Cagayan Valley Area (6 Provinces), based on the Cagayan Valley Electrification Program by the National Electrification Administration (NEA) and the 230 KV Ambuklao-Santiago Transmission Line Expansion Program by the National Power Corporation (NPC) of the Republic of the Philippines.

Upon its return to Japan, the Study Team made the demand forecast, formulated the development plan, made the preliminary design and estimation of construction cost, financial plan and economical evaluation based on the results of the surveys and collected data, and prepared this report.

In parallel with the foregoing works, the Study Team prepared an interim report of the survey results and made explanations to NEA, NPC and other Philippine Government Agencies and discussed the contents of this feasibility report in the period from July 17th through July 27th, 1977.

To summarize the conclusion, the electrification rate in Region II (Cagayan Valley Area) is as low as 5 ~ 6% and is the lowest among the Regions, and it is only natural that the Government of the Philippines strongly desires a speedy expansion of electrification in Region II which holds an important position on Luzon Island.

In Region II Area, the national highways have been completed by the Japanese Loan with resultant briskness of communication functions, and the stabilization of people's living and promotion of education have started steady progress.

As a means to advance electrification, National Electrification Administration (NEA), a government agency, is establishing 9 Electric Cooperatives (COOP's) in the 6 Provinces of Region II, (2 COOP' already in operation, 1 COOP established and 6 COOP's scheduled to be established within 1977), and the system for construction of full-scale distribution networks for expansion of electrification is being established steadily. And on the other hand, the preparatory works for construction of the 230 KV transmission trunk line to Region II and the substations in major localities in the Region are under way by National Power Corporation (NPC).

Thus, with the improved highways, construction of trunk transmission lines and major substations, and establishment of COOP's, all the basic conditions for the construction of the distribution network, by which the latent demands in irrigation and other industries including sugar refinery, saw mills, ice plants, commercial and public demands and general households can be brought out as real demands.

The effect of this Project in the expansion of electrification will be large, and the 9,626 KW of supply capacity in 1977 will be expanded to be capable of stable supply of about 42 MW of maximum demand in 1980 and about 68 MW in 1982.

We have made the technical and economic studies of the Project as detailed in this report, and found that this Project is sufficiently feasible, and it is desired that the Project be implemented as soon as the required conditions are fulfilled.

The Project is planned to be implemented in three consecutive stages, namely 1979 ~ 1982, 1982 ~ 1984 and 1984 ~ 1990. The electrification rate will be raised to 33.6% in the 1st stage, to 50.0% in the 2nd stage and to 100% in the 3rd stage.

The 1st stage covers the extension of 69 KV transmission lines (148 km), construction of 4 substations 1,274 km of 13.2 KV 3-phase 4-wire distribution trunk lines to COOP's, 2,213 km of 13.2 KV V-phase or single phase branch distribution lines, and 3,824 km of 240 V or 480 V low voltage distribution lines, by which 33.6% of electrification rate will be achieved. The required construction cost is estimated at 9,385 million Yen of Foreign Currency and 166.03 million Peso of Domestic Currency, and the system rate is calculated to be 0.414 ₱/KWH in 1982, which is about 30% lower than the current rate in Region II of 0.63 ₱/KWH. The internal rate of returen becomes 9.1%.

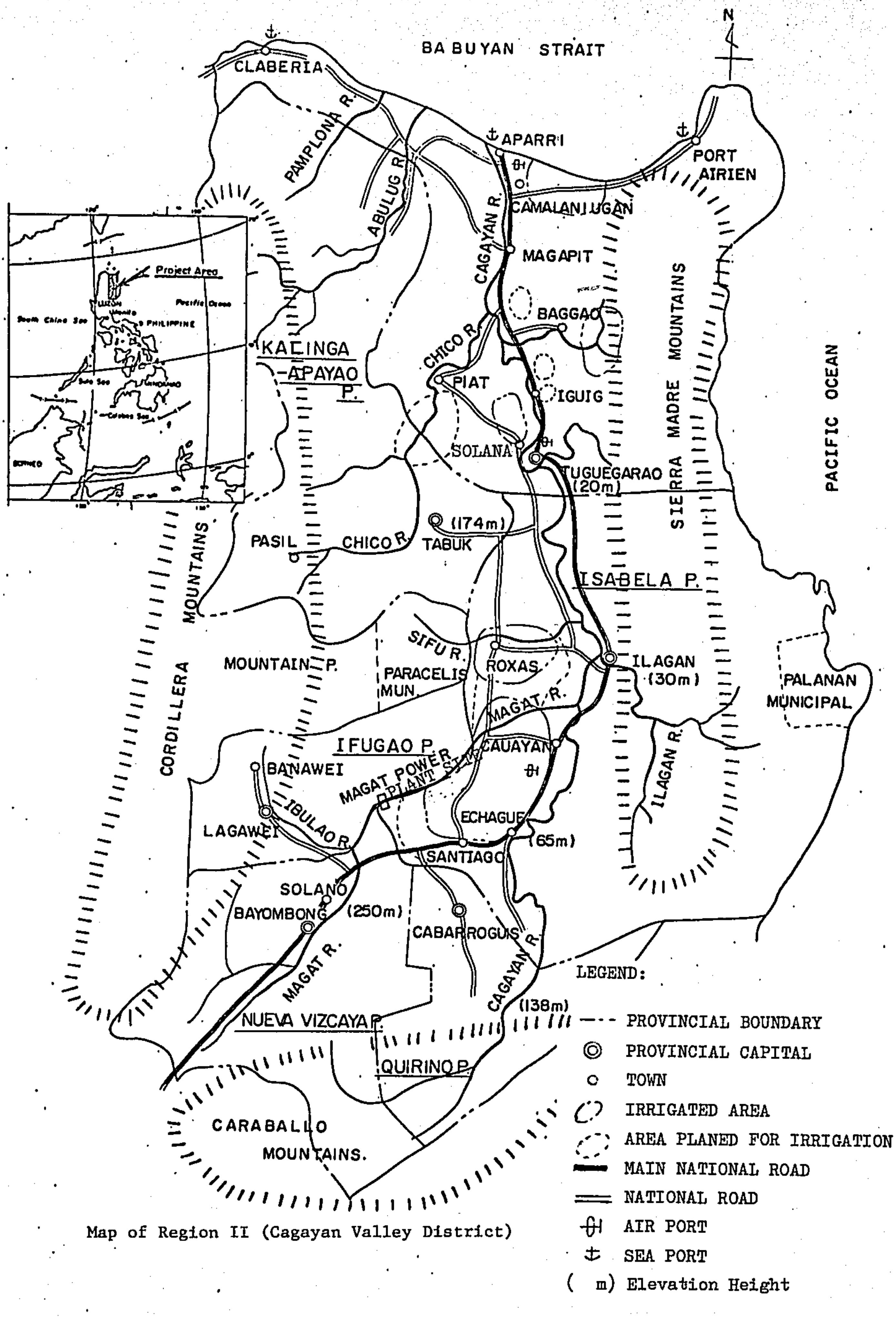
By the request of the Government of the Philippines, we studied also addition of one circuit of 230 KV transmission line to the Santiago-Ambuklao Section of the afore-mentioned 230 KV trunk line now under way by NPC, and addition of related facilities to Santiago, Solano and Ambuklao Substation, in connection with the commissioning of Magat Hydro Power Plant scheduled for 1983. Chico Hydro Power Plant had been scheduled to be built before Magat Power Plant, but because of the difficulty in acquisition of necessary land space for Chico Power Plant, the construction of Magat Power Plant had to be advanced. In the demand and supply balance program for whole Luzon Island, this hydro power plant is indispensable as the peaking power station to be operated combinedly with PNPP (Nuclear) No.1 Unit (600 MW) to be commissioned in 1983. Therefore, the above-mentioned program of expansion of transmission line and substation facilities in connection with Magat Power Plant, is believed better to be implemented as additional to the Cagayan Valley Transmission System Project by NPC from the economical viewpoint also, and an early arrangement is desired. The construction cost as additional work to the Cagayan Valley Transmission System Project by NPC, is estimated at 1,380 million Yen of Foreign Currency and 11.32 million Peso of Domestic Currency, on the basis of completion of work in 1980.

We wish to take this opportunity to express our deep gratitude to the Government Agencies of the Republic of the Philippines, Administrator of NEA and his staff, the staff of NPC, and the staff of the Japanese Embassy, who extended generous assistance and cooperation to the Study Team. Our sincere gratitude is due also to the Ministry of International Trade and Industry, Ministry of Foreign Affairs, Japan International Cooperation Agency and other organizations concerned who extended full cooperation and guidance on the dispatch of the Study Team.

Your sincerely,

Y. Matsumoto

Yutaka Matsumoto
Leader, Japanese Study Team
for Cagayan Valley
Distribution Project



Map of Region II (Cagayan Valley District)

Summary of Project

I 69KV, 13.2KV Transmission, Substation, Distribution Facilities

I-1 Out Line of Facilities and Construction Cost

Description		Foreign Currency (10^3¥)	Domestic Currency (10^3₱)	Total (10^3₱)
A 69KV Transmission Facilities		760,000	7,020	27,600
1) Sucban-Abulug Line	46km			
2) Piat Line	66km			
3) Tabuk Line	36km			
B 69KV Substation Facilities		723,000	2,870	22,450
1) Lucban-Abulug S/S	15MVA			
2) Piat S/S	15MVA			
3) Tabuk S/S	10MVA			
4) Magapit S/S	15MVA			
5) Tuguegarao S/S 69KV Draw Out Equipment	1circuit			
C Communication Facilities Power Line Carrier Telephone Intra Substations		108,000	270	3,190
D 13.2KV Distrivution Facilities		6,045,000	104,820	268,490
1) 13.2KV High Voltage Line	3,487km			
2) 240V Low Voltage Line	3,824km			
3) KW-Hour Meter	130,596			
E Administrative Facilities Vehicle, Tooles	set	525,000	20,000	34,210
F Contingency		816,000	13,500	35,590
G Administrative Expenses		-	9,450	9,450
H Engineering Fee		408,000	8,100	19,150
I Grand Total		9,385,000	166,030	420,130
Equivalent Yen		9,385,000	6,132,000	15,517,000

I-2 Construction Schedule (Tentative)

Expectation of Work Beginning 1978.

Expectation of Work Completion 1st Phase Dec. 1979.
2nd Phase Dec. 1982.

II 230KV Transmission and Substation Facilities

II-1 Out Line of Facilities and Construction Cost

	Description	Foreign Currency (10^3¥)	Domestic Currency (10^3₱)	Total (10^3₱)
A	230KV Transmission Facilities	482,000	5,950	19,000
	between Ambuklao and Santiago 107km One Line Stringing			
B	230KV Substation Facilities	772,000	3,880	24,780
	1) Ambuklao Power Station Circuit Breaker 2sets			
	2) Solano Substation Circuit Breaker 1set			
	3) Santiago Substation Circuit Breaker 3sets			
C	Contingency	63,000	980	2,690
D	Engineering Fee	63,000	510	2,220
E	Grand Total	1,380,000	11,320	48,690
	Equivalent Yen	1,380,000	418,000	1,798,000

II-2 Construction Schedule (Tentative)

Expectation of Work Beginning Mar. 1979.

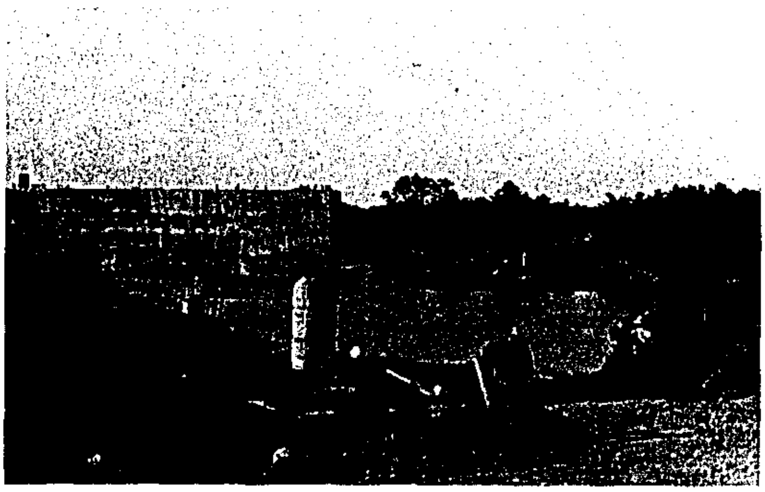
Expectation od Work Completion May. 1980.

Photographs

River Crossing (200m) at San Mariano

H Pole (Crossing of River 200m) at Jones

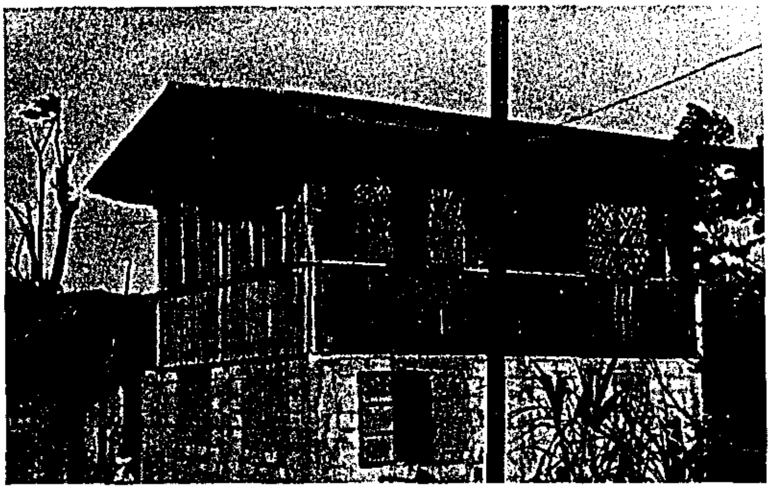
Cagayan River at Echague (Isabela Province)



Bridge Construction at Magapit (Cagayan Province)

Magat River Crossing Point Between
Solano and Quezon

Capitol of Nueva Vizcaya at Bayombong

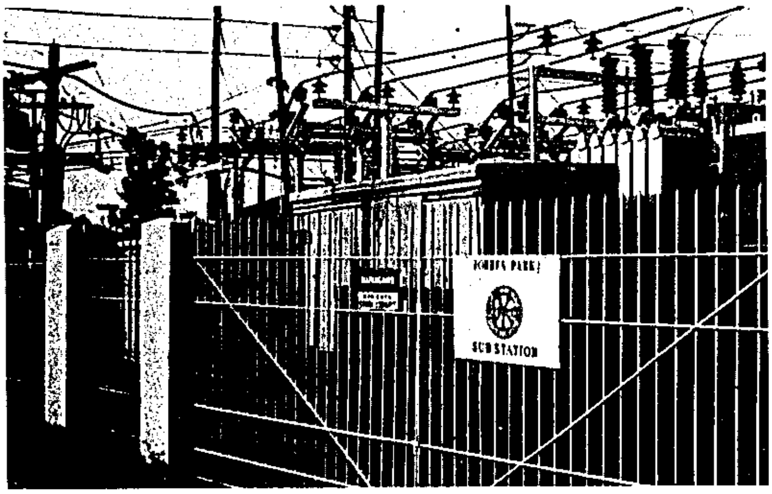


Wooden House

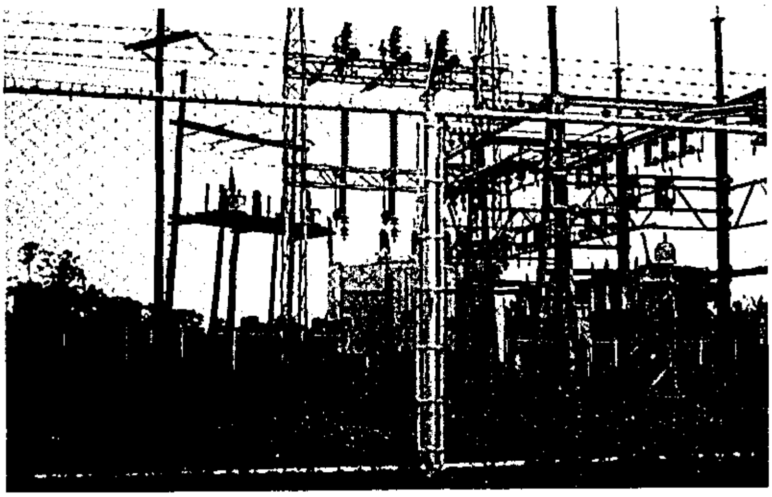
Farmer's House

Market at Alicia

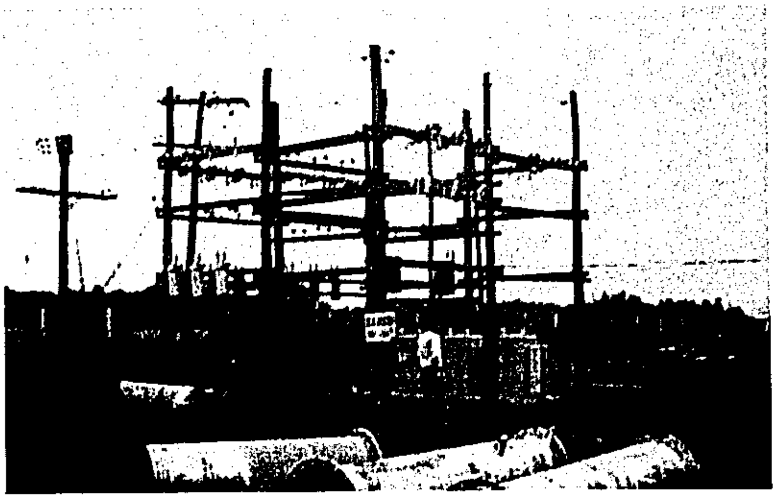
Japan-Philippine Friendship Road at Alicia



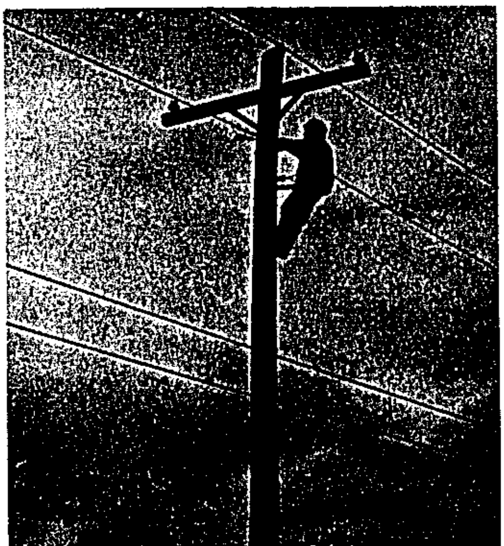
69KV Metal-clad Substation at Manila



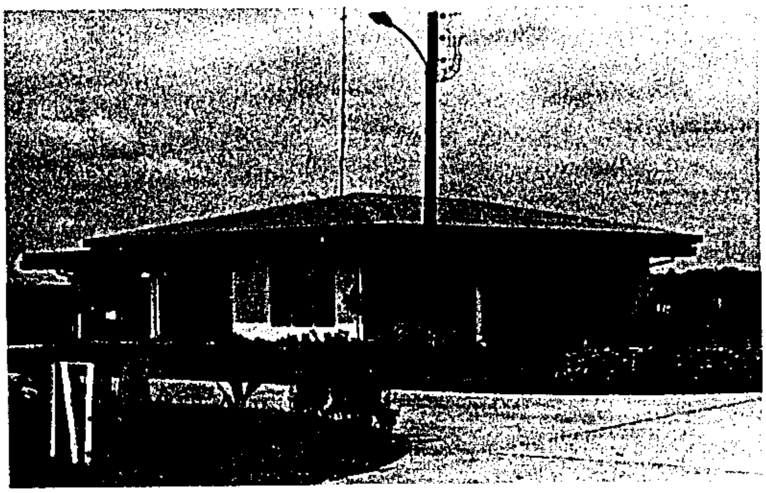
69KV Substation at Batangas



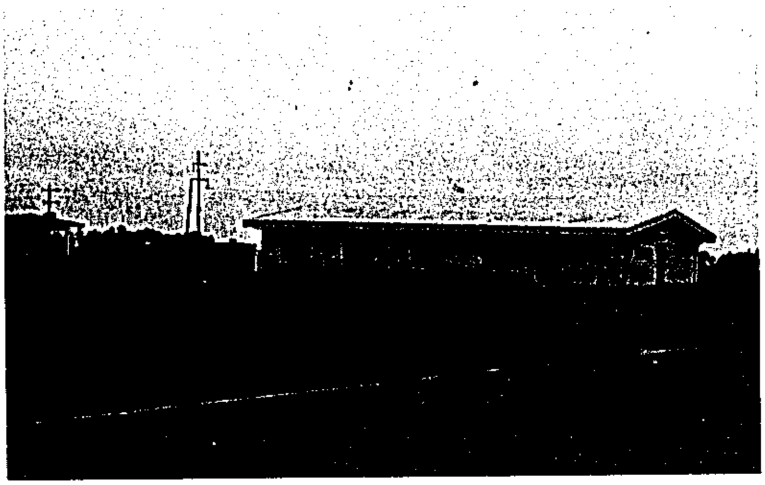
Distribution Switch Yard at ISELCO



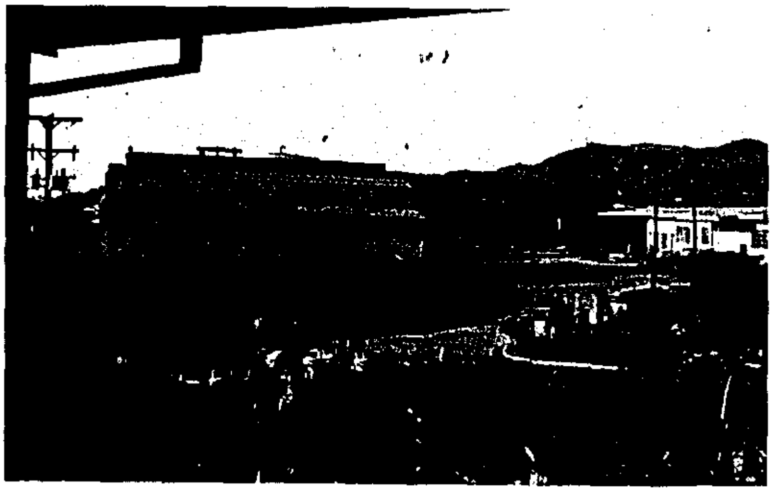
Construction Work of Distribution Line
at Jones Line (ISELCO)



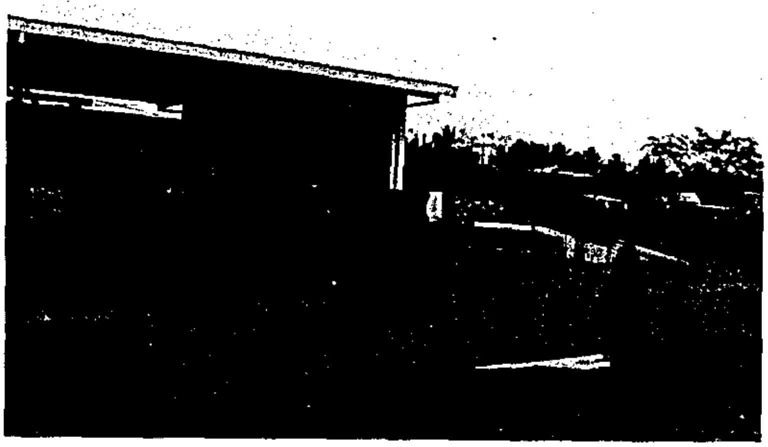
Manager House at ISELCO



Multi-purpose House at ISELCO



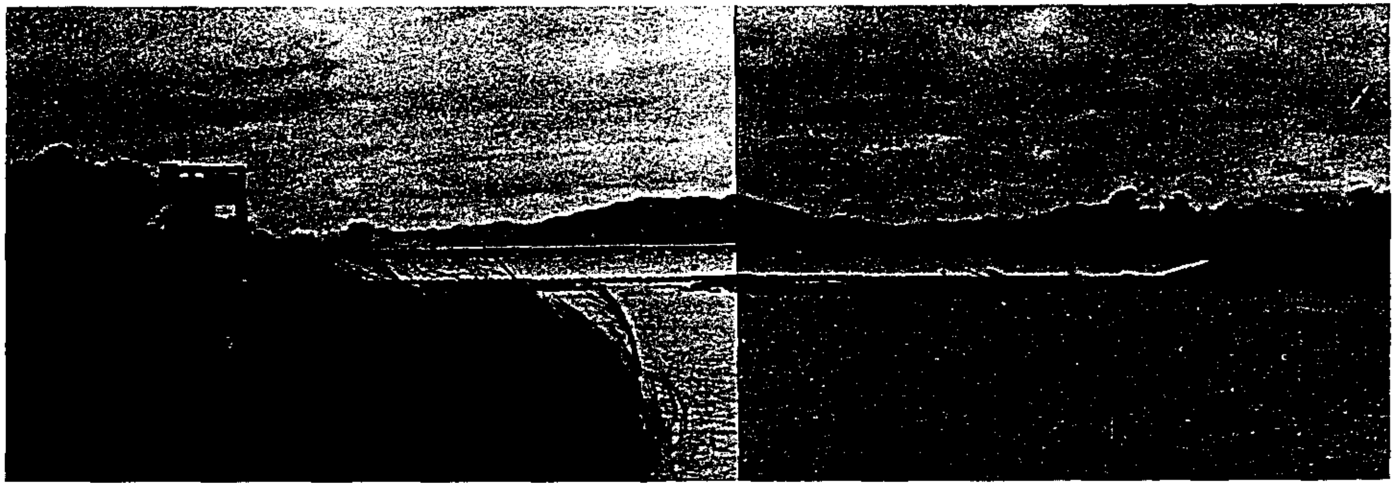
Diesel Power Plant and Warehouse at CAGELCO



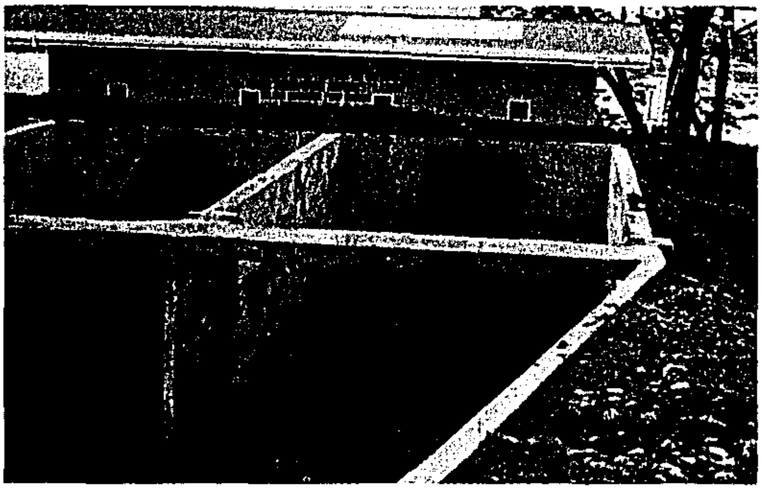
Maintenance House at Batangas

Stock of Pole Transformer at CAGELCO

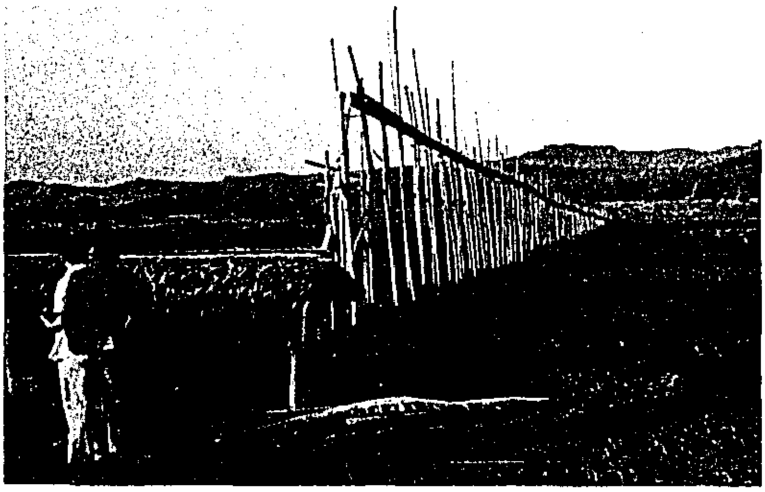
Inside of Warehouse at ISELCO



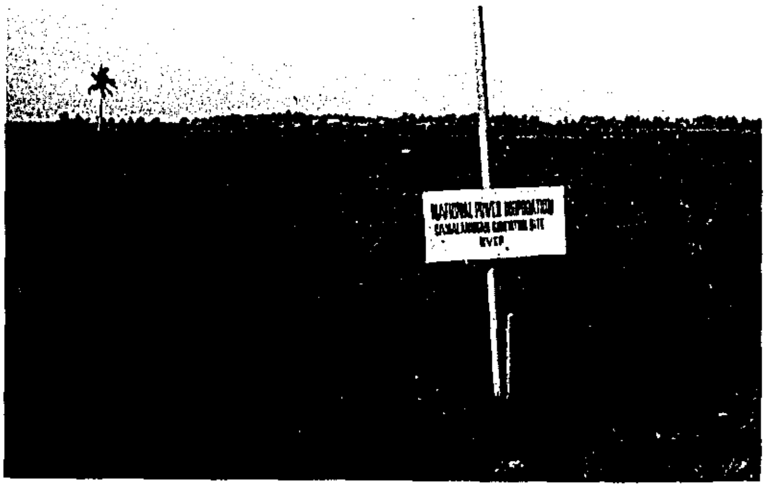
Dam for Irrigation at Ramon (Magat River)



Outlet of Solana Irrigation Pump Site
(Cagayan Province)

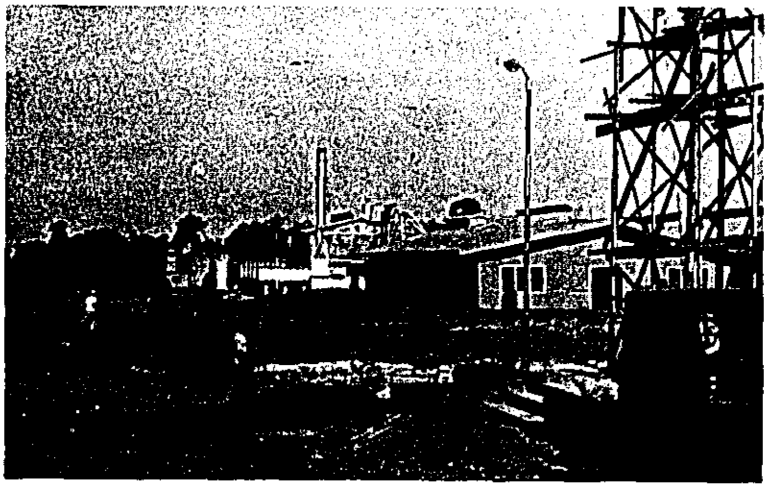


Private Well Pump up Irrigation at Solana
(Cagayan Province)



Site of Camalanuigan S/S

Site of Tuguegarao S/S



Tropical Plywood Factory at Magapit
(Cagayan Province)

Site of Santiago S/S

GLOSSARY

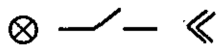
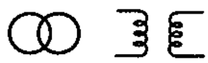
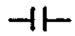
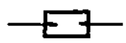
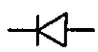
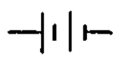
Metric System

	Unit	Abbreviation or Symbol
Length	Millimeter	mm
	Centimeter	cm
	Meter	m
	Kilometer	km (10^3m)
Area	Square millimeter	mm^2
	Circular Mil	CM ($0.000567mm^2$)
	Kilo Circular Mil	KCM (1000 CM = $0.567\ mm^2$)
	Square centimeter	cm^2
	Square meter	m^2
	Square kilometer	km^2 (10^6m^2)
	Hectare	ha (10^4m^2)
Volume	Cubic centimeter	cm^3
	Cubic meter	m^3
Time	Hour	h
	Minute	min
	Second	sec
Mass and weight	Gram	g
	Kilogram	kg
	Metric ton	mt
Velocity	Meter per second	m/sec
	Miles per hour	mph (0.297m/sec.)

	Unit	Abbreviation or Symbol
Flow	Cubic meter per second	m^3/sec
Power	Horsepower	HP (0.75KW)
Temperature	Centigrade degree	$°C = \frac{5}{9}(°F-32)$
	Fahrenheit degree	$°F = \frac{9}{5}°C + 32$
Electric Power		
Power Energy	Watt hour	WH
	Kilowatt hour	KWH (10^3WH)
	Megawatt hour	MWH (10^6WH)
	Gigawatt hour	GWH (10^9WH)
Electric Power	Watt	W
	Kilowatt	KW (10^3W)
	Megawatt	MW (10^6W)
	Gigawatt	GW (10^9W)
Apparent Power	Kilovolt ampere	KVA
	Megavolt ampere	MVA
Voltage	Volt	V
	Kilovolt	KV
Current	Ampere	A
	Kilo ampere	KA
Frequency	Herz	Hz
	Megaherz	MHz
Rate	Percentage	%

Currency	Unit	Abbreviation or Symbol
	Yen	¥
	Peso	₱
	US dollars	US$
Values	1 US$ = 277¥ = 7.5₱	

Symbol

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

Abbreviation

Organization terms

A & E	Architects & Engineer
BCS	Bureau of Census and Statistics
BISA	Barrangai Irrigation Service Association
CAGELCO	Cagayan Electric Cooperative
CB	Central Bank of the Philippines
COOP	Electric Cooperative
DPH	Department of Public Highway
FSDC	Farm System Development Committee
IBRD	International Bank for Reconstruction and Development
ISELCO	Isabela Electric Cooperative
JICA	Japan International Cooperation Agency
LTC	Land Transportation Commission
MERALCO	Manila Electric Company
MITI	The Ministry of International Trade and Industry in Japan
MORESCO	Misamis Oriental Rural Electric Cooperative Inc.
NEA	National Electrification Administration
NEDA	National Economic and Development Authority
NIA	National Irrigation Administration
NPC	National Power Corporation
NUVELCO	Nueva Vizcaya Electric Cooperative
OECF	Overseas Economic Cooperation Fund in Japan
REA	Rural Electrification Administration
USAID	United States Agency for International Development

Economic terms

CY	Calendar Year
DC	Domestic Currency
E/L	Export Licence
FC	Foreign Currency
FY	Fiscal Year (form Jan. to Dec. in Philippines)
GDP	Gross Domestic Product
IP	Implementation Program
IRR	Internal Rate of Return
L/A	Loan Agreement
L/C	Letter of Credit
NDP	National Development Product

Technical terms

ACSR	Alminium Cable Steel Reinforced
BC	Blocking Coil
BIL	Basic Impulse Insulation Level
ch	Channel
CB	Circuit Breaker
cct	Circuit
CCPD	Coupling Capacitor Potential Device
CRP	Carrier Relaying Protection
EL	Elevation Level (meter)
EX	Automatic Exchange
FM	Frequency Modulation
HV	High Voltage
LV	Low Voltage
LT	Line Trap
LTC	Load Tap Changer
LTU	Line Tuning Unit
OCB	Oil Circuit Breaker
OLTC	On Load Tap Changer
P/S	Power Station
S/S	Substation
SSB	Single Side Band
SVR	Step Voltage Regulator
PD	Condenser Type Potential Divider
PLC	Power Line Carrier
T/L	Transmission Line

Tr.	Transformer
VHF	Very High Frequency
WHM	Watt Hour Meter

Local terms

Region	An administrative control division (composed of several provinces)
Region II	Means Cagayan Valley District
Province	An administrative division
Municipal	Towns and counties in a Province
Capital	Capital town of a Province
Town	Seat of town or county office (Locally called "Poblacion")
Rural	A town or village without town or village hall
Barrio	A division of a town or village

<u>Contants</u>

Page

I. GENERAL

I. GENERAL

Summary, Conclusion and Recommendations of Feasibility Survey

1. Outline of Survey

1-1. Background and Purpose of Survey

This feasibility survey was conducted for the Electric Distribution System Project in Cagayan Valley at the request of the National Electrification Administration (NEA) of the Philippines made to the Japanese government in 1976.

The area covered by the feasibility survey includes mainly six provinces, namely, Cagayan, Isabela, Quirino, Kalinga Apayao, Ifugao and Nueva Vizcaya, which form the so-called Region II (see Fig. 1) of the Project division in the northeastern part of Luzon Island. The Region II, despite its important geographical location in the Philippines, is most backward in the nation in respect of electrification.

The purpose of this feasibility survey was to make the necessary studies to map out a detailed power distribution system program for the realization of rural electrification in line with the main project for construction of 230 kV and 69 kV transmission lines and substations, with Japanese financial aids for commissioning in 1979 for which preparations are now under way in the hand of National Power Corporation (NPC).

The rural electrification by the Philippines Government is being carried out by Electric Cooperatives (COOP's) established in the Provinces under NEA. In Region II, the site of this Project, there are 2 COOP's, CAGELCO I (Cagayan Electric Cooperative I) in Cagayan Province and ISELCO I (Isabela Electric Cooperative I) in Isabela Province as of January 1977, and they are supplying electric power for limited hours of the day with a 1,000 KW generator each. Besides, there are about 20 small public and private power enterprises in some of the towns in the Region. According to a survey of 1975, the rate of electrification in Region II is 5%, the lowest among the regions of the nation.

The main industry in the Region II is agriculture and the Region II occupies an important position in the Philippines as a granary, with the export of rice exceeding 200,000 tons a year. At present, large scale irrigation projects involving large pumps are being carried out in the Region II to improve the productivity of agriculture as a measure to cope with the increase of population in future. Though modern industrial plants are coming to the Region II, their electric power requirements are supplied by private thermal power and diesel generators.

It is necessary to expand and strengthen the public utility facilities for the development of these industries, promotion of employment and elevation of the living standard. And as a part of such efforts, it is the urgent duty and mission of NEA to expand the electrification in Region II, which falls behind the other Regions.

To meet these requirements, the Survey Team has prepared the program of the electrification project in Cagayan Valley as follows.

Surveyed area

In general, administrative divisions of the Philippines are as follows.

o Region:	An administrative control division (composed of several provinces)
o Province:	An admistrative division
o Municipal:	Towns and counties in a Province
o Capital:	Capital town of a Province
o Town:	Seat of town or county office (Locally called "Poblacion")
o Rural:	A town or village without a town or village hall.
o Barrio:	A division of a town or village

Under the system of administrative division mentioned above, the so-called Cagayan Valley includes six provinces belonging to Region II as mentioned previously. The areas included in the project are as follows.

Region	Province	Regional capital
Region II	Cagayan	Tuguegarao
	Isabela	
	Quirino	
	Nueva Vizcaya	
	Ifugao	
	Kalinga Apayao	
Region I	Rural Paraceris of Mountain Province.	

The number of municipals covered by the survey is 104.

REGION I
1. Ilocos Norte
2. Abra
3. Ilocos Sur
4. Mt. Province
5. Benguet
6. La Union
7. Pangasinan

REGION II
8. Batanes
9. Cagayan
10. Kalinga-Apayao
11. Isabela
12. Nueva Vizcaya
13. Quirino*
13-1 Ifugao

REGION III
14. Nueva Ecija
15. Tarlac
16. Zambales
17. Pampanga
18. Bulacan
19. Bataan

REGION IV
20. Rizal
21. Cavite
22. Laguna
23. Batangas
24. Quezon
25. Marinduque
26. Occidental Mindoro
27. Oriental Mindoro
28. Romblon
29. Palawan

REGION V
30. Camarines Norte
31. Camarines Sur
32. Albay
33. Sorsogon
34. Catanduanes
35. Masbate

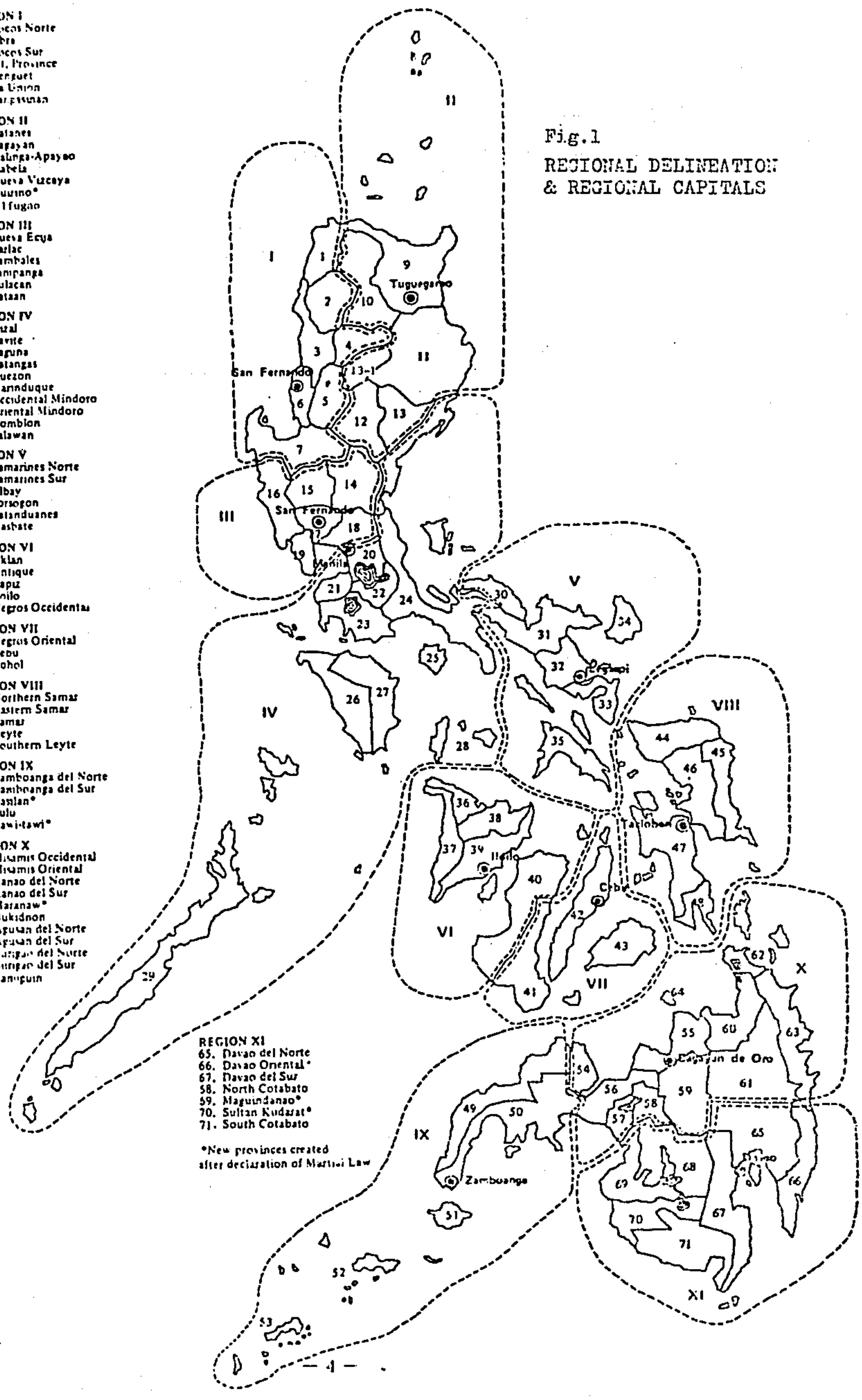
REGION VI
36. Aklan
37. Antique
38. Capiz
39. Iloilo
40. Negros Occidental

REGION VII
41. Negros Oriental
42. Cebu
43. Bohol

REGION VIII
44. Northern Samar
45. Eastern Samar
46. Samar
47. Leyte
48. Southern Leyte

REGION IX
49. Zamboanga del Norte
50. Zamboanga del Sur
51. Basilan*
52. Sulu
53. Tawi-tawi*

REGION X
54. Misamis Occidental
55. Misamis Oriental
56. Lanao del Norte
57. Lanao del Sur
58. Maranaw*
59. Bukidnon
60. Agusan del Norte
61. Agusan del Sur
62. Surigao del Norte
63. Surigao del Sur
64. Camiguin



REGION XI
65. Davao del Norte
66. Davao Oriental*
67. Davao del Sur
68. North Cotabato
69. Maguindanao*
70. Sultan Kudarat*
71. South Cotabato

*New provinces created after declaration of Martial Law

Fig.1
REGIONAL DELINEATION & REGIONAL CAPITALS

1-2 Composition of Survey Mission and Survey Period

Upon request of the Philippine Government to conduct a feasibility survey for the project, the Japan International Cooperation Agency (hereinafter referred to as JICA) of the Japanese Government organized a survey team comprising members shown in the list below and sent it to the Philippines during the period from January 25 through March 20, 1977. During the survey period, the survey team held consultations and exchanged views with NEA, NEDA and other organizations concerned and conducted various surveys in the project area of Region II.

The feasibility report, was prepared after the return of the Survey Team on March 20, 1977 on the basis of the findings of field survey mainly with respect to the demand forecast, development programs, preliminary basic design, construction schedule, construction cost and financial plan and economic feasibility.

Members of Survey Team

Mr. YUTAKA MATSUMOTO
(Electrical Engineer)

Head of the Survey Team
Management & Planning
West Japan Engineering Consultants, Inc.

Mr. SHIGEMITSU SUZUKI
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Mr. HIDETSURA KURIBAYASHI
(Electrical Engineer)

Planning & Demand Forecast
West Japan Engineering Consultants, Inc.

Itinerary for Survey Mission

	1977 JAN. (24, 31) / FEB. (7, 14, 21, 28) / MAR. (7, 14, 21)	
Survey Team arrived in Manila 25/Jan.	25 ⊢—⊣ 4	25/Jan. - 4/Feb. meeting with Japanese Embassy and NEA. 5/Feb. left for Alicia.
Field survey in South part of Region II	5 ⊢—⊣ 24	5/Feb. - 24/Feb. Visited and consulted with, ISELCO. Ifugao Province Government N. Vizcaya Prov. Gov. Quirino Prov. Gov. Isabela Prov. Gov.
Field survey in North part of Region II	25 ⊢—⊣ 10	25/Feb. - 10/Feb. Visited and consulted with, CAGELCO. Cagayan Prov. Gov. Kalinga-Apayao Prov. Gov.
Meeting and preparation of Interim Report, in Manila Survey Team left Manila 20/Mar.	11 ⊢—⊣ 20	18/Mar. Interim Report submitted to NEA. 11/Mar.- 17/Mar. Meeting with NEA and NPC Meeting with Japanese Embassy

1-3 Basic Data Used for Survey

The basic data and materials used as references in the preparation of this feasibility report are listed in Table 1.

Table 1 Basic Data and Materials

Type of data	No.	Description
General	1	The Essential Reference Work on the Philippines for 1975. - Philippine Almanac & Handbook of Facts -
	2	Journal of Philippine Statistics, 1st ∿ 3rd Quarter 1976.
	3	Socio Economic Profile Region II, Part 1, Part 2, 1976.
	4	Socio Economic Profile, Province, Isabela, Cagayan, Quirino, Kalinga Apayao.
	5	Population Density of Region II, 1975.
	6	Development Digest Region II, 1976.
	7	List of Small Industry, Isabela.
	8	Consumer Price Index for the Philippines, 1957 ∿ 1976.
	9	Presidential Decree 269.
Map	10	NEA Region II Project Map.
	11	Region II Municipal Map, 98 sheets.
NPC Data	12	Philippine-Japan Project Loan Assistance Program; Plans & Specification Vol 1 ∿ Vol 7.
	13	NPC: Power Expansion Program.
Irrigation	14	BISA Program: Isabela, Cagayan.
NEA	15	Progress Report 1976, 1975
	16	An Evaluative Study of the Misamis Oriental Rural Electric Service Cooperative,Inc. (MORESCO) 1976.
Coop	17	Monthly Report Dec. 1976, CAGELCO, ISELCO.
	18	Estimated Operational Budget Jan ∿ Jun 1977, CAGELCO, ISELCO.
Engineering	19	Rulal Line Manual, NEA.
	20	Specification & Drawings for 34.5 kV and 69 kV Transmission Line Construction, NEA.
	21	Specification & Drawings for 7.62/13.2 kV Line Construction

2. Conclusion

2-1. Present State of the Region as the Object of Electrification

Construction of major power generating facilities and transmission systems is the responsibility of NPC as mentioned previously. For power distribution which forms an important part of the electrification program, NEA is the principal promoter, which is now aiming at the rapid electrification on a national scale through integration and merger of a number of small and medium local electric enterprises into new organizations and also through expansion of distribution networks in parallel with the expansion of the trunk line system to be carried out by NPC for a final objective of supplying high quality power to a wider area at low costs.

The method used by NEA for promotion of electrification on a national scale is to establish an Electric Cooperative (COOP) in provinces within the administrative control division (Region), which are composed of local residents and are under the direct control of NEA. The establishment of COOP's is being promoted under the direct guidance and financial aids and other assistance of NEA, and each COOP is encouraged to strive for the promotion of electrification for development of its own area and make efforts for systematic operation and management of the organization.

While the number of Electric Cooperatives (COOP's) increased to 63 (for 71 Provinces) at the end of 1976 for a total of 11 Regions, a sharp increase since 1974, the progress of the establishment of COOP's in Region II, the project area, is far behind the other Regions with only 2 COOP's established as far for six provinces in the Region despite its important geographical location in the nation. This is mainly attributable to the government policy for Luzon Island which gave priority to the development and social welfare of the Manila District. However, the Philippine Government now plans the expansion of COOP's in Region II as follows.

Province	Name of cooperatives	Project area
Cagayan	CAGELCO I (Expansion)	South district of the province including Tuguegarao and Conner in Kalinga Apayao Province.
	CAGELCO II (New)	North district of the province including Aparri.
Isabela	ISELCO I (Expansion)	South district of the province including Santiago and Potia in Ifugao Province.
	ISELCO II (New)	North district of the province including Ilagan and Paracelis in Mountain Province. Palanan is not included.
Quirino	Quirino (New)	Quirino Province.
Kalinga Apayao	Kalinga Apayao I (New)	South district of the province including Tabuk.
	Kalinga Apayao II (New)	North district of the province including Luna. Conner is not included.
Ifugao	Ifugao (New)	Entire province excluding Potia and Lamut
Nueva Vizcaya	NUVELCO (New)	Entire province including Lamut in Ifugao Province

2-2. Electrification Program in Region II

Through this feasibility survey it was confirmed that the number of Electric Cooperatives (COOP's) would be increased to nine in the six Provinces as shown in the foregoing table for promotion of electrification in Region II, and the feasibility of this project could be endorsed.

Planning of the electrification program was made carefully by conducting the necessary surveys centering on the location of the head office of each COOP in Region II (including Paraceris of Region I which is under the jurisdiction of ISELCO II) as a first stage of electrification and also by considering the economy of the project in relation to the 230 kV and 69 kV Trunk Line Project which is to be implemented by NPC in the same region.

It must be noted in planning an electrification project that the speed of electrification and the economy of the project run counter to each other. It is desirable, therefore, to promote electrification step by step while maintaining the substance of electrification through construction of the necessary facilities which become the core of the electrification project. For this reason, implementation of the electrification project in stages as shown below is projected.

1st Stage of Project

1979~1980

13.2 KV distribution Trunk Lines to Capital and Towns will be completed by 1980, and 35-40% of the households in Barrios located within 500 m from the trunk lines will be electrified. Electrification rate of Capitals and Towns will be 40-65%.

1981-1982

35-40% of the households in the 50% of Barrios not electrified by 1980, will be electrified. Electrification rate in Barrios electrified by 1980 will be increased to 45-50%.
Electrification rate in Capitals and Towns will be increased to 50-75% (Overall electrification rate will be 33.6%).

2nd Stage of Project

1982-1984

All Barrios will be electrified by 1984. The electrification rate in Capitals and Towns will be raised to 60-85%, the electrification rate in Barrios where electrification was started before 1982 will be raised to 45-60%, and the electrification rate in the other Barrios will be advanced to 30-35%. (Overall electrification rate will be 50%.)

3rd Stage of Project

1985-1990

Electrification rate in Region II, including Capital, Towns and all Barrios, will be 100%.

Hence, the load forecast by type of consumers was made by considering the following. One of the main objectives of the project is residential electrification which is as important as the expansion of the facilities to meet the increasing power demand of irrigation projects which are now being developed as a main industry in Region II.

For electrification of residential areas, priority will be given to electrification of important districts and electrification of other districts will be carried out in stages.

As previously mentioned, electrification of the Barrios which can be electrified most effectively and can produce the highest efficiency of investment among residential areas in Municipals, will be promoted by each of the nine cooperatives (COOP's) for completion in 1982 as the 1st stage. Hence, the electrification rate of residential areas in the 1st stage of the Project will reach 33.6% or 129,227 households out of a total of 384,069 households in Region II in 1982. But, at the time the distribution system will cover 70% or 271,615 households in 1982. (See Table 6-14-1). The residential electrification scheme for each cooperatives (COOP) is shown in the following table.

Table 2 Progress of Residential Electrification Rates in Region II

Name of COOP	1980			1982			1984		
	No. of households electrified	Electrification rate (%)	Total No. of households	No. of households electrified	Electrification rate (%)	Total No. of households	No. of households electrified	Electrification rate (%)	Total No. of households
N. VIZCAYA	11,743	26.5	44,320	19,164	40.6	47,196	27,782	55.3	50,262
IFUGAO	1,905	9.8	19,504	4,813	23.7	20,299	9,280	44.0	21,112
QUIRINO	2,097	14.9	14,096	4,678	30.4	15,397	7,943	47.2	16,811
ISELCO I	15,577	19.9	78,396	28,284	34.5	81,911	43,420	50.8	85,497
ISELCO II	10,813	19.0	56,814	20,535	34.6	59,361	31,309	50.5	61,960
CAGELCO I	9,790	15.6	62,736	21,242	32.6	65,134	33,010	48.8	67,646
CAGELCO II	10,996	18.2	60,461	20,533	32.7	62,772	32,057	49.2	65,193
K. APAYAO I	3,643	17.5	20,769	7,187	32.4	22,165	11,581	49.0	23,649
K. APAYAO II	1,218	13.2	9,215	2,791	28.4	9,834	4,835	46.1	10,492
Total	67,782	18.5	366,311	129,227	33.6	384,069	201,317	50.0	402,622

Another main demand will be by irrigation projects which may be classified roughly into the following.

(1) Irrigation projects implemented by NIA as national projects.

(2) Irrigation projects implemented by local governments.

(3) Irrigation projects implemented as private local undertakings.

The main irrigation load required during the 1st stage of the project (by 1982) will be as follows.

North Cagayan - Camalaniugan S/S:	Magapit Irrigation; (Lower Cagayan Integrated Agricultural Development Project) 4800KW
South Cagayan - Tuguegarao S/S :	Solana NIA; 1,500KW
	Tuguegarao NIA; 500KW

In addition, small scale irrigation pumps are installed in various parts of the region.

For industrial demands, a demand of 2,500 KW of Tropical Plywood as the load of Camalaniugan S/S and a demand of 1,500 KW of the Piat Sugar Refinery as the load of Piat S/S may be pointed out. Besides, such industrial loads as rice mills and saw mills and demands of public entities such as town and village facilities may also be considered. When these demands are integrated, the total annual power demand will be as shown in the following tables.

Table 3 Energy Demand Forecast by Type of Consumers

(MWH)

	1980	1981	1982	1983	1984	1985	1990
Residential	32,536	52,036	79,086	113,433	164,192	206,262	557,495
Rice mill	12,240	17,952	23,664	29,376	35,088	40,800	44,880
Others	6,994	10,558	14,947	20,218	27,367	31,476	36,513
Irrigation BISA, Private	9,965	13,340	17,143	21,262	25,790	29,167	44,851
" Large (NIA)	27,300	27,300	27,300	27,300	27,300	27,300	27,300
Irrigation Subtotal	37,265	40,640	44,443	48,562	53,090	56,467	72,151
Industry	28,080	29,808	29,808	21,168	21,168	31,968	31,968
Grand Total	117,115	150,994	191,948	232,757	300,905	366,973	743,007

BISA: *Barrangai Irrigation Service Association*

NIA : National Irrigation Administration

Table 4 Maximum Power Demand at Substation Sending End, by Year

(For User Category) (KW)

	1980	1981	1982	1983	1984	1985	1990
Residencial	11,076	16,966	24,740	34,550	48,729	59,681	157,379
Rice mill	5,100	7,480	9,860	12,240	14,620	17,000	18,700
Public and Others	1,619	2,444	3,460	4,680	6,335	7,286	8,452
Irrigation							
BISA	3,529	4,107	4,727	5,325	5,956	5,956	6,849
Private	2,007	3,304	4,797	6,487	8,372	10,248	18,068
NIA	7,775	7,775	7,775	7,775	7,775	7,775	7,775
Sub total	13,311	15,186	17,299	19,587	22,103	23,979	32,692
Large Industry	6,900	6,900	6,900	4,900	4,900	7,400	7,400
Loss	3,801	4,898	6,226	7,597	9,670	11,534	22,463
Total	41,807	53,874	68,485	83,554	106,357	126,880	247,086

Table 5 COOP's Maximum Power Demand, at Substation Sending End, by Year

(KW)

	1980	1981	1982	1983	1984	1985	1990
N. VIZCAYA	3,189	4,646	6,434	8,565	11,409	13,621	28,227
IFUGAO	645	1,102	1,670	2,477	3,595	4,390	10,678
QUIRINO	656	1,069	1,596	2,253	3,158	3,907	9,939
ISELCO I	9,705	12,739	16,330	18,310	23,689	27,775	53,648
ISELCO II	5,080	7,291	9,911	12,891	16,718	19,813	38,878
CAGELCO I	8,455	10,352	12,693	15,298	18,784	21,479	40,476
CAGELCO II	12,518	14,230	16,313	18,864	22,276	27,679	46,047
K. APAYAO I	1,145	1,768	2,534	3,478	4,748	5,790	13,313
K. APAYAO II	414	677	1,004	1,418	1,980	2,426	5,880
TOTAL	41,807	53,874	68,485	83,554	106,357	126,880	247,086

Table 6. Substation's Maximum Power Demand, by Year

(KW)

Substation		Capacity (KVA)	1980 (KW)	1981 (KW)	1982 (KW)	1983 (KW)	1984 (KW)	1985 (KW)
Solano S/S	(4)	15,000	3,834	5,748	8,104	11,042	15,004	18,011
Santiago S/S	(4)	15,000	6,931	8,887	11,233	11,924	15,647	18,474
Cauayan S/S	(3)	10,000	3,430	4,921	6,693	8,639	11,200	13,208
Ilagan S/S	(4)	15,000	5,080	7,291	9,911	12,891	16,718	19,813
Tuguegarao S/S	(4)	15,000	5,793	6,610	8,122	9,740	11,750	13,425
Piat S/S	(2)	15,000	2,663	3,742	4,571	5,558	7,034	8,054
Tabuk S/S	(2)	10,000	1,145	1,768	2,534	3,478	4,748	5,790
Camalaniugan S/S	(4)	15,000	2,398	3,225	4,158	5,351	7,169	8,057
Abulug S/S	(3)	15,000	2,096	3,068	4,131	5,395	7,045	8,449
Magapit S/S	(3)	15,000	8,438	8,614	9,028	9,536	10,042	13,599
Total Load 10 S/S		41,8	41,807	53,874	68,485	83,554	106,357	126,880
Total Capacity 10 S/S			140,000	140,000	140,000	165,000	180,000	180,000
Total Load/Total Capacity (%)			30	38	49	51	59	70

Number of Substations: NPC Project 6, NEA Project 4
( ) : Number of feeders, Number of total feeders: 34
New construction of substation at 2nd Stage: (1983 - Ifugao (10,000 KVA), Roxas (15,000 KVA)
1984 - Echaque(15,000 KVA)

On the basis of the foregoing policy for electrification, the development program has been formulated as follows.

1st stage: In this stage, all Municipals in the Region will be linked with each other by 13.2 KV trunk distribution lines (69 KV transmission lines and substations will be provided in some Municipals) and low voltage distribution lines will be extended to cover main Barrios of each Municipal, where high investment efficiency can be expected (Residential electrification rate will be 33.6%) by 1982.

2nd stage: In this stage, distribution lines will be built in all the Barrios and the rate of residential electrification will be raised to 50.0% and the necessary facilities for supply of power to irrigation projects, industrial plants such as agricultural processing plant, ice plant, sugar refinery, saw mill and public facilities, all of which are expected to be developed to some extent by then, will be provided by 1984. Besides, the facilities at Solano S/S, Santiago S/S, Cauayan S/S and Ilagan S/S will be expanded since there will be a shortage of capacity in these substations. Moreover, installation of three additional substations will be required. One unit of 230/69 KV transformer will be added to Tuguegarao S/S, the transformer capacity of which will come to be short in 1984.

3rd stage: The rate of residential electrification in Region II will reach almost 100% by 1990 and extension of transmission lines, installation or expansion of substations and expansion of distribution networks will be carried out to meet the increased demands of irrigation projects, various industries following the expansion of industrial activities and public facilities and also of the tertiary industry including educational, recreational and transportation facilities for modernization of communities in Region II.

Five additional substations will have to be provided in this stage.

The feasibility survey was made mainly for the 1st stage of the project which is the most important phase, among the above-mentioned three phases, for the establishment of initial operating system of overall power system under the Electrification Program in Region II. The following are details of the result of the feasibility survey.

Facilities to be completed in the 1st stage of the project are outlined below.

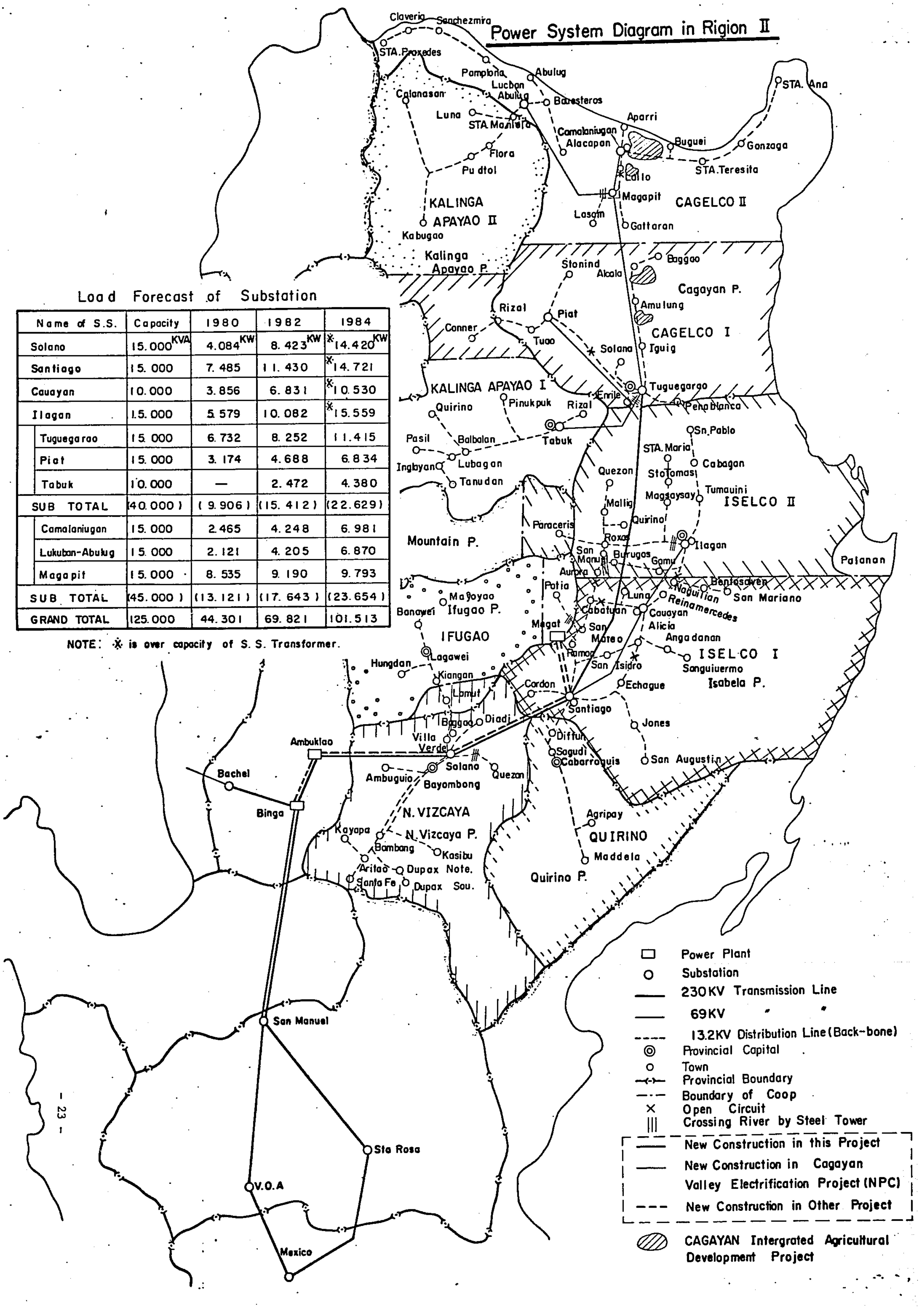
1) Transmission and Substation Facilities

Four 69 KV substations with a total capacity of 55 MVA	<u>Cagayan Province</u>: Lucban-Abulug (15 MVA) Magapit (15 MVA) Piat (15 MVA) <u>Kalinga Apayao Province</u>: Tabuk (10 MVA) 13.2KV outgoing line-15 circuits	
69 kV transmission lines for a total length of 148 km	One circuit of Magapit-Lucban-Abulug line	46 Km
	One circuit of Tuguegarao -Piat line	66 Km
	One circuit of Tabuk branch line from the above	36 Km

2) Distribution Facilities

13.2 KV high voltage distribution line		3,487 km
240V low voltage distribution line		3,824 km
Pole transformer	6,320 Units	93,530 KVA
Voltage regulator	37 Units	83,000 KVA
Watt-hour meter		130,000 KVA
Other equipment and materials		1 lot

Power System Diagram in Rigion II



Load Forecast of Substation

Name of S.S.	Capacity	1980	1982	1984
Solano	15.000 KVA	4.084 KW	8.423 KW	※14.420 KW
Santiago	15.000	7.485	11.430	※14.721
Cauayan	10.000	3.856	6.831	※10.530
Ilagan	15.000	5.579	10.082	※15.559
Tuguegarao	15.000	6.732	8.252	11.415
Piat	15.000	3.174	4.688	6.834
Tabuk	10.000	—	2.472	4.380
SUB TOTAL	(40.000)	(9.906)	(15.412)	(22.629)
Camalaniugan	15.000	2.465	4.248	6.981
Lukuban-Abulug	15.000	2.121	4.205	6.870
Magapit	15.000	8.535	9.190	9.793
SUB TOTAL	(45.000)	(13.121)	(17.643)	(23.654)
GRAND TOTAL	125.000	44.301	69.821	101.513

NOTE: ※ is over capacity of S. S. Transformer.

2-3. Construction Cost

As outlined in the preceding Section 2-2, Electrification Program in Region II, this Project should be carried out in three stages by setting the target for 100% electrification by 1990.

Of the three stages, the 1st stage should be implemented keeping pace with the 230 KV System Project by NPC. This stage is the main object of the feasibility survey in which precise calculation was made for basic design, quantity of equipment and materials and construction costs. The estimated construction costs for 1st stage through 3rd stage of the project are as follows.

1st Stage (1978 - 1982) — 1980 price, based on 1977 with 5% of annual rate of price rise.

F.C. ¥9,385,000,000 (US$33,881,000)
D.C. ₱166,030,000 (US$22,137,000)

Equivalent total: ₱420,130,000 (US$56,018,000) (1US$ = 277¥ = 7.5₱)

2nd Stage (1982 - 1984) — 1983 price, based on 1977 with 5% of annual rate of price rate

F.C. ¥5,101,000,000
D.C. ₱80,420,000

Equivalent total ₱218,530,000

3rd Stage (1985 - 1990) — 1983 price (to be revalued in the future)

F.C. ¥9,540,000,000

D.C. ₱134,110,000

Equivalent total ₱392,420,000

The present worth as of 1980 of the total construction cost (1st Stage through 3rd Stage) is

$$₱(420,130,000 + \frac{218,530,000 + 392,420,000}{1.15}) = ₱951,390,000$$

and ₱420,130,000 of the cost of 1st Stage accounts for as high as 44% of the total cost.

2-4. Economic Feasibility

The construction cost of the 1st Stage of this electrification project is as shown in the following table.

The economic feasibility is computed by the use of the KWH forecasted, and the following selling price and IRR (Internal rate of return) value are obtained.

On the basis of 0.239₱/KWH of unit buying price from NPC, the selling, price in Cagayan Valley will be 0.414₱/KWH in 1982 and 0.410₱/KWH in 1984. This selling price is 30% lower than ₱0.63/KWH of the current selling price by ISELCO by diesel power generation, and this Project proves to be economically effective.

The IRR value computed for a period of 25 years with 0.45₱/KWH selling price, is 9.1%.

Thus, the Cagayan Valley Rural Electrification Project is sufficiently feasible economically, and is worth implementing for the elevation of economic basis and people's livelihood in the area.

Table 7. Total Project Cost

Item	F.C. 10^3 Yen	D.C. 10^3 ₱	Total 10^3 ₱
(1) Transmission facilities	760,000	7,020	27,600
(2) Substation facilities	723,000	2,870	22,450
(3) Communication facilities (PLC)	108,000	270	3,190
(4) Distribution facilities	6,045,000	104,820	268,490
(5) Administrative facilities	525,000	20,000	34,210
A. Total Direct Const. Cost	8,161,000	134,980	355,940
B. Contingency (A x 0.1)	*816,000	13,500	35,590
C. Subtotal (A + B)	8,977,000	148,480	391,530
D. Administrative Expenses (D.C. A x 0.07)	---	9,450	9,450
E. Engineering Fee F.C. A x 0.05 D.C. A x 0.06	408,000	8,100	19,150
F. Total Const. Cost (C + D + E)	9,385,000	166,030	420,130
Equivalent Yen	9,385,000	6,132,000	15,517,000

Note: 1US$ = 277¥ = 7.5₱
* including contingency on Engineering fee.

2-5. 230 KV Transmission Line Expansion Plan

In addition to the study of the distribution program, a study was made on the addition of one circuit to the 230 KV transmission line between Ambuklao and Santiago.

This expansion of 230 KV transmission line has come to be necessary for transmission of power from Magat Hydro Power Plant (output of 1st stage construction: 360 MW, scheduled to be commissioned in 1983) now under construction by NPC with the I BRD loan. The Magat Hydro Power Plant is located on the north-west of Santiago Substation, and the generated power will be transmitted by 2 circuits of 230 KV transmission lines to Santiago Substation, and supplied to the load around Manila, through Solano and Ambuklao.

Between Santiago and Ambuklao, one circuit of 230 KV transmission line (with towers designed for 2 circuits) is now in preparation for construction by NPC with the 4th Yen Loan, but one circuit will be short in transmission capacity for the full output operation of Magat Power Plant, and hence addition of 1 more circuit is needed.

At the time of the JICA study in 1974, the Magat Power Plant Project had already been programmed (with planned output of 300 MW) and the Ambuklao-Santiago Line towers were designed for 2 circuits based on the plan of making this line into a 2-circuit line by the time of completion of Magat Power Plant.

(1) Outline of Works

<u>Transmission Line</u>

Circuit Length:	107 km between Ambuklao and Santiago
Voltage:	230 KV
Conductor:	405 mm^2 (795 MCM) ACSR
Insulator Assembly:	250 mm ball-socket insulators, 14-insulator string
Support:	Steel towers (Tower construction works are not necessary, because the work is an addition of a circuit on the existing towers.)

Substations

In connection with the addition of 1 circuit to the transmission line, 230 KV line lead-out equipment are added to Ambuklao Power Plant, Solano Substation and Santiago Substation.

Ambuklao P/S	2 units of 230 KV circuit breakers with related equipment and PLC relays are added.
Solano S/S	1 unit of 230 KV circuit breaker with related equipment and PLC relays are added.
Santiago S/S	3 units of 230 KV circuit breakers with related equipment and PLC relays are added.

(3) Construction Cost — 1979 price, based on 1977 with 5% of annual rate of price rise.

F.C.	¥1,380,000,000	(US$4,980,000)
D.C.	₱11,320,000	(US$1,510,000)
Equivalent Total	₱48,690,000	(US$6,490,000)

3. Recommendations

(1) As already mentioned in the previous chapter Cagayan District is behind the other districts in Luzon Island in economic and social development. This Electrification Project has a very important meaning as it will provide a basis for industrial development, promotion of employment, improvement of public facilities and elevation of the standard of living of the people through electrification of households in the Cagayan District, with a final objective of narrowing the gap between this district and other advanced districts and promoting the welfare of the people. The Project is feasible both technically and economically.

(2) Upon completion of this Project, the Electric Cooperatives (COOP's) in Region II, will purchase power from NPC at a wholesale price of about 0.239 peso/KWH and then COOP's will supply power to consumers at an average price of 0.44 peso/KWH. When compared with the power rate in other advanced district, this rate is a little higher than the selling price of 0.378 peso/KWH now prevailing in Region III where the share of lamp load is quite high in the total load. This rate is about 30% lower than the prevailing rate of 0.63 peso/KWH for the power supplied by independent diesel power plants in Region II.

(3) For operation and management of this project, a total of nine Electric Cooperatives (COOP's) are to be established in Region II. Three Cooperatives (COOP's) have already been established and are in operation as of March 1977. The remaining six Cooperatives are expected to be established within next year and preparations are being made by NEA for their establishment. Since the cooperatives will be directly responsible for the operation of this Project, an early organization of each cooperative, complete and substantial, is desired so that it will be able to take the responsibility of the Project.

(4) The following are also recommended for the implementation of the project.

(i) Soil surveys should be made in advance for foundations of steel towers for 69 KV transmission lines at two crossing points of the Cagayan River and for foundations of steel towers for high voltage distribution lines at four crossing points of the river.

(ii) Frequency allocation should be confirmed prior to placing orders for communication equipment.

(iii) Instruction manuals for tap operation of distribution pole transformers should be prepared and training courses should be provided for COOP's technicians.

(iv) The location of substations should be determined by considering the convenience of maintenance of facilities. In particular, the location of Magapit S/S should be determined by considering the relationship with the geographical location of NPC 69 KV transmission lines.

(v) For river crossing points of high voltage distribution lines where bridges are to be utilized in addition to the four crossing points mentioned in the previous paragraph (i), approval of the related road office should be obtained at an early stage.

(vi) The progress of electrification in the service area of new substations should be coordinated well with the progress of the construction of the substations.

II. DETAILS OF SURVEY RESULT

Chapter 1 Economic Situation of the Philippines

II DETAILS OF SURVEY RESULT

Chapter 1. Economic Situation of the Philippines

1-1. General Economic Situation of the Philippines until 1973

The gross national product of the Philippines in 1973 was extremely favorable as shown in Table 1-1 and exceeded the gross national product of the previous year by 1.25 times with a real growth rate of 9.8%/year. The trade balance in 1973 also showed a large excess of exports for the first time in 10 years.

As shown in Table 1-2, Gross Domestic Product by Industry, the production in 1973 increased sharply as compared with 1971 in each sector of industry and an increase of 1,400 million peso or a growth of 17% over 1971 in the production of agriculture and forestry is particularly noteworthy.

As for regional gross domestic product, however, Region IV which includes the Manila District still leads the others, accounting for 45.3% of the gross national product. There is a big difference in absolute values between Region IV and other regions. That is, the difference of 1,100 million peso in 1971 between Region IV and Region VI (West Visaya), which ranked 2nd both in 1971 and 1973, widened to 1,410 million peso in 1973 (see Table 1-3).

In addition to the above-mentioned difference in the productivity of regions, the economy of the Philippines is confronted with the following problems.

Table 1-1 Changes in Trade Balance and GNP

(1US$ = 7.5₱ = 277yen)

Base year: 1967

Item \ Year	1970	1971	1972	1973
Gross National Product (in 1,000 million ₱)	40.7	54.1	56.9	71.3
(Over previous year)	-	(1.32)	(1.05)	(1.25)
(Real growth rate)	(4.6%)	-	(4.2%)	(9.8%)
Export (in million pesos)	7,961	8,814	9,696	16,027
Import (in million pesos)	8,089	9,146	10,143	13,574

The Statistical Report NEC
National Income Series NEDA.

Table 1-2 Gross Domestic Procuct in the Philippines by Industry, CY. 1967, 1971 and 1973

(at constant 1967 prices, in million ₱)

Item \ Year	1967	1971	1973
Agriculture & Forestry	7,091	8,045	9,442
Mining	457	970	1,047
Manufacturing	6,025	7,682	8,326
Construction	915	1,355	1,875
Trans. Comm. Storage	1,549	1,717	1,931
Commerce	4,992	7,861	8,855
Service	5,688	6,191	6,548

Table 1-3 Gross Regional Domestic Product by Region
CY 1967, 1971 and 1973

(at constant prices, in million pesos)

Region \ Year	1967		1971		1973	
	Value	%share	Value	%share	Value	%share
Philippines	27,617.0	100.0	33,820.7	100.0	38,023.8	100.0
Region I	1,404.0	5.1	1,807.8	5.4	1,911.9	5.0
(Cagayan valley) II	664.0	2.4	908.2	2.7	816.7	2.2
III	2,033.0	7.4	3,042.4	9.0	3,267.3	8.6
IV	12,950.0	46.9	14,767.5	43.7	17,239.6	45.3
V	1,070.0	3.9	1,227.2	3.6	1,343.5	3.5
VI	2,241.0	8.1	3,210.4	9.5	3,125.5	9.8
VII	1,575.0	5.7	2,173.4	6.4	2,455.7	6.5
VIII	848.0	3.1	1,029.5	3.0	1,052.2	2.8
IX	779.0	2.8	1,465.2	4.3	1,135.0	3.0
X	2,067.0	7.5	1,912.1	5.6	2,309.0	6.1
XI	1,986.0	7.2	2,277.0	6.7	2,766.7	7.3

Source: National Income Accounts Staff, NEDA

1) Need for Expansion of Employment to Cope with the Increase of Population.

The population of the Philippines has increased from 27 million in 1960 to 32 million in 1965, to 37 million in 1970 and further to 42 million in 1975 at an annual rate of one million.
Table 1-4 shows changes in working population and unemployed population.

The table also shows the existence of an unemployed population of around 900,000 every year. It will be an important task of the Philippine Government to reduce the unemployed population by expanding employment opportunities in order to cope with the constant increase of population every year.

Table 1-4 Changes in Working Population
(1,000 persons)

Item \ Year	1967	1970	1971	1972
Working population	11,229	11,355	11,627	13,217
Unemployed population	817	942	661	983
Rate of unemployment	7.3%	8.3%	5.7%	7.4%

Source of data - BCS, Survey of Households Bulletin

2) Need for Improvement of Income in Rural Areas

Table 1-5 shows a comparison of family income between national average, Manila District and Region II for 1965 and 1971. Fig. 1-1 shows the difference of family expenditure between these sectors for 1965 and 1971. Although the gap between the city area and rural area is being narrowed year by year, the difference is still evident as shown in the table. Therefore, it will be necessary to make further efforts to narrow the gap through relocation of manufacturing industry and improvement of agricultural productivity through improvement of agricultural infrastructures.

3) Fall of Real Wages

The real wages have a tendency to fall down because of the unbalance between the progress of the inflation and the tempo of wage increase. This relationship is shown in Table 1-6.

Fig. 1-1 Comparison of Income between Region II, National Average and Manila by Income Class

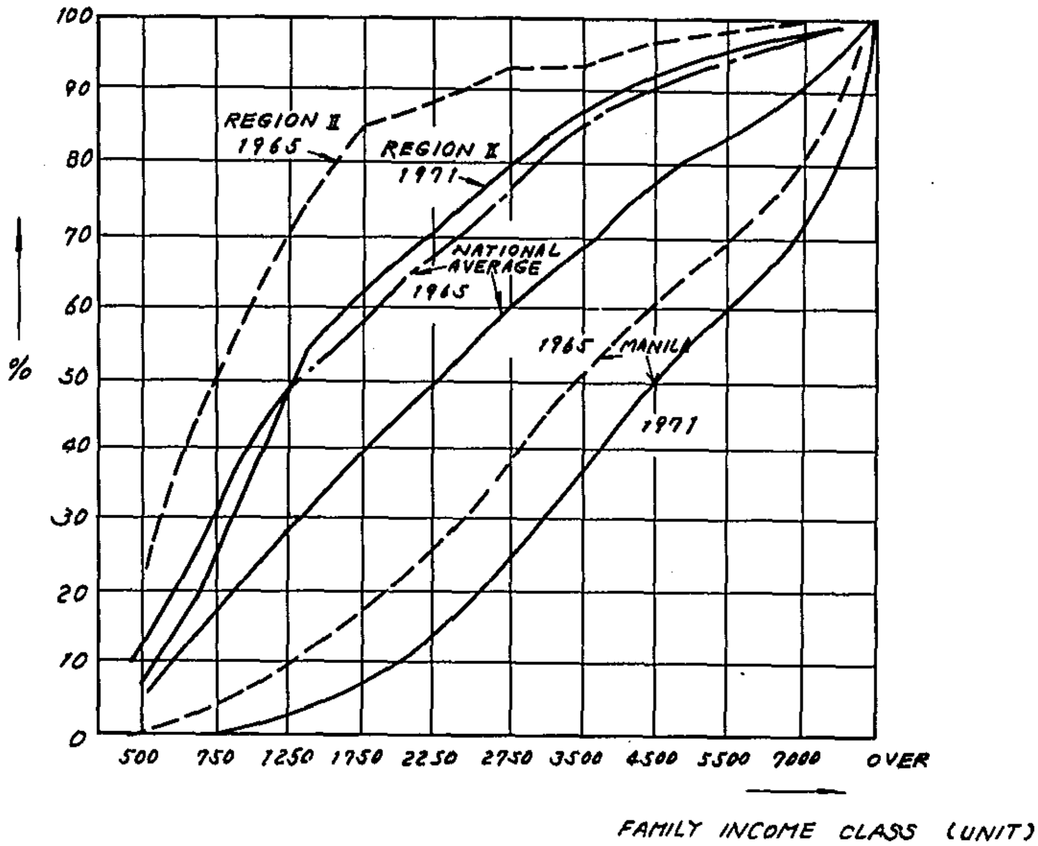


Table 1-5 Comparison of 50% cumulative income

		1965	1971	71/65
Manila	A	₱3,500	₱4,500	1.29
National average	B	1,250	2,250	1.80
(B/A)		(35.7%)	(50%)	
Region II	C	750	1,250	1.66
(C/A)		(27.8%)	(21.4%)	

From 1972 to the first half of 1973, the increase of consumer price index showed a sign of stability and the fall of real wage seemed to have come to an end. However, the oil crisis in the latter half of 1973 triggered a sharp rise of commodity prices, setting off big falls of real wages. How to cope with this rampaging inflation is an important task of the Government for stabilization of people's livelihood.

Table 1-6 Purchasing Power of the Peso, Wage Rate Index of laborers in Manila

Period	Consumer price index	Purchasing power of the Peso	Wage rate skilled	Real wage rate
1965	100	100	100	100
67	112.0	89.3	109.9	98.1
69	116.9	85.5	125.0	106.9
70	133.7	74.8	132.8	99.3
71	153.2	65.3	139.7	91.3
72	160.9	59.2	146.6	86.8
73M	171.2	58.4	151.5	88.5
73D	213.8	46.8	157.3	73.6
74M	235.5	41.9	168.2	71.4

Source: Central Bank of the Philippines

1-2. Four-year Development Plan (1974 ∿ 1977)

For the purpose of solving the above-mentioned problems, the Four-year Development Plan (1974 ∿ 1977) was mapped out by the Government as a positive measure to develop the national economy on the favorable economic achievements in 1973 which attained a real growth rate of 9.8% of production and showed a black figure of 2,500 million pesos in trade balance. The Four-year Development Plan aims at the following.

1. Expansion of employment
2. Improvement of economic growth rate
3. Impartial income distribution
4. Regional development and industrialization
5. Promotion of social development
6. Maintenance of appropriate price levels and stabilization of the national finance.

To achieve these objectives, the Four-year Development Plan calls for industrialization of the nation through induction of foreign capital, construction of infrastructures for improvement of industrial basis, establishment of landed farmers through farmland reform and promotion of electrification of rural area.

Table 1-7 Projected All Funds Expenditures by Functions
* (Fiscal Years. In Million Pesos)

Description	FY 1974 Estimated	FY 1975 Projected	FY 1976 Projected	FY 1977 Projected
Economic Development	3,414 (39.6%)	2,989 (33.7)	3,355 (33.9)	3,663 (30.9)
Social Development	2,442 (28.4)	2,598 (29.3)	2,916 (29.4)	3,193 (29.3)
National Defense	1,373 (16.0)	1,559 (17.5)	1,745 (17.6)	1,927 (17.7)
General Government	855 (10.0)	1,177 (13.3)	1,312 (13.2)	1,516 (13.9)
Debt Service	522 (6.0)	551 (6.2)	577 (5.9)	505 (5.3)
Total Expenditures	8,606	8,874	9,905	10,884

* Fiscal year starts from January and ends in December.

Table 1-8 Four-year Infrastructure Program
(Fiscal Years. In Million Pesos)

Description	FY 1974 Estimated	FY 1975 Projected	FY 1976 Projected	FY 1977 Projected
Highway Transportation	796.7 (45.9)	1,007.4 (57.0)	925.9 (47.0)	1,088.5 (49.5)
Telecommunication	19.1 (1.0)	30.4 (1.5)	38.0 (1.9)	27.6 (1.3)
Electric Power	225.6 (13.0)	194.8 (9.9)	214.2 (10.9)	222.3 (10.1)
Irrigation	238.7 (13.7)	269.9 (13.7)	270.7 (13.7)	301.5 (13.7)
Water Supply	136.2 (7.8)	123.4 (6.2)	148.8 (7.5)	194.4 (8.8)
School Buildings	46.6 (2.8)	84.8 (4.3)	74.8 (3.8)	64.3 (2.9)
Flood control & Drainage	161.9 (9.4)	181.4 (9.2)	192.2 (9.8)	190.5 (8.6)
Others	111.4 (6.4)	84.0 (4.2)	107.0 (5.4)	112.0 (5.1)
Grand Total	1,736.2(100)	1,976.1(100)	1,971.6(100)	2,201.1(100)

Source: Philippine Almanac & Handbook of facts

Table 1-7 shows the projected all funds expenditures under the Four-year Plan and Table 1-8 shows the projected funds expenditures for improvement of infrastructures.

From Table 1-7, it is known that the projected expenditure for social development increases sharply from 2,440 million peso in 1974 to 3,190 million peso in 1977. An annual expenditure of 3,000 - 3,600 million peso for economic development is also projected.

Expenditures for infrastructures account for approximately 20% of the total national budget each year, in which highway transportation, electric power, irrigation and flood control are the main project items.

1.3 Present Economic Situation in the Philippines

Because of the sharp rise of oil prices following the oil crisis and the slowdown of exports due to the slump of world economy, the trade balance of 1974, 1975 and 1976 showed big red figures of 1,450 million US Dollars and 1,200 million US Dollars and 1,080 million US Dollars respectively. While the overall balance including tourist income and capital revenue in 1974 showed a black figure of 110 million US Dollars, the overall balance in 1975 and 1976 showed a red figure of 500 million US Dollars and 164 million US Dollars. In addition, the increased borrowings of foreign currency to maintain the foreign currency reserves at the 1,000 million US Dollar level boosted the foreign debts to 5,500 million US Dollars (1,800 million US Dollars over the previous year) as of the end of 1976.

Table 1-9 shows an account of national domestic product.

On the other hand, the gross national product attained a 5.9% of real growth in 1975. Also because of the stable supply of main foodstuffs, the increase of commodity prices began to show a stable pattern, 7.4% in 1975 and 5.6% in 1976 as shown in Table 1-10. The price increase in 1977 is expected to be in the order of 7%.

The number of the unemployed also decreased to 3.6% or approximately 400,000 by the end of 1975. However, the limitation of available funds has necessitated the postponement of the execution of some of the infrastructure related projects in the Four-year Plan for a considered length of time. Hence, the unemployment relief has become an important task of the Government. Efforts are being made by the Government for stability of people's livelihood, improvement of industrial basis and construction of industrial plants through such means as the induction of foreign capitals to the maximum extent possible.

For additional information, the amount of foreign capitals by country is shown in Table 1-11 and the amount of foreign aids (commitment base) is shown in Table 1-12.

Table 1-9 National Domestic Product (NDP) (1972 price level)

(in million peso)

Industry	At Constant Prices of 1972					
	1971	1972	1973	1974	1975	1976
1. AGRICULTURE, FISHERY AND FORESTRY	15.457	16.040	17.026	17.465	18.116	19.144
2. INDUSTRIAL SECTOR	16.222	17,442	19,586	20,630	22.638	24,537
a. Mining and Quarrying	1,282	1,346	1,400	1,403	1,423	1,457
b. Manufacturing	12,611	13,388	15,252	15,981	16,537	17,464
c. Construction	1,889	2,240	2,433	2,665	4,060	4,952
d. Electricity, Gas and Water	440	468	501	581	618	664
3. SERVICE SECTOR	21,847	22,593	24.319	25.813	27.368	28.802
a. Transport, Communication and Storage	2,184	2,418	2,657	2,933	3,263	3,491
b. Commerce	12,484	12,688	13,589	14,200	14,985	15,786
c. Services	7,179	7,487	8,073	8,680	9,120	9,525
GROSS DOMESTIC PRODUCT	53.526	56.075	60,931	63.908	68.122	72.483
GROSS NATIONAL PRODUCT	52.921	55.526	60.881	64.508	68.291	72.576
Export (Million US$)	1.148	1.138	1.871	2.693	2.262	2.518
Import (Million US$)	1.186	1.260	1,597	3.143	3.459	3.593

Note: Import items accounting for more than 20% of the total import are petroleum and machinery.

Source: NEDA 1977 Philippine Statistical Year Book.
NEDA Report on the Philippine Economy 1976.

Table 1-10 Changes in Price Index (1965=100)

	1973	1974	1975	1976
Wholesale price index	218.4	337.5	347.2	372.4
(Over previous year)		(1.545)	(1.029)	(1.072)
Consumer's price index	194.5	271.9	292.1	308.3
(Over previous year)		(1,398)	(1,074)	(1,056)

Source: CB Review

Table 1-11 Amount (Approved) of Foreign Investments Classified by Major Countries (Feb. 1970～ End of Mar. 1975)

(in million US$)

	Total	USA	Japan	UK	Canada
Amount	290.6	158.2	48.2	25.3	24.0
(%)	(100)	(54.4)	(16.6)	(8.7)	(8.3)

Source: NEDA Development Digest

Table 1-12 Foreign Aids (Commitment base) 1974

(in million US$)

	Total	USA	Japan	IBRD	ADB
Amount	443.1	60	59.1	244	58.3
(%)	(100)	(13.5)	(13.3)	(55.0)	(13.1)

Source: NEDA Development Digest

Chapter 2 Present and Future of Power Industry in the Philippines

Chapter 2

Chapter 2. Present and Future of Power Industry in the Philippines

2-1. Power System in the Philippines

2-1-1. Present State of Power Industry in the Philippines

The main power industry in the Philippines at present includes Manila Electric Company (MERALCO), which is a private enterprise supplying power to the Manila District. In other parts of the Philippines, power supply is shared by small and medium private or public power enterprises and Electric Cooperative (COOP's) which are subordinate organs of the National Electrification Administration (NEA). The organization which sells power to these power supply companies at wholesale prices is the National Power Corporation (NPC) which is responsible for power generation and transmission.

As of June 1973, there are 659 power enterprises in the Philippines, comprising 193 private enterprises, 277 public enterprises and 179 enterprises which also operate other businesses.

The power generating facilities have a total capacity of approximately 2.95 million KW as of 1973, of which 61.2% are accounted for by thermal power, 20.5% by hydro power and 18.3% by diesel power (See Table 2-1).

Of the total number of generators, 845 units (87%) are accounted for by generators having a capacity of less than 1,000 KW, which is indicative of a wide distribution of small generators (mainly diesel generators) in various parts of the country (see Table 2-2).

Table 2-1 Installed Capacity of Generators
(As of June 1973)

Enterprise	Capacity of generator	Percentage
NPC	665.5 MW	22.6%
Public enterprise	22.4 MW	0.8%
MERALCO	1,521.0 MW	51.6%
Others	138.6 MW	25.0%
Total	2,947.5 MW	100%

Table 2-2 Distribution of Generators by Capacity
(As of June 1973)

Capacity	Thermal	Hydro-electric	Internal combustion	Total
Less than 50 KW	1	-	257	258
50 ∿ 100 KW	-	1	248	249
100 ∿ 500 KW	2	4	269	275
500 ∿ 1,000 KW	4	2	57	63
1,000 ∿ 5,000 KW	9	5	64	78
5,000 ∿ 10,000 KW	1	-	16	17
More than 10,000 KW	8	6	12	26
Total (unit)	25	18	923	966
Capacity (MW)	1,803.2 (61.2%)	606 (20.5%)	538.3 (18.3%)	2,947.5 (100%)

The power generating facilities owned by NPC, MERALCO and COOP in 1976 are shown in Table 2-3.

Table 2-3 Power Generating Facilities Owned by Major Enterprises (As of 1976)

	Hydro	Thermal	Diesel	Total
NPC Luzon Dist.	521.4	225	5.5	751.9
NPC Visaya Dist.	2.0	-	-	2.0
NPC Mindanao Dist.	205.1	-	-	205.1
MERALCO	15	1,802	-	1,817.0
COOP	-	-	50	50
Total	743.5 (26.3%)	2,027 (71.7%)	55.5 (2.0%)	2,826 (100%)

It is noteworthy that the capacity of power generating facilities owned by MERALCO accounts for 1,817 MW (64.3%) of the total capacity of 2,826 MW as shown in the table.

A comparison of the capacity of power generating facilities at the end of 1976 with that in 1973 shows an increase of 300 MW each for both NPC and MERALCO. The diesel generators owned by public and private enterprises with a total capacity of 760 MW as of 1973, increased to 860 MW in 1976. And the total capacity of power generating facilities owned by major power enterprises in the Philippines in 1976 is estimated at about 3,700 MW (20.1% by hydro power, 55.0% by thermal power and 24.9% by diesel power).

Changes in power consumption in the Philippines and Luzon and maximum power in Luzon are shown in Tables 2-4 and 2-5, respectively.

Table 2-4 Changes in Output Energy in the Philippines and Luzon (10^6 KWH)

Year	Whole Philippines					Luzon			
	Hydro	Thermal	Diesel	Non-utility	Total	NPC	MERALCO	Total	Load factor
1970	2,091	4,539	576	1,460	8,666				
1971	1,877	3,861	1,425	1,982	9,145				
1972	2,133	4,561	1,450	2,254	10,398	1,571	5,645	7,216	62%
1973	-	-	-	-	11,000 (1.085 /year)	1,799	6,082	7,881	67%
1974					-	1,979	5,646	7,625	59%
1975					-	2,228	6,493	8,721	66%
1976					-	2,415	6,782	9,197 (1.05/ year)	66%

Table 2-5 Changes in Maximum Power (MW) of NPC and MERALCO in Luzon

Year	NPC	MERALCO	Total	Over previous year
1972	317	1,054	1,330	-
1973	332	1,042	1,333	0.2%
1974	389	1,132	1,475	10.6%
1975	438	1,122	1,513	2.6%
1976	476	1,158	1,585	4.8% (Average 4.0%)

The NPC system in Luzon transmits generated power to private and public power supply companies as well as to COOP's in Luzon Island but details of power transmission are not known due to lack of statistical data.

The COOP's in Luzon receives most of the power from NPC, which amounts to about 320 million KWH according to the tabulation in the 1976 NEA Annual Report.

The output energy of NPC and MERALCO in Luzon Island accounts for more than half of the total output energy in the Philippines including non-utility generation, with the share of 69.4% (approx. 7,200 million KWH) in 1972 and 71.6% (7,900 million KWH) in 1973. While the growth of output energy in the Philippines during the 1970-1973 period was at a rate of 1.085/year, the growth of output energy for NPC and MERALCO in the Luzon District, which accounts for more than half of the total output energy in the country, during the 1972-1976 period was at a low rate of 1.05/year.

The maximum power in the NPC and MERALCO systems in 1976 was 1,585 MW.

The growth rate of output energy in the Philippines until 1973 is considered to be about the same as those in other Southeast Asian countries when compared with the following. (The growth rate in the Philippines during the 1970-1973 period was 8.5%/year.)

West Malaysia	(1968-1972)	:	Growth of 8.9%/year
Indonesia	(1968-1972)	:	Growth of 9%/year
Thailand	(1969-1973)	:	Growth of 13%/year

2-1-2. Power Development Program in the Philippines

In order to meet the growing power demand in the Philippines, NPC is now constructing power plants in the generating system suitable to the local conditions of each island, and is also constructing or planning the construction of 230 KV and 138-110 KV trunk transmission lines. The outline of transmission systems and the trend of power demand in each island are shown in Fig. 2-1 and Table 2-6, respectively. As shown in the table, the total load in the Philippines is expected to increase from 1,971 MW in 1977 to 2,977 MW in 1980 and further to 4,550 MW in 1984. Of the total load, the load in the Luzon District, which is 1,722 MW (of which 1,200 MW by MERALCO) in 1977, is expected to increase to 2,331 MW in 1980 and to 3,110 MW in 1984 (a growth rate of 9%/year during the 1977-1984 period.)

Power demand and power resources development projects in the Luzon District are shown in Table 2-7a.
The power generating facilities in the Philippines are composed of hydro power plants (20.1%), thermal power plants (50%) and diesel power plants (24.9%), with the share of thermal power plants being the highest among the three.

Table 2-6 Power Demand Forecast in the Philippines

(Unit: MW)

Year	1977	1980	1984	1987
Luzon system	1,722	2,331	3,110	3,735
Visaya system (Negros, Panay, Leyte, etc.)	46	74	382	457
Mindanao system	203	572	1,058	1,507
Total	1,971	2,977	4,550	5,694

With the oil crisis as the turning point, the Philippine Government decided to scrap all the thermal power plant projects except those under construction to reduce the degree of dependency on thermal power and now plans to develop hydro power in the central and northern districts, geothermal power in the southern district and nuclear power (600 MW) in the central district.

For trunk transmission lines, the existing 230 KV transmission lines with a total length of 681 km in the northwestern part of Luzon is scheduled to be extended to the south end of Luzon to cover the entire island as interconnecting 230 KV trunk lines.

The program of construction of 230 KV transmission lines (230 km in length) and 69 KV transmission lines (140 km in length) and six substations (to be commissioned in 1979) in Region II (Cagayan Valley), the project area, with the Yen Loan is now in the process of implementation. When completed, this system will form a northeeastern portion of the 230 KV trunk system interconnecting the north and south ends of Luzon Island, and will play an important role.

Fig. 2-1 Projected Trunk Transmission Lines in the Philippines

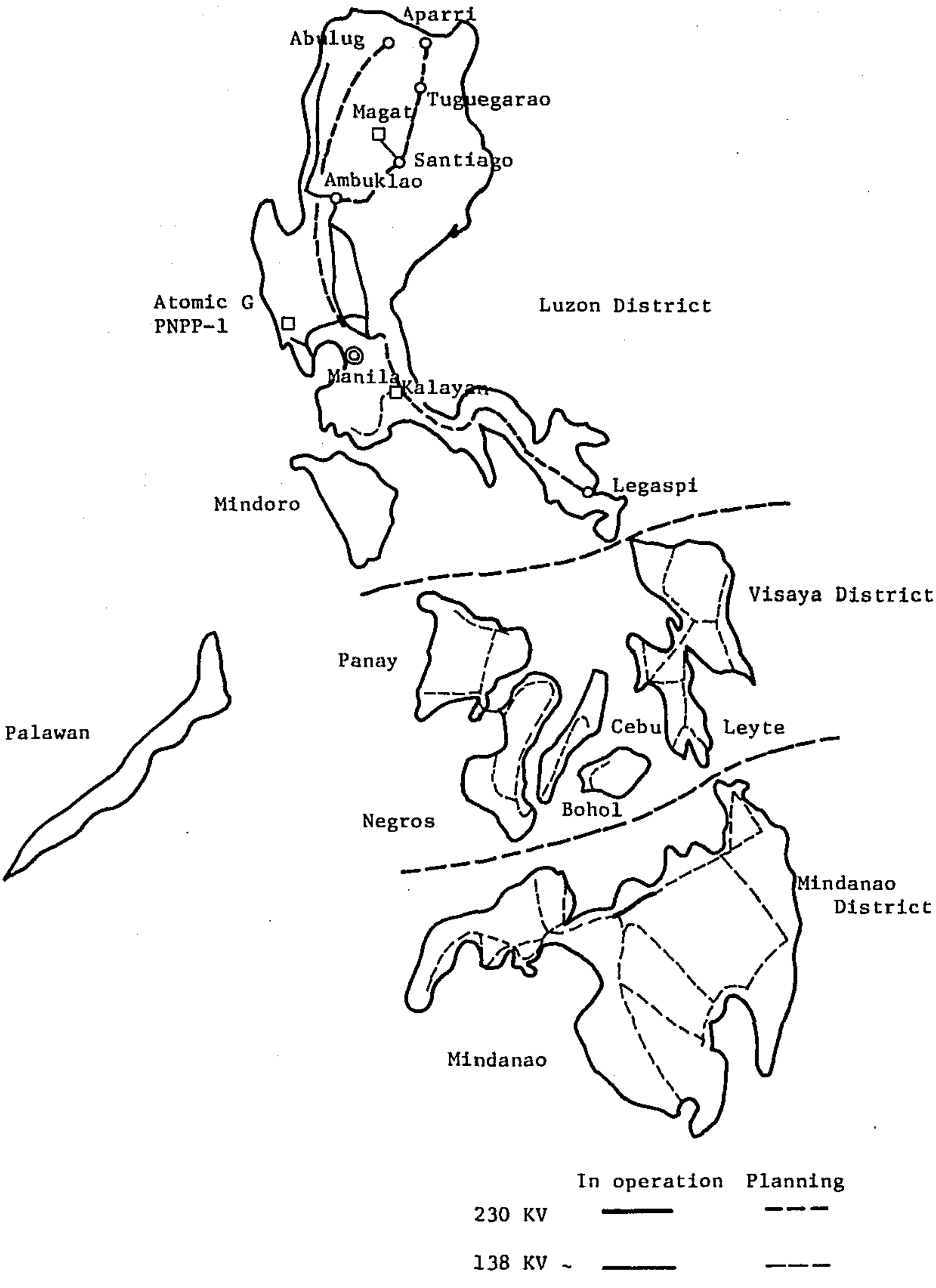


Table 2-7a. Power Demand & Supply KW Balance and Power Resources Development Projects in Luzon

Fiscal year		1977	1978	1979	1980	1981	1982	1983	1984
Max. demand MW		1,722	1,887	2,111	2,331	2,577	2,797	2,941	3,110
Max. gen. capacity MW		2,195	2,250	2,660	2,715	3,033	3,535	4,004	3,879
Reserve capacity MW		4.73	3.63	5.49	3.84	4.56	7.38	10.63	7.69
Power Resources Development Project	Hydro	Panta Bangan 100 MW				Kalayan 1,2 360 MW		Magat 1∿4 360 MW	
	Thermal	Batlan II 150 MW		Malaya 2 300 MW					Pockwell discontinued -125 MW
	Nuclear						PNPP1 600 MW		
	Geothermal		Tiwi 1 55 MW	Tiwi 2 55 MW Maka Ban 1, 2 110 MW			Tiwi 3, 4 110 MW Maka Ban 3 55 MW	Maka Ban 4 55 MW	

Table 2-7b. Progress and Plan of Construction of Main Transmission Lines in Luzon (Project and Funds)

IBRD Loan	USAID Loan	OECF Loan
5th Electrification Program for Ilcos, Zambales, Central Luzon, Laguna-Batangas, Southern Luzon. Completed in 1976. 6th Construction of Maka Ban Geothermal transmission line. To be completed in 1978. Expansion of transmission and substation facilities of existing system, North-South Luzon inter-connection, Tiwi geothermal related transmission lines. To be completed in 1979. 7th (Under negotiation) Construction of nuclear Power related transmission line, expansion of system in connection with hydro power development. Expansion of 69KV system.	Expansion of South Luzon transmission system To be completed in 1978.	Construction of Cagayan Valley transmission system. To be completed in 1979. * Expansion of transmission system in connection with Magat Power Plant.

* Magat Hydro Power Plant will be built in Cagayan Valley in Region II, and in this connection, expansion of Ambuklao-Santiago Line and Ambuklao and Santiago S/S in needed.

Magat Power Plant is scheduled to be commissioned in 1983, and the above-mentioned expansion must be made during the construction of the Cagayan Valley transmission system, and the request for aid is field with the Japanese Government.

2-1-3. Rate of Electrification, Target of Electrification Program and Voltages in the Philippines

Until 1970, electrification of city and town areas in the Philippines had been carried out by private and public power enterprises and the rate of electrification in 1970 was 24%. With the establishment of NEA-COOP thereafter, however, electrification of rural areas has become more positive than before. The progress of electrification by region is shown in Table 2-8.

During the priod of 1970 to 1975, the number of households electrified by COOP's was 228,000 and that by the existing power enterprises was 264,000. During the one-year period from 1975 to 1976, a total of 226,000 households were electrified, of which more than half was electrified by COOP's.

Accordingly, the rate of electrification in the Philippines increased from 24% in 1970 to 30% in 1975 and to 35% (estimate) in 1976. However, the rate of electrification in Region II at the end of 1976 was a mere 6.3%, which was the lowest in the country.

In most of the Southeast Asian countries, national enterprises play the leading part of the power industry for both generation and distribution, while in the Philippines, private enterprises are the main stream of the power industry, which operate under the franchise system.

As previously mentioned, there were 659 power enterprises in the Philippines at the end of June 1973 and these companies were supposed to supply power to consumers under the franchise system. However, many of these private enterprises were in a very difficult financial position as evidenced by the fact that only 2,915 Barros (districts) or 18.5% of the total number of Barros (15,715) located within the territory of franchise were actually serviced by these power supply companies.

Against this background, the Philippine Government, in order to further promote electrification of rural areas, has decided to integrate these enterprises into NEA-COOP and accelerate electrification in a positive manner by providing the necessary financial aid.

Since the 24 hours power supply is limited only to the Manila District and part of the country, the 24-hours power supply has become a main objective of the electrification program together with the improvement of electrification rate.

With respect to electrification of rural area, NEA has a long-range plan to construct high voltage trunk distribution lines connecting various towns in each municipal by 1980, complete high voltage distribution lines linking all Barrios by 1984 and realize power supply to all the households in the region by 1990. On the basis of this long-range plan, the government is now making vigorous efforts to establish and foster COOP's which form a basis of rural electrification.

Construction of roads and bridges is also being coordinated with the progress of electrification under theoverall coordination effort of the government.

Since the first power supply by some of the COOP's in 1972, the number of COOP's supplying power to consumers in Luzon increased to 63 by the end of 1976.

The progress of establishment of COOP's is remarkable and the number of COOP's including those which have concluded loan agreements with NEA is now 86.

Fig. 2-2 shows a regional distribution of COOP's actually engaged in power supply, from which the progress of establishment of COOP's throughout the country is evident. It must be noted, however, that the establishment of COOP's is lagging particularly in Regions X and XI of the Mindanao District and Region II in Luzon which is the object of this project. The sharp increase of the number of COOP's since 1974 is evidenced by the changes in annual NEA financial status shown in Table 2-9. From the table it is known that the amount of financial assistance to COOP's by NEA increased sharply from 44 million peso (US $5.87 million) in 1973 to 167 million peso (US $22.27 million) in 1974 and further to 310 million peso (US $41.33 million) in 1976.

For transmission system, the 230 KV and 69 KV directly-grounded systems are mainly used. For high voltage distribution, 13.8KV 3-phase four-wire multiple grounded neutral system is used as the standard system. For low voltage distribution, the 240V/480V system is used for rural electrification.

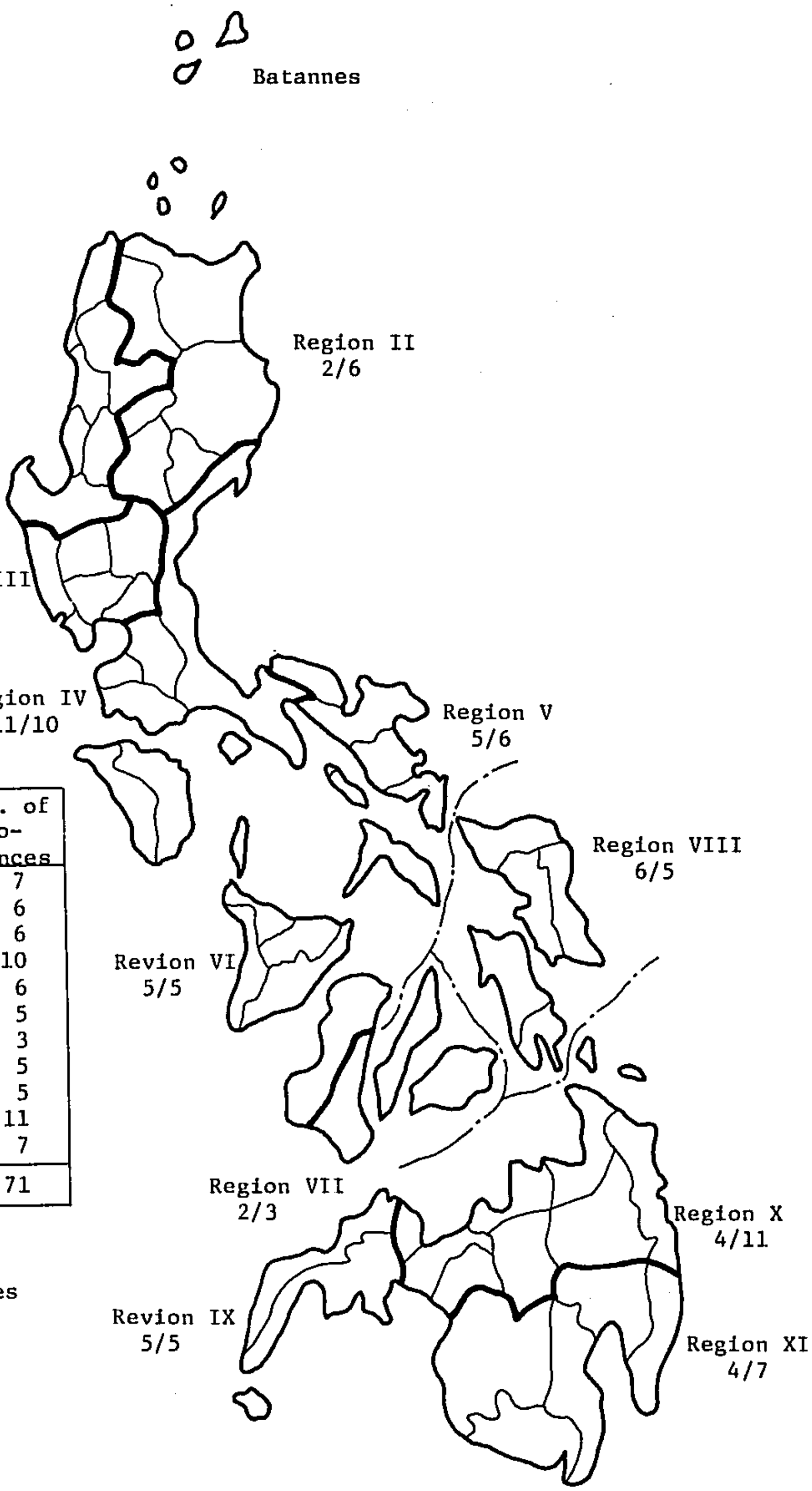
The distribution lines are grounded at each pole, and the plle transformers are equipped with lighting arresters. All the consumers are meter-rate consumers, and there are no flat-rate consumers.

Table 2-8 Progress of Electrification in the Philippines by Region

Region	1970			1975				1976			
	No. of House-holds	No. of Consumer	Electri-fied Ratio	No. of Consumer			Electri-fied Ratio	No. of Consumer			Electri-fied Ratio
				NEA	Others	Total		NEA	Others	Total	
I	524,259	77,928	15%	36,818	87,116	123,934	24%	84,664	87,116	171,784	32.8%
II	302,590	12,070	4	-	15,654	15,654	5	7,047	11,943	18,990	6.3
III	600,592	229,199	38	78,113	222,013	300,126	50	157,778	215,000	372,778	62.1
IV	1,168,940	586,687	50	43,106	777,319	820,425	70	68,117	777,319	845,436	72.3
Manila	215,213	203,575	95	-	215,288	215,288	100				
V	482,442	38,845	8	9,587	45,932	55,519	12	26,423	45,932	72,355	15.0
	Above Luzon Island										
VI	603,408	67,563	11	20,483	63,656	84,139	14	33,800	59,656	93,456	15.5
VII	461,590	64,294	14	864	85,139	86,003	19	3,849	85,139	88,988	19.3
VIII	416,948	19,692	5	13,050	16,309	29,359	7	21,741	14,309	36,050	8.6
IX	308,942	27,416	9	8,961	18,605	27,566	9	13,549	16,100	29,649	9.6
X	499,122	47,788	10	17,289	77,920	95,209	19	27,850	77,920	105,770	21.2
XI	509,482	62,714	12	-	77,050	77,050	15	9,665	77,050	86,715	17.0
Total	6,093,528	1,437,771	24	228,271	1,702,001	1,930,272	30	454,483	1,682,776	2,137,259	35.0
				11.8%	88.2%			21.3%	78.7%		

Source: NEA Annual Report

Fig. 2-2 Number of COOP Established by Region As of Dec. 1976



	No. of COOP's Operating	No. of provinces
Region I	8	7
" II	2	6
" III	11	6
" IV	11	10
" V	5	6
" VI	5	5
" VII	2	3
" VIII	6	5
" IX	5	5
" X	4	11
" XI	4	7
Total	63	71

Legend: a/b
a ... No of COOP's
b ... No of Provinces

Table 2-9 NEA Funding History, FY 1970 - 1976

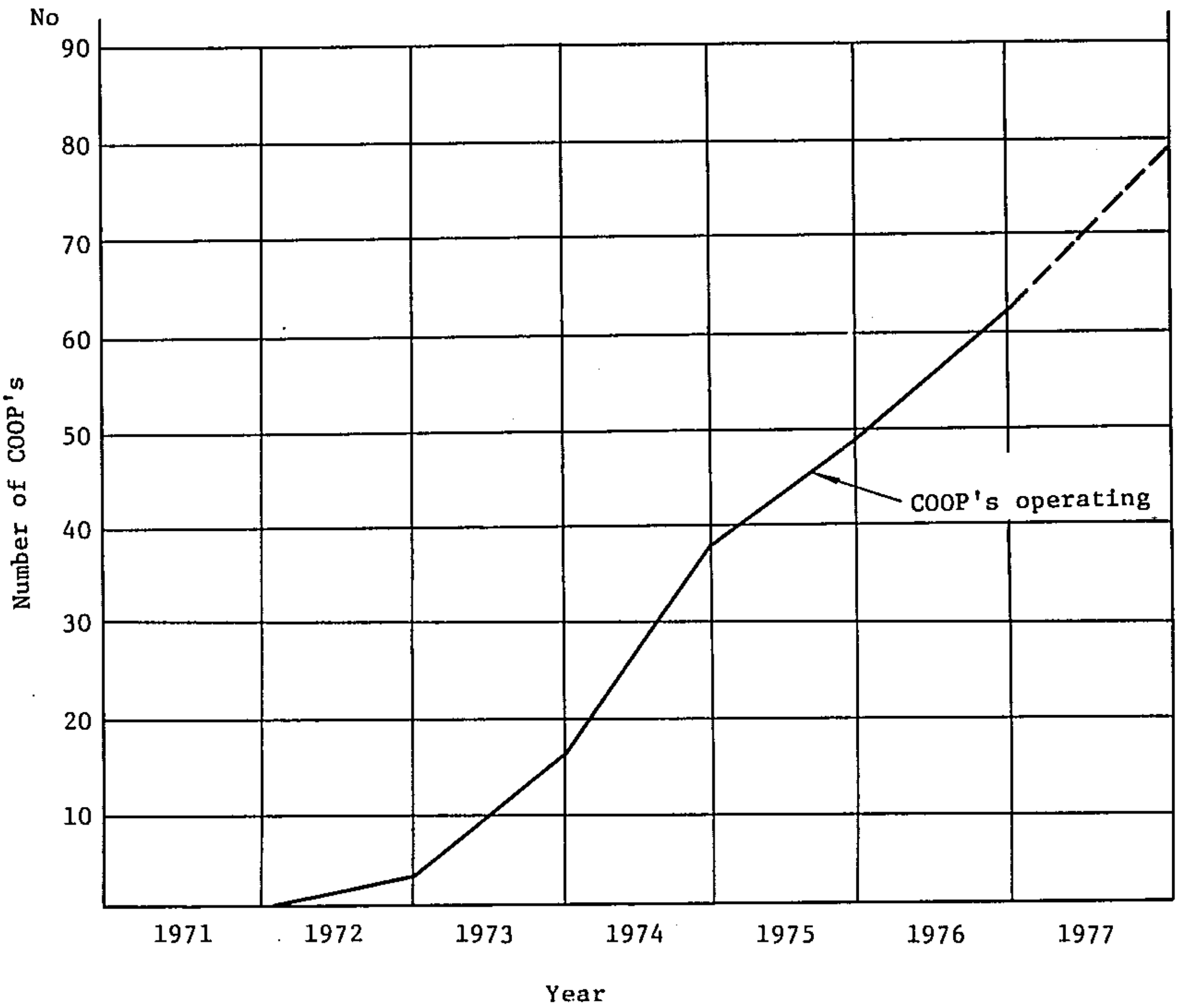
(In thousand Peso)

	1970	1971	1972	1973	1974	1975	1976	Total
Current (NEA In-House)	1,100	1,300	2,000	3,900	5,600	11,000	15,000	39,900
Capital Outlay	-	-	2,200	40,100	161,400	227,000	295,000	725,700
D.C. (Peso)	-	-	2,200	5,400	90,000	69,000	134,000	300,600
F.C. (10^3 US$ = 10^3 Peso)	-	-	-	5,000 (34,700)	9,600 (71,400)	21,100 (158,000)	21,500 (161,000)	57,200 (425,100)
Total	1,100	1,300	4,200	44,000	167,000	238,000	310,000	765,600

*Letters of Credit Opened

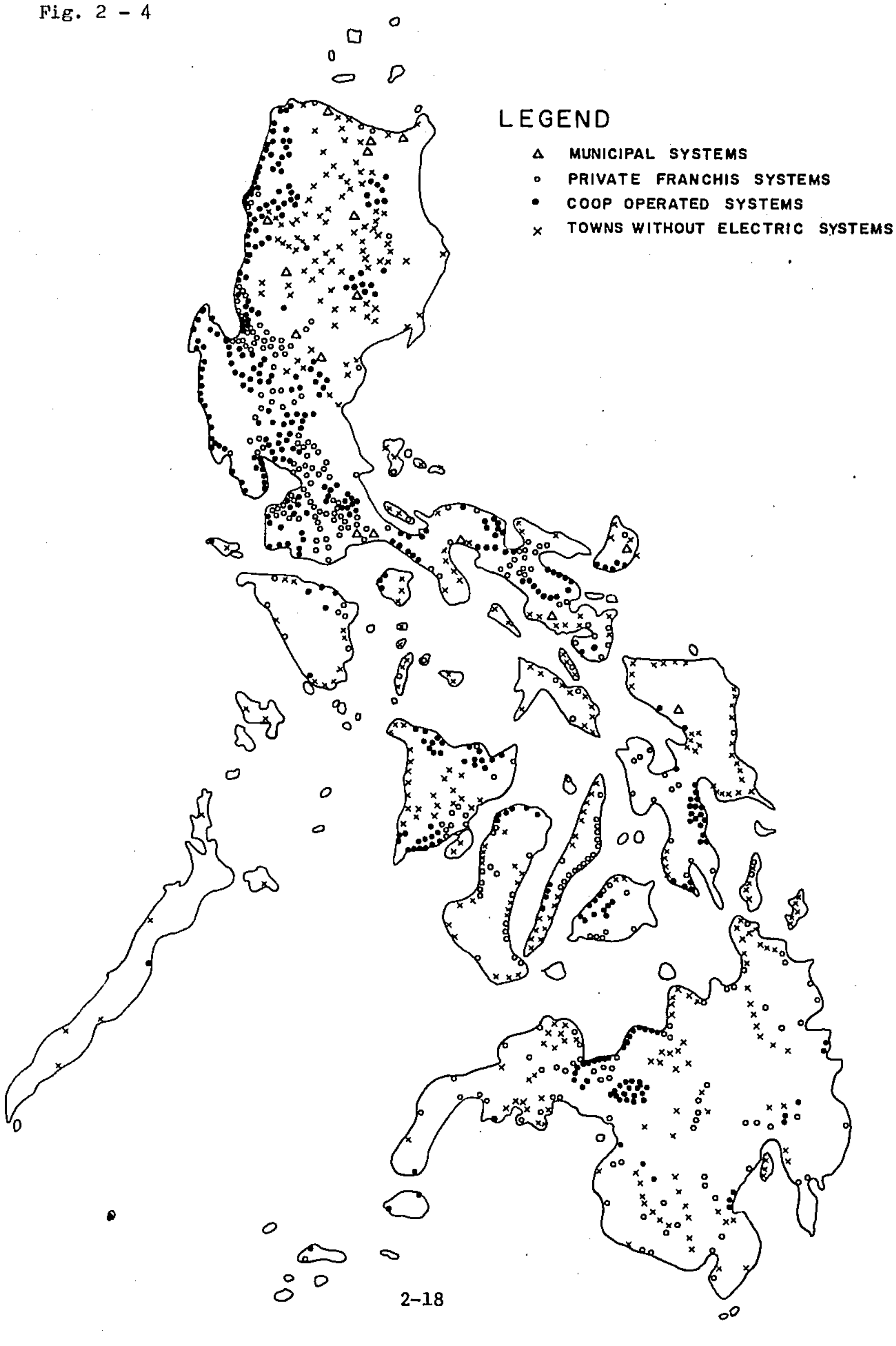
Source: NEA Annual Report 1976

Fig. 2-3 Progress of Establishment of COOP's



STATUS OF ELECTRIC SYSTEMS

Fig. 2 - 4



Chapter 3 Electrification of Region II (Cagayan Valley District)

Chapter 3

Chapter 3. Electrification of Region II (Cagayan Valley District)

3-1. Rural Electrification as National Policy

The National Electrification Administration (NEA) and The Electric Cooperatives (COOP) came into being in August 1969 under the Republic Law No. 6038 as promoting organs of rural electrification in the Philippines. In November 1972, partial changes were made to the power and responsibility of these organizations by Presidential Decree No. 40 on the basis of the achievements and experiences in the operation and management since their inauguration. In August of 1973, the nation-wide electrification was declared as a national policy by Presidential Decree No. 269 with the subsequent legislation endorsing the responsibility, power and financial backing of NEA and COOP. The Presidential Decree No. 269 expressed the following as main objectives of electrification as a national policy.

(1) Since the total electrification of the country is essential for the promotion of public welfare and sound and efficient development of the country, the total electrification of the country in an orderly and positive manner must be achieved as a national policy. It is the intention of the government to make efficient use of COOP as a central body for the promotion of electrification and extend a full support to the activities of COOP.

(2) Electrification of areas with a low load density or areas with relatively high electrification costs must be carried out in combination with electrification of areas with a high load density so as to reduce electrification costs. Otherwise, it will be impossible to achieve the object of total electrification of the country.

(3) Public entities must give their support in promoting mergers of service areas covered by the existing power enterprises into new systems in line with the national policy for total electrification of the country.

To help achieve the above three objectives, the government intends to provide NEA with a fund amounting to 1,000 million pesos in 10 years. NEA is also authorized to induce foreign capitals up to 500 million US dollars.

The management of COOP is also backed by such government measures as favorable treatments in taxation system under Articles 39 and 40 of Presidental Decree No. 269 and support of National Power Corporation (NPC) in power supply. As a result, the operation of COOP has become more active since 1974 and rural electrification has been making remarkable progress.

3-2. Present Power Situation in Region II

As of January 1977, Region II is provided with only sporadically distributed independent high voltage distribution systems with small diesel power plants and is not provided with any transmission system.

As for the future power resources development in Region II, there are a number of promising sites for large capacity hydro power plants, including Magat and Chico Rivers, which are tributaries of Cagayan River, and Abulug River in the north.
Besides, the construction of Magat No.1 - No.4 units (360 MW) is expected to start in the near future with the target of commissioning set for 1983. With respect to the transmission and substation system, the existing Ambuklao power plant (75 MW) is linked to the Manila power system with 230 KV transmission lines.

Preparation are now under way for construction of one circuit of 230 KV transmission line (230 km) linking the Ambuklao power plant with Solano, Santiago and Tuguengarao, one circuit of 69 KV transmission line (70 km) linking Santiago - Cauayan - Ilagan and one circuit of 69 KV transmission line (73 km) linking Tuguegarao - Camalaniugan and also six new substations with OECF Loan with the target of commissioning set for 1979.

In the meantime, the rate of electrification in Region II as of December 1976 is approximately 6.3% with about 7,000 households being served by 2 COOP's and 12,000 households served by small private and public power enterprises.
Besides, a very small number of industries and wealthy families generate power with small generators for private use outside the service area of existing power enterprises.

The status of electrification in each Municipal is shown in Table 3-1. The rate of establishment of COOP's in Region II is the lowest in the nation, and there are only 2 COOP's, ISELCO I and CAGELCO I. ISELCO and CAGELCO own a 1,000 KW diesel power plant each and supply power for 20 hours and 12 hours a day, respectively. Constructionof two additional units of 2,500 KW generator is in progress at ISELCO and CAGELCO power plants for commissioning in May and April 1977, respectively. Upon completion, these two Municipals will be able to start the long-awaited 24-hour service and expand the number of customers and service areas.
For distribution system, 13.2 KV distribution lines are being used as trunk lines.

Among the public and private power enterprises in Municipals of Region II, only Solano supplies power 24 hours a day and others supply power only for 4 to 6 hours in the evening. The capacity of diesel power plants ranges from 40 KW to 700 KW and is only sufficient to serve part of the town. Distribution facilities are also inadequate and distribution voltage is either low voltage (200 V) or 2,000 V.

Table 3-1 Capacity of Existing Electric Plants in Region II

Plant	Capacity (MW) 1973	Capacity (MW) 1977	Remarks
Cagayan Province			
1. Aparri	0.298	0.700	
2. Ballesteros	0.070	0.070	
3. Claveria	0.045	0.045	
4. ENRILE	0.040	-	Take off in 1976
5. Tuguegarao	1.335	-	Suffered fire in Dec. 1976
6. Gonzaga	- -	0.070	
7. Lal-lo	- -	0.100	
8. Camalaniugan	- -	0.100	
9. CAGELCO I	- -	1.0	3.5 MW in Apr. 1977 6.0 MW at End of 1977
10. Tropical Ply Wood	- -	2.5	Open in Mar. 1977
11. Piat Sugar	- -	2.0	Will open in 1977
Isabela Province			
1. Alicia	0.050	-	Take off in 1976
2. Cauayan	0.405	0.405	Will take off in 1977
3. Echague	0.210	0.210	Will take off in 1977
4. Llagan	0.211	0.211	
5. Nagulian	0	0	Served by other
6. Roxas	0.035	0.035	
7. San Mateo	0.200	0.200	Will take off in 1977
8. ISELCO I	-	1.0	3.5 MW in May 1977 6.0 MW at End of 1977
Ka.-Ap. Province			
1. Tabuk	0.105	0.105	
N. Vizcaya Province			
1. Bambang	0.080	0.080	
2. Bayombong	0.035	0.035	
3. Solano	0.316	0.700	
Quirino Province			
1. Diffun		0.030	
2. Maddela		0.030	
Total	3.435	9.626	

(5.126) ...... Residential use
(4.500) ...... Industries

Note: Actual energy in 1975

Cauayan	1,006 MWN
Solano	549 MWH
Bayombong	558 MWH
Ilagan	504 MWH

Actual energy in 1976

ISELCO I	1,637 MWH (11 months)
CAGELCO I	133 MWH (6 months)

Power rate is relatively high as shown in Table 3-2 and the customer charge is 0.6 - 0.7 ₱/KWH in the case of COOP and is more than 1.0 ₱/KWH in the case of others.
As compared with 0.3 - 0.35 ₱/KWH, the power rate offered by COOP in other regions where power is supplied by main distribution systems, the present power rate in Region II is extremely high, which is 2 to 8 times the rate in other regions.

The progress of establishment of COOP's in Region II is also the slowest in the country with only two COOP's established as far for six provinces.

Table 3-2 Power Supply Situation in Region II

(Feb. 1977)

	Service area	Power plant	Supply method	Power rate
ISELCO	Municipals and Barrios where distribution lines pass through	1,000 KW diesel, 2500 KW x 2 now under construction	13.2 KV distribution lines. 20-hour supply at present. 24-hour supply in near future.	0.63∿0.65 ₱/KWH
CAGELCO	Same as above	Same as above	13.2 KV distribution lines. 12-hour supply at present. 24-hour supply in near future.	0.70₱/KWH
Solano Power Company	Only towns in Solano		2 KV distribution lines. 24-hour supply (only for lighting)	1.0₱/KWH
Private enterprises in Aparri and others	Only towns in the area	30-100 KV	Night time only (4-6 hrs) 2 KV distribution lines	1.5∿2.7₱/KWH
Public enterprises in Bonzaga and others	Same as above	Same as above	Night time only (4-6 hrs) Low voltage distribution	More than 1.0₱/KWH

3-3. Method of Electrification in Region II.

3-3-1. Benefits of Rural Electrification

Table 3-3 shows a summary of the result of a survey of public opinion on the benefit of rural electrification conducted by the Mindanao Cultural Research Institute of Xavier University for the Misamis Oriental Rural Electrification Cooperatives (MORESCO) in the northern district of Mindanao Island.

In this district where the level of family income is far below the national average, it is significant that approximately 58% of the respondents mentioned the night-time agricultural processing and other productive works and night-time work doing household chores so that housewives can allocate sufficient time to farm work in the day-time as the advantage of rural electrification.

Efficient use of 2 or 3 hours in the time zone after nightfall, which was rarely utilized for fear of the increase of light and fuel cost, is quite meaningful for elevation of the standard of living and improvement of agricultural productivity.

A comparison of light and fuel costs before and after electrification made by the same survey is shown in Table 3-4.

The reason for the increase of total light and fuel cost, despite the decrease in the consumption of kerosene after electrification, is that the price of kerosene before the oil crisis is used as fuel costs before electrification. When the price increase of kerosene thereafter and the extension of the use of lamp by the hour equivalent to the duration of lighting after electrification are used as factors for comparison, the light and fuel cost in the case of kerosene is estimated at ₱25.4, which is higher than the cost of electricity by about 67%.

Table 3-3 Major Uses of Electricity by MORESCO Users

Things done with electricity that can not be done without it	Percentage of response mentioning
1) Night-time agricultural processing and other productive works	18.7% (38)
2) Night-time work doing household chores	39.4% (80)
3) Use of household appliances	11.8% (24)
4) Lighting of house	17.7% (36)
5) Reading/Studying	10.8% (22)
6) Use and enjoyment of entertainment facilities (radio, stereo, etc.)	18.2% (37)
7) Adequate water supply	3.7% (7)
8) Lighting of farm buildings	3.0% (6)
9) Others	3.9%
10) No response	7.4% (15)
Total number of respondents	(203)

Table 3-4

Alternative Household Energy Sources and Costs among Users Before and after Electrification.

Energy Source	Percent Using	Average Monthly Cost	Percent of total cost
Before Electrification			
Candles	1.0%	₱ 0.02	0.2%
Kerosene	95.6	7.22	65.6
Gas (LPG)	10.3	1.31	11.9
Charcoal	10.8	0.43	3.9
Wood	2.0	0.06	0.5
Batteries	50.7	1.96	17.8
Total		₱11.00	
After Electrification			
Candles	0.5%	₱ 0.01	0.1%
Kerosene	44.3	2.73	18.0
Gas (LPG)	6.9	1.27	8.4
Charcoal	6.9	0.28	1.8
Wood	-	-	-
Batteries	31.5	1.89	12.4
Electricity (34.7 KWH user)		9.0	59.3
Total		₱15.18	

: After and Before, actual increase in prices not adjusted.

3-3-2. Trunk Line System Project in Region II (Based on JICA's Feasibility Survey for Cagayan Valley Electrification Program, 1974).

The power facilities to be provided by the electrification program must be such that will enable power supply at the lowest cost, accelerate electrification at a higher rate, ensure stable and constant supply of power and allow easy expansion when necessary, to meet the growing power demand over a long period of time. From this point of view, the establishment of a trunk line system in Region II is essential and most appropriate. In this connection, preparations are under way for construction of the following transmission and substation facilities with OECF Loan for the target completion in 1979.

As shown in Fig. 11-1, one circuit (2-circuit design) of 230 KV transmission line (107 km) will be extended from the Ambuklao Hydro Power Plant, which is the northernmost power plant in the power system in Luzon, to Santiago in Isabela Province via Solano in N. Vizcaya Province, and another circuit of 230 KV transmission line (120 km) will be extended from Santiago to Tuguegarao in Cagayan Province as trunk lines under theproject. Besides, one circuit of 69 KV transmission line (70 km) will be extended from Santiago to Ilagan via Cauayan and another circuit of 69 KV transmission line (70 km) will be provided between Tuguegarao and Camalaniugan.

To supply power to main districts of Region II from this trunk line system, Solano (230/13.8 KV), Santiago (230/69/13.8 KV) Tuguegarao (230¥69/13.8 KV) Substations, and Cauayan, Ilagan and Camalaniugan (69/13.8 KV) Substations will be built.

The trunk line system project outlined above will be carried out by NPC and the completion of this project will provide a basis of the main power system in Region II for full-fledged electrification (One substation is to be provided in N. Vizcaya Province, 3 substations in Isabels Province and 2 substations in Cagayan Province).

3-3-3. Distribution System Program and Partial Extension of 230 KV Trunk Line (Project under Present Study)

3-3-3a. Distribution System Program

As mentioned previously, the basic plan of the distribution system program under the Electrification Program, which is being promoted as a national policy, was reviewed and examined in detail by NEA, and the guideline of the electrification program in Region II was disclosed to the JICA Survey Team when the team met with NEA for discussion of the basic plan during the survey period of January through March 1977.

After the necessary studies and investigations, the following distribution system program has been formulated for electrification of six provinces in Region II, which will be implemented in conjunction with the previously mentioned NPC's Trunk Line System Project.

In order to implement this program successfully, it is essential to expand the activities of the existing COOP's and promote the establishment of COOP's as shown in Table 3-5. It has been confirmed that the establishment of COOP's will nearly be complete by the end of 1977. These COOP's are expected to carry out all the works required of a power supply company including extension work of electrification, planning of distribution systems, construction work, operation of facilities, collection of customer charges and other necessary services for the customers in their respective areas under the administrative control of NEA.

Table 3-5 COOP's in Existance or under Planning

Province	Cagayan	Isabela	N. Vizcaya	Quirino	Kalinga-Apayao	Ifugao
Name of COOP	CAGELCO I (South district) (Expansion)	ISELCO I (South district) (expansion)	NUVELCO (New)	Quirino (New)	K. Apayao I (South district) (New)	Ifugao (New)
	CAGELCO II (North district) (New)	ISELCO II (North district) (New)			K. Apayao II (North district) (New)	

The objective of the electrification program in Region II is to complete a 13.2 KV (3ϕ 4-wire system) distribution trunk line connecting various towns of Municipals by 1980, expand the distribution lines along this trunk line system in stages and provide the necessary facilities to realize 100% electrification of the customers by 1990, in line with the national electrification program.

Accordingly, the distribution system program calls for the expansion of 69 KV system under the Trunk Line System Projet (NPC) at four points and construction of four 69KV/13.8KV substations (Magapit, Lucban Abulug, Piat and Tabuk) in three stages. The 1st stage of the project, which will be carried out in the 1978 - 1982 period, is most significant and was given top priority in the survey as it forms a basis of electrification in Region II. Implementation of the 2nd stage is planned for the 1982-1984 period and the 3rd stage for the 1985 - 1990 period.

3-3-3b. Trunk Line System (230 KV) Expansion Project for Region II.

The Electrification Project (Trunk Line System Project) for Cagayan Valley (Region II) based on JICA survey of 1974 is being promoted by NPC as mentioned in the previous Section 3-3-2. However, the requirement for an additional expansion of part of trunk line system (230 KV) in Region II was felt as a result of the recent JICA survey for the distribution system, and this feasibility survey was conducted as an additional survey at the request of the Philippine Government.

The nuclear Power Plant PNPP No.1 Unit (600 MW) will be built in the Bataan Peninsular in 1983, and with an aim to maintain more than 20% of reserve capacity, Chico Hydro Power Plant No.4 Unit (300 MW) and expansion of new trunk line to Mexico S/S in the Metropolitan Area had been planned for commissioning in 1982. However, an early construction of this power plant is found difficult because of difficulty in acquisition of land, and Magat Hydro Power Plant (360 MW) is advanced for completion in 1983.

Magat Power Plant is located near the border line between Ifugao and Isabela Provinces, and the transmission line will be added to the Santiago-Ambuklao Line now planned as the trunk line by the OECF Loan.

This Power Plant is to utilize the Magat Multi-purpose Dam for power generation, and is designed as a 3-hour peak load power station with an annual generation of about 1,000 million KWH. Namely, this power plant is needed for the demand and supply KW balance in Luzon Island, and if this power plant fails to be commissioned in 1983, these would occur shortage of the peak load supply capacity in case of failure of any power plant in Luzon, with resultant need of power supply restrictions. In the wet season, the power plant can be operated 24 hours and contribute to the supply in Region II also.

Thus, Magat Power Plant is an indispensable power source for stable power supply in Luzon Island including Region II, and studies and planning of addition of one circuit of 230 KV line to the Santiago-Ambuklao Line and related expansion of facilities in Santiago, Solano and Ambuklao substations were made within the present study.

Chapter 4 Description of Region II

Chapter 4

Chapter 4. Description of Region II

4.1. Outline of Region II

4-1-1. Topography

The Cagayan Valley, which is called Region II as an administrative division in the Philippines, consists of seven provinces: Battanes, Cagayan, Isabela, N. Vizcaya, Quirino, Ifugao, and Kalinga-Apayao.

The six provinces in the northeastern part of Luzon Island, excluding Battanes Province, an offshore island are considered as the area of the present electrification program. The said six provinces face the Babuyan Straight on the north, and form a shoreline on the east where the precipitous Sierra Madre falls into the Pacific Ocean. The region is separated from the western coast of Luzon by the Cordillera Mountain Range standing more than 2,000 m above sea level which runs through the middle of the island, and is separated from the central plain of Luzon by the Caraballo Mountain Range on the south. The area to be electrified is 36,000 km^2 and extends from 16° to 18° North Latitude in the tropical zone. The Cagayan River originates in N. Vizcaya Province on the southern tip of the said district, runs northward through Quirino, Isabela, and Cagayan Provinces, and flows into the Babuyan Straight. In addition, the Magat River runs through N. Vizcaya Province from south to north into Isabela Province and joins the Cagayan River in the northern part of Cagayan Province. Also, the Ibulao River, which runs through Ifugao Province from north to south, joins the Magat River at the border of three provinces; Ifugao, Isabela, and N. Vizcaya. The Chico River runs toward north in the southern part of Kalinga-Apayao Province and joins the Cagayan in the north of Alacala of Cagayan. Tributaries which flow from the eastern mountains and join the Cagayan are smaller in comparison with the above western tributaries. However, the Ilagan River, which joins the Cagayan at Ilagan and the Pinacauan River, which runs into it at Tuguegarao are large rivers. The

Abulug and the Pamplona Rivers, which run north through the northern part of Kalinga-Apayao Province and flow into the Babuyan Straight belong to another river system. These river systems are shown in Fig. 4-1.

The Cagayan is a slow current river with the elevation of Tuguegarao, about 100 km from the estuary, being only EL.20 m and at Echague, about 200 km upstream, being only EL. 65 m. In the downstream area, the right bank is precipitous clayish wall with the height of from 5 to 10 m and the left bank is sandy clay strata of a moderate slope. The width of the river is about 2 km at the estuary. This river is constricted to about 300 m in the vicinity of Magapit, but the width becomes greater again in the upstream, about 1 km at Tuguegarao. The width is about 300 m in the northern part of Isabela Province and is about 200 m near Echague. The flow at Tuguegarao is from 5,000 to 6,000 m^3/sec during the rainy season and is about 80 m^3/sec in the dry season. There is an iron bridge over the river between Tuguegarao and Solana. In Magat, downstream of this bridge, a suspension bridge with a span of about 30 m is being constructed with the Japanese financial aid. (The Japanese-Philippine Friendship Highway crosses the river by an iron bridge in the north of Cauyan). The national irrigation project covering 4,000 ha with 2 pumping stations on the main Cagayan near Tuguegarao is expected to be completed in the near future. Small pumped irrigation systems, some operated by associations (BISA) and some by individuals, are in operation between the mid-stream through the upstream of the river. A large pump station with the Japanese aid is planned in the vincinity of Magapit for the purpose of irrigating Aparri and the neighboring areas. A very few large scale irrigation projects are planned for the upstream of the main Cagayan, the only project being the national project covering an area of 2,000 ha planned for the left bank in the northern part of Solano. In the case of tributaries, on the other hand, gravity irrigation is being practiced, for instance, in the plain of N. Vizcaya and in the south-western part of Isabela using the using the water of the Magat River. In the plain west of the Cagayan River in Isabela Province, large scale irrigation is being practiced by the national government utilizing the water of the Magat and the Sifu Rivers. See Fig. 4-3.

These irrigation projects are expected to be expanded further upon completion of the Magat Dam in 1983. In addition, utilization of the Chico and the Palanan Rivers for gravity irrigation purposes is promoted by the Government. Particularly, the Chico River, which has abundant flow of water and runs along grassy highland, is much expected to be developed for irrigational uses in the future.

Agricultural activities are becoming more vigorous in the well developed plains along the above-mentioned rivers and their tributaries. Numerous unexploited lands are being opened for agricultural uses by irrigation, and population mobility is quite active in these plains.

Urban areas developed along the Cagayan include Echague and Cauayan on the left bank of the upstream and Ilagan, Tuguegarao, Lal-lo and Aparri, on the right bank of the midstream and downstream. Santiago, San Mateo, Roxas, Piat, and others have developed as distribution centers of agricultural products in the middle of the plain. The biggest Town at present is Santiago, followed by Tuguegarao, Aparri, Solano, and so forth.

The central parts of the Sierra Madre Range in the east and Cordillera Mountains in the west are covered with forests, whereas the portions of these mountains near plain are merely grass-covered.

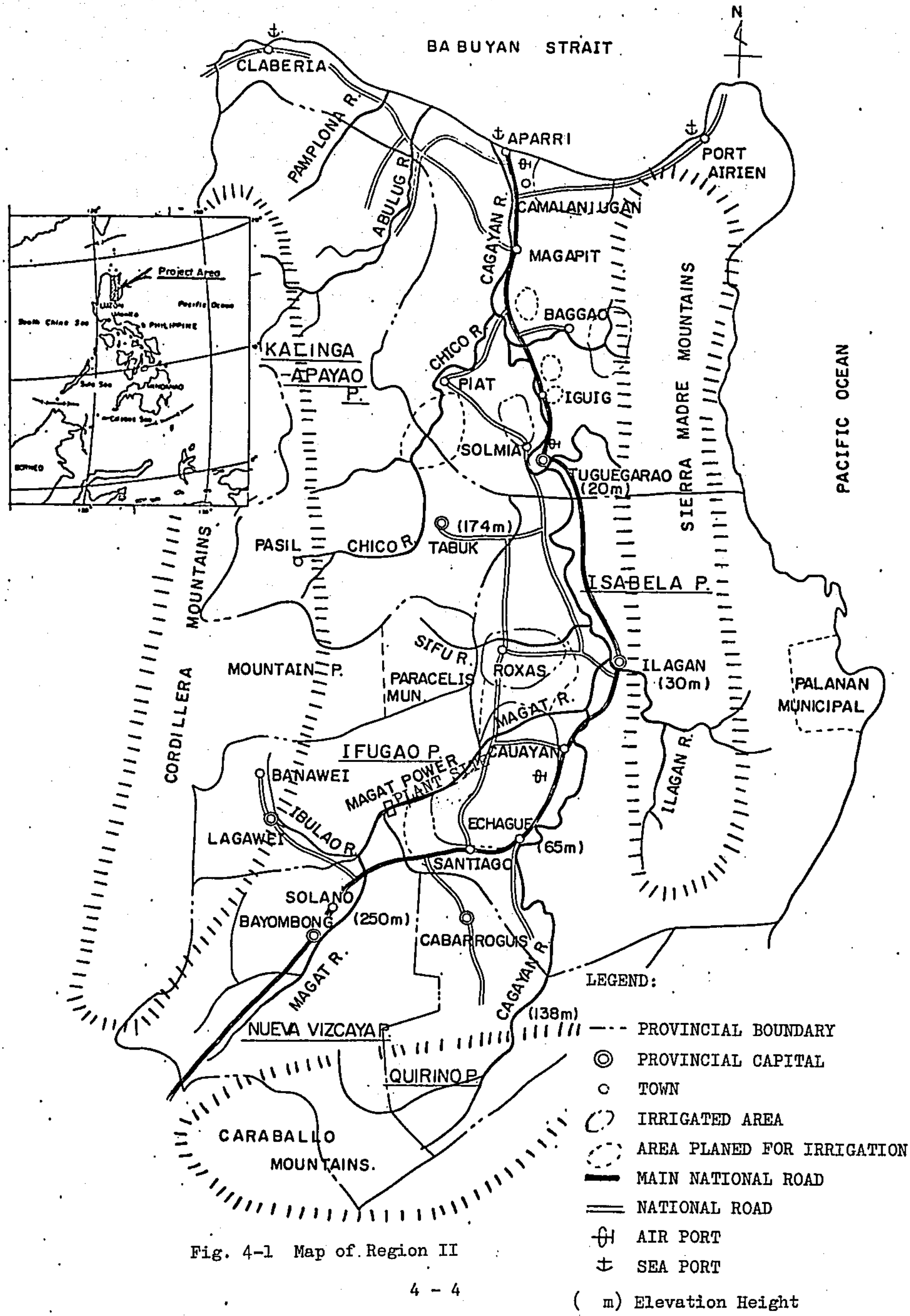


Fig. 4-1 Map of Region II

Fig. 4-2.1 Land Classification of Region II

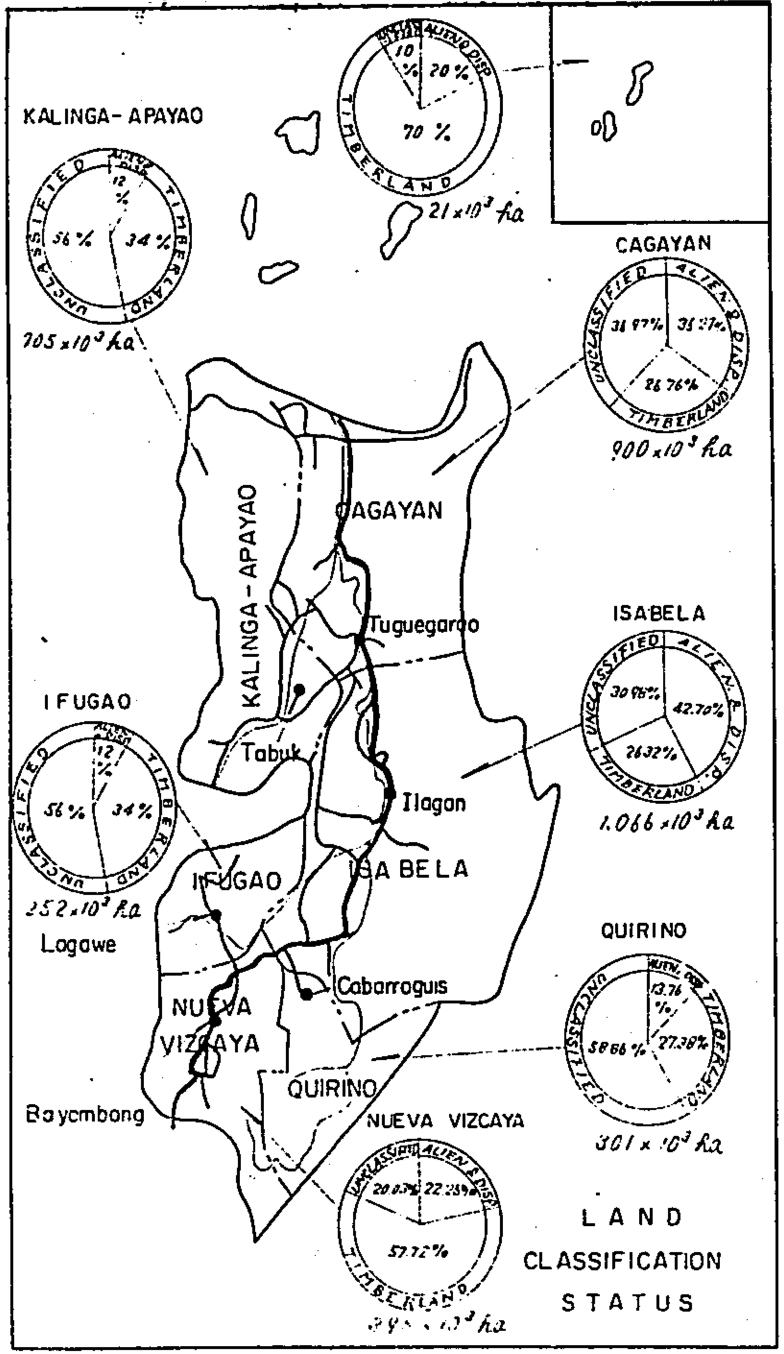


Fig. 4-2.2 Slope Map ofRegion II

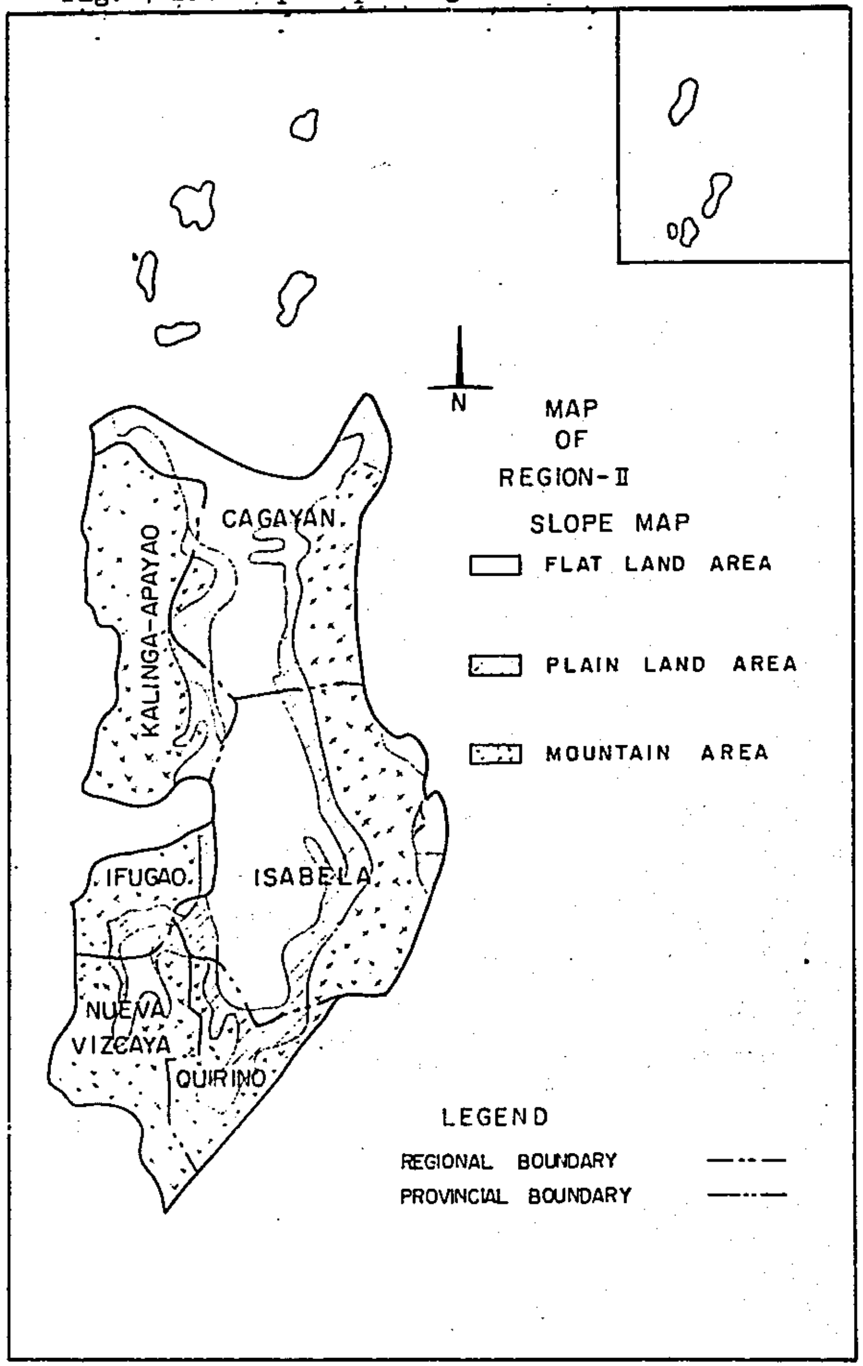
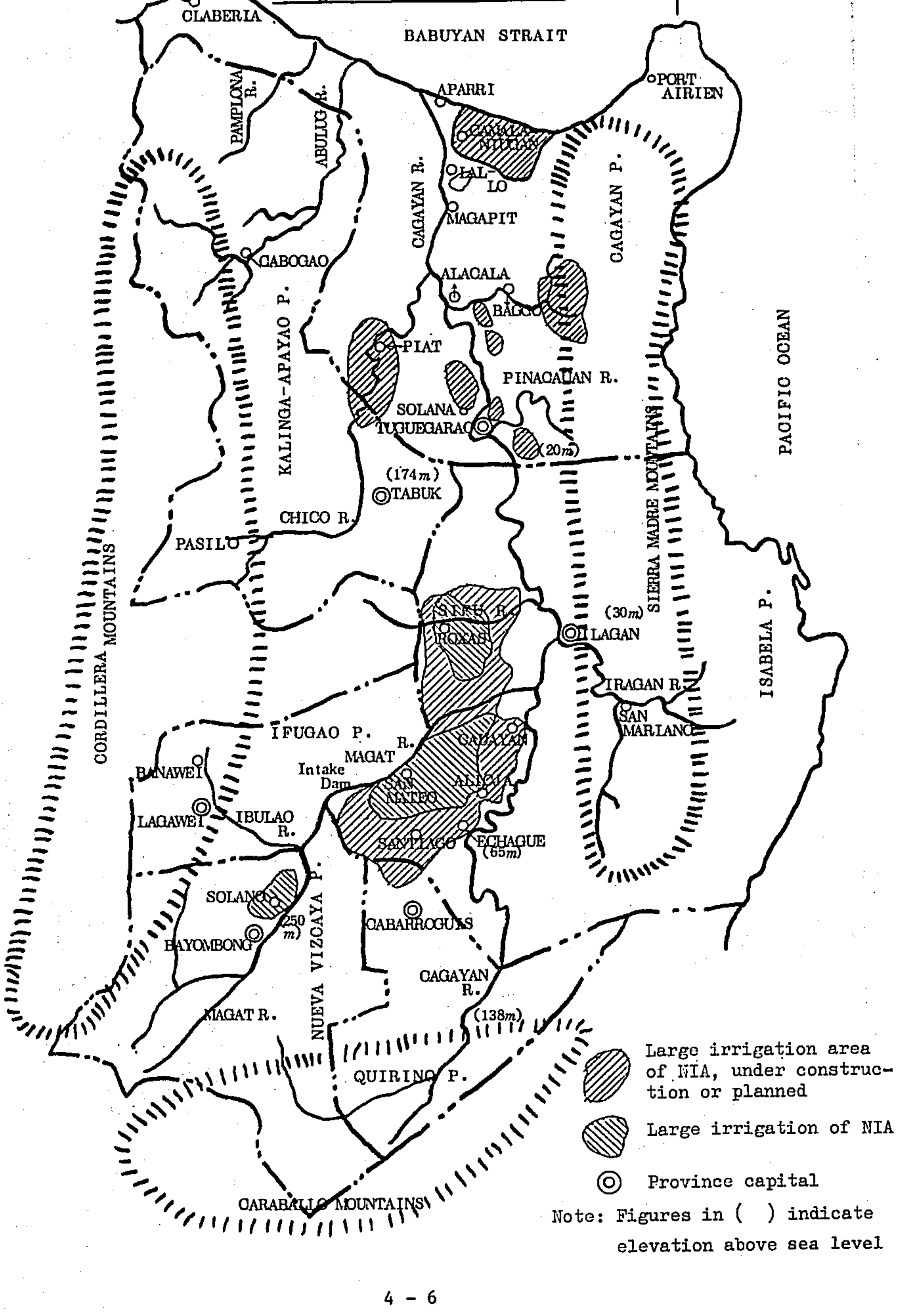


Fig 4 − 3

Irrigation Map of Region II



4-1-2. Climate

The northeastern part of Kalinga Apayao Province goes into the rainy season from September through next January. There is little seasonal fluctuation in the remaining parts of the Province, but rainfall is relatively smaller from February through May than in other months. In most of the remaining part of Region II, rainfall is comparatively small from December through next March and, in order months, precipitation varies little from month to month, the average annual rainfall being from 1,800 mm to 2,000 mm depending on the location. The frequency of typhoon is four to five times per year at the maximum, which can cause a substantial rainfull in some cases. Wind velocity of 90 mph (60 m/sec) should be adequate for design purposes for Region II, except for eastern coastal area (NEA, Rural Line Manual). Temperature is high in the inland area around Tuguegarao, where it reaches above 30°C from March through October but declines to 12 or 13 °C in the morning and evening in January and February. Thunder is experienced in summer, the frequency of which being from thirty days to forty-five days. (See Fig. 4-4 and Fig. 4-5.)

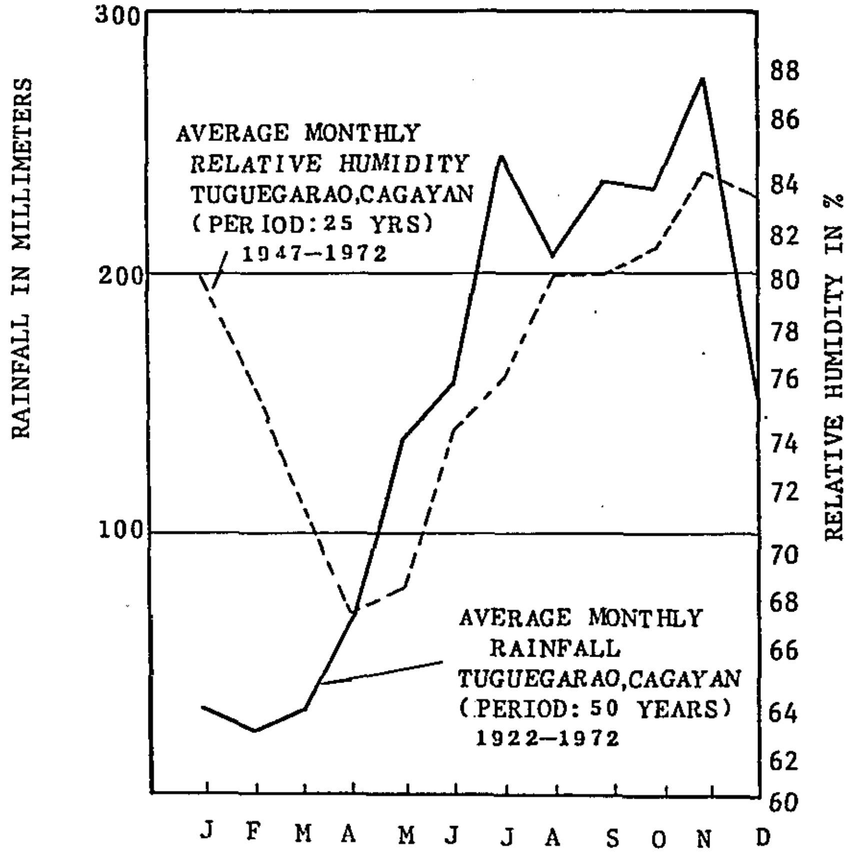


fig 4-4 AVERAGE MONTHLY RAINFALL AND HUMIDITY TUGUEARAO.CAGAYAN

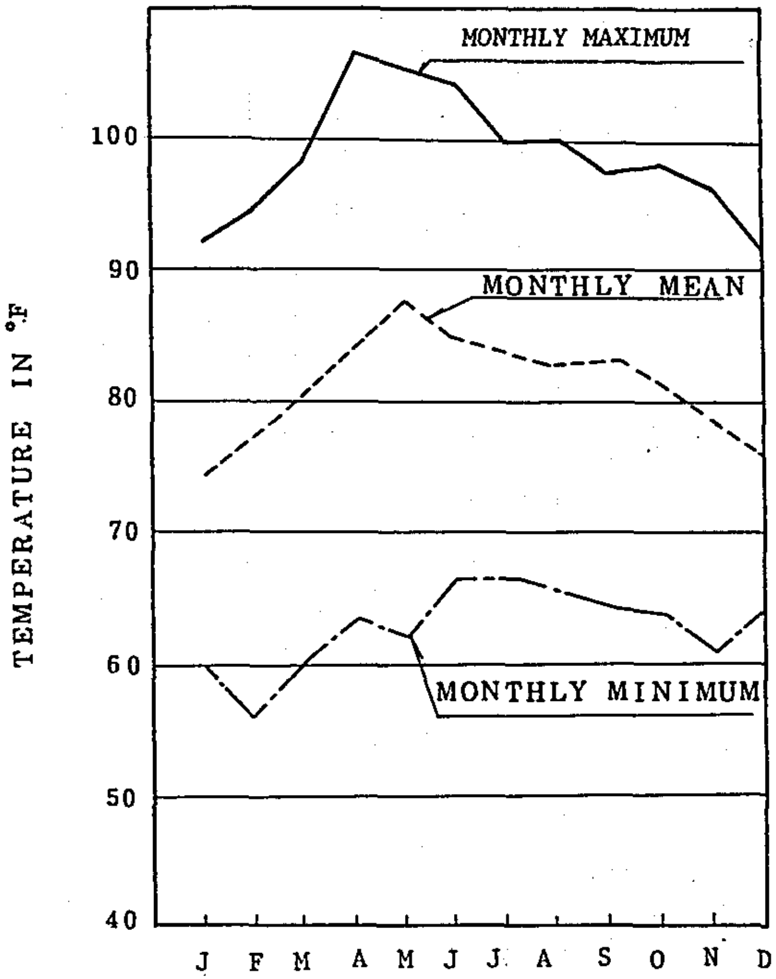


fig 4-5 TEMPERATURE DATA, ALAMINAO RESERVOIR, TUGUEGARAO. CAGAYAN (PERIOD: 9 YRS) 1957-1965

4-1-3. Population and Housing

The population of Region II was 1,930,000 according to the census of 1975, which was 4.6% of the Philippines' total population of 42,000,000. In Region II, Cagayan and Isabela Provinces have a larger populations than in others provinces. The total population of these two provinces represent more than 71% of the Region's total population. Population increases since 1960 are shown for each provice in Table 4-1. Population increase was remarkable during the period from 1960 through 1970, when 32,000 people flowed into the Region from other areas. If this unusual inflow is disregarded, population increase rates during the 1960-1970 period were almost comparable to those during the 1970-1975 period. One thing unusual is that some 20,000 people moved from Cagayan Province to rural villages in Isabela, Nueva Vizcaya, or Quirino Province. Therefore, future population increase is expected to be about 2.8% per annum unless affected otherwise by some economic changes.

The housing situation of the Region is shown on Table 4-3, per 1970 statistics. The distribution of households shown in Table 4-3 has been and is changing substantially due to agricultural and other income increases and establishment of local offices of the central government. The so-called "nipa houses" are changing to wooden-sided houses, concrete-block buildings, and, in Towns, concrete buildings.

Table 4-1 Population in Region II by Province

(10^3 persons)

	1960	1970	1970/ 1960	1975	1975/ 1970	1980	1985	1990	Area 1,000 ha	Density per km^2 in 1975
N. Vizcaya	113.8	172.2	5.1 %/Y	211.3	4.5 %/Y	263	327	407	394.9	53.5
Ifugao	76.8	93.0	2.1	104.6	2.5	118	133	150	251.8	41.5
Quirino	24.3	49.8	10.0	65.8	6.4	89	121	165	301.2	21.8
Isabela	442.1	648.1	4.7	735.9	2.7	840	959	1,095	1,066.5	69.0
Cagayan	445.3	581.2	3.0	638.1	2.0	740	777	857	900.3	70.9
Kalinga - Apayao	89.5	136.2	5.2	162.9	3.9	197	238	288	704.8	23.1
Total	1,191.8	1,680.5	4.1	1,918.6	2.8	2,211	2,555	2,962	3,640.3	52.7

Table 4-2 Number of Households in Region II by Province

Unit: 10^3 Houses

	1970	1975	1975/ 1970	1980	1985	1990
N. Vizcaya	30.0	36.1	1,203	42.5	50.9	60.7
Ifugao	20.1	21.1	1,047	22.3	23.7	25.6
Quirino	8.6	11.3	1,313	14.3	18.7	24.8
Isabela	108.2	115.0	1,063	126.6	139.1	154.0
Cagayan	100.7	111.9	1,111	126.6	139.1	154.0
Kalinga - Apayao	24.0	27.1	1,129	31.0	37.0	43.0
Total	291.7	322.5	1,129	360.5	400.6	446.2

Construction of two- or three-storied concrete buildings is noted particularly in commercial areas of Aparri, the central part of Tuguegarao which suffered a big fire in the winter of 1976, Cauayan and San Mateo. Newly built private dwellings tend to become larger in size, with three or more room houses becoming common even in rural areas. Towns and Barrios are checkrowed, and each dwelling lot is divided into a size of about 500 m^2 in most of the residential areas. Afforestations function as wind-breaks. In Barrios, many farmers display potted flowers by their homes, indicating that they are enjoying a comfortable life.

4-1-4. Traffic

Region II is connected with Manila by three air routes with one roundtrip flight arriving at and departing from Aparri, Tuguegarao, and Cauayan every day. Morning edition of newspapers printed in Manila is transported to these places by air every morning.

Waterway transportation is currently limited to midstream and downstream where cargo is carried by ships of a light draft or by bamboo rafts and is less and less popular with the development of roads and highways. Ferry services are still active for crossing of people and vehicles over the Cagayan or its tributaries where the width of the river is large but no bridge are provided.

The Philippines-Japan Friendship Highway, which runs through Region II from north to south, constitutes the spine of road/highway network of the Region as shown in Fig. 4-1. Various points of the Region are connected with Manila by long-distance regular bus and large truck services in five to eight hours. Towns within the Region are connected with one another by medium-distance bus and jeep services. The total number of motor vehicles in the Region is more than 14,000 as shown in Table 4-5 (as of 1974).

State and provincial roads stem from the Friendship Highway and connect municipal Towns in the Region. Average extension of these roads is 0.2 kilometers per square kilometer of land as shown in Table 4-4.

Table 4-3 House Type in Region II : by Province
1970 : unit 10^3 houses

	Total	Concrete	Wood	Bamboo and others
Cagayan	99.4	3.4	33.0	63.1
Ifugao	20.1	0.1	12.8	7.2
Isabela	115.2	4.9	36.1	74.2
Kalinga-Apayao	23.9	0.5	14.6	8.8
N. Vizcaya	38.1	1.5	14.2	22.4
Region II	296.7	10.4	110.6	175.6

Table 4-4

Road Kilometerages per Square Kilometer:
by Province, as of June 30, 1973, Region II

Province	Road kilometerages	Area (sq. km.)	Road kilometerages per sq. km.
Batanes	148.97	209.3	0.7
Cagayan	1961.39	9002.7	0.2
Ifugao	764.32	2517.8	0.3
Isabela	2584.86	10664.6	0.2
Kalinga-Apayao	551.19	7047.6	0.1
N. Vizcaya	1195.69	6969.1	0.2
Quirino*	-	-	-

* included with Nueva Vizcaya

Source : DPH (Department of Public Highway)

Table 4-5 Motor Vehicles Registered by Province: According to Type, as of June 30, 1974, Region II

Type	Total	Cagayan	Ifugao	Isabela	Kalinga - Apayao	N. Vizcaya	Quirino
Cars number	4,110	1,089	31	1,970	257	598	165
%	29.1	26.1	13.6	33.2	26.6	28.9	31.4
Jeepneys number	1,132	328	7	464	183	100	50
%	8.0	7.8	3.1	8.6	19.0	4.8	9.5
Buses number	500	279	19	111	40	33	18
%	3.5	6.7	8.4	2.1	4.1	1.6	3.4
Trucks number	5,594	1,645	117	2,166	355	1,086	225
%	39.8	39.4	51.5	40.1	36.8	52.6	42.8
Motorcycles number	1,705	740	53	530	115	203	64
%	12.1	17.7	23.3	9.8	11.9	10.5	12.2
Trailers number	1,061	96	-	338	15	44	3
%	7.5	2.3	-	6.3	1.6	2.1	0.6
Total number	14,102	4,177	227	5,399	965	2,069	525
%	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: LTC (Land Transportation Commission)

New farm roads, inter-Barrio roads, and bridges are now under construction at various locations. In constructing roads and bridges, a comprehensive infrastructure development is aimed at with due consideration given to the electrification program.

As for marine transportation, the only available ports were Appari and Claberia which were able to berth only small vessels because of shallow waters extending to a distance. Port Irien was completed in the northeastern part of the Region in February 1977, with quays having a water depth of twelve meters. One additional quay is to be constructed in this port in the future. The problem of this port is that land transportation from the port to the Friendship Highway takes about two hours over unpaved roads. It is desired that this road be paved in the future.

4-1-5. Communication

The chief means of communication between various points of the Region and between the Region and Manila is wired and wireless telephone and telegram. Wireless is in wide use because of the land area sandwiched by two mountain ridges on both sides. The development of wired telephone is markedly retarded, and the wired telephone is used only between Bayombong and Salano in Nueva Vizcaya Province and in very limited Towns. Communication in general, therefore, must depend on jeep or other motor vehicle or mail. This means that reports of any accidents of power distribution lines by the public cannot be expected. Also, the advance notice of power stoppage must be carried by a messenger. This makes the transmission of information very difficult. Television broadcasting can be received only in the central and southern districts of Isabela Province with the aid of a repeater station located at Baguio (Bengnet Province). Two to four private radio stations are engaged in radio broadcasting in each of Cagayan, Isabela, and Nueva Vizcaya Provinces.

4-2. Social Structure of Region II

4-2-1. Administrative Struture

Under the wide area administrative system of the Republic of the Philippines, many central administrative organizations have their local offices in Region II. Cagayan's Provincial Capital, Tuguegarao, has been designated as the capital of Region II. The Economic Planning Agency, and agricultural and other administrative agencies of the central government have their offices in the consolidated government building in Tuguegarao. However, road-related agencies and the National Irrigation Agency, which are more operational than administrative, have their local offices in Solana, Cauayan and other areas because of the convenience in acquiring the necessary land space. The military headquarters for Region II is located in Echague. A liaison conference is organized by these local offices located within Region II and by the local autonomous bodies, and this conference has been very active in the Region.

Provincial governments are located in their respective capacital cities, excepting for Isabela Province, whose capital functions are devided between Ilagan and Cauayan. The number of local officials of provincial governments is small due, for one, to the small population of Region II, and the available statistical data are much less than adequate. The size and quality of provincial government facilities vary depending on the economic condition of the Province. The provincial government building of Cagayan boasts the affluence of the Province. Also, Cagayan is proud of its historical museum as the only one of the kind in the Region.

The subordinate administrative division immediately below the Province is Municipal. Each municipal has its administrative functions housed in the Town Hall. In every old Town in the plains of the Region there is always a square where the

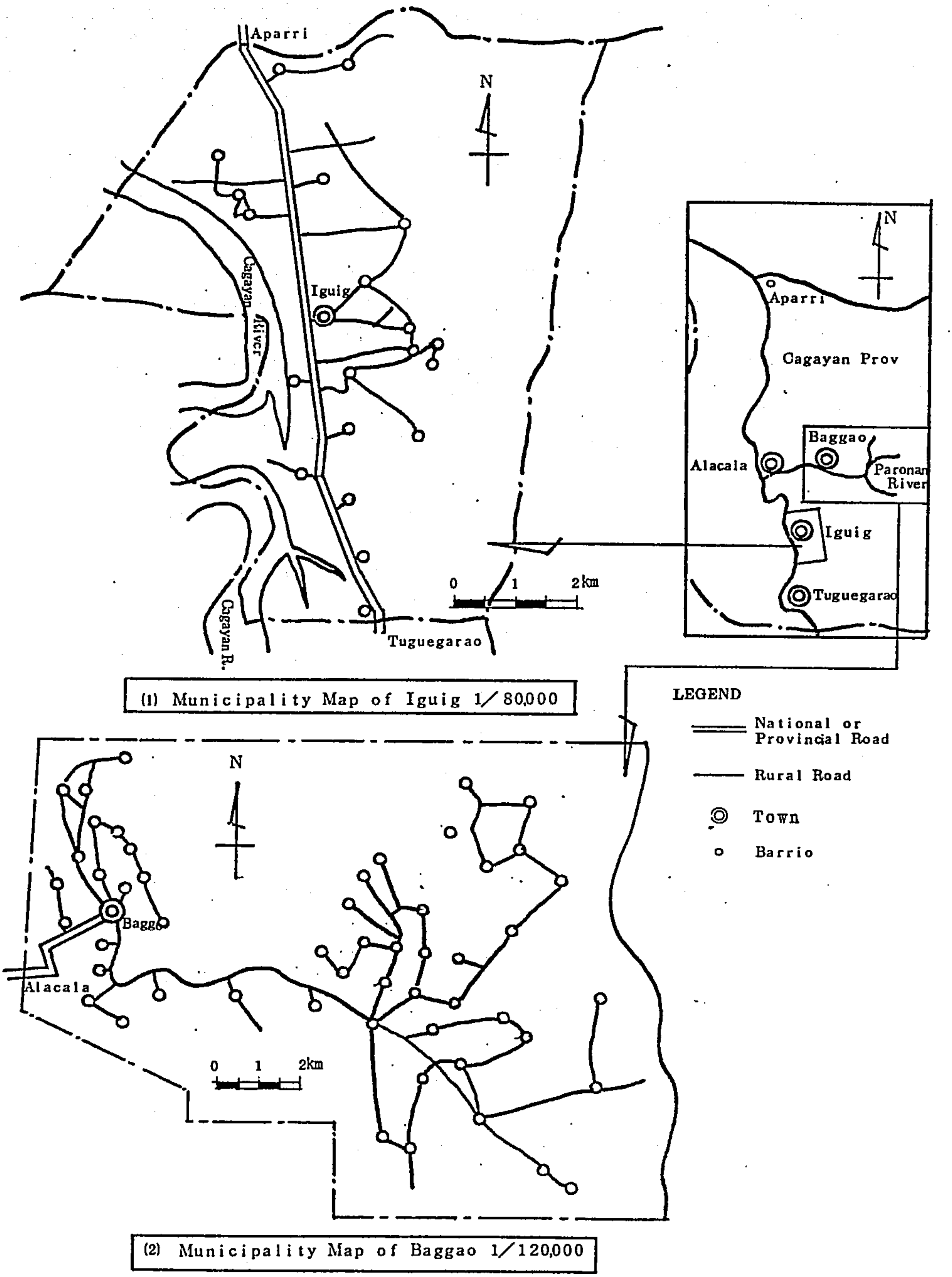


Fig. 4-6 Example of Location of Town in Municipal

statute of Rizal, the hero-father of the Philippines, is standing with a church standing nearby.

The number of town hall officials is small, and mayor and other officers appear quite busy with daily routine works such as giving guidance and disseminating information.

Each Municipal has ten to twenty Barrios, each with an elected Captain. Fig. 4-7 presents typical examples of Barrio composition within Municipal; Fig. 4-7(1) shows an example of Barrios distributed in the plain along the Philippines-Japan Friendship Highway or national road, and fig. 4-7(2) gives an example of Barrios distributed in mountain areas in the eastern and western parts of the Region. In the latter example, only a limited number of roads are available for communication with Towns of other Municipals, and farm lands extend widely in the plains along the rivers in the depth of the Municipal, where Barrios are distributed in the radial pattern.

4-2-2. Education

The illiteracy rate in the Region is 24%, which is higher than the all-Philippine average of 16.6%. But the educational level of the Region is generally low.

The primary education, which starts at the age of six and continue for six years, is compulsory. Region II has some 2,300 schools, most of which are public schools. The enrollment rate is about 75% (as of 1976).

About 72,000 students are enrolled at 192 high schools which comprise 92 public and 100 private high schools. The 72,000 represents about 26% of the Region's youths of the high school age.

There are three national or provincial colleges and ten private colleges in the Region, where 16,000 students are being educated.

The primary and high school education places emphasis on the fostering of community consciousness in the minds of students through practice, and students are engaged in group activities in the cleaning of national and provincial roads near the shcool and in the beautification of their school grounds. Military education is mandatory to both male and female students of high school and above, and the qualification for a reserve officer in the army, navy, or air force is the requirement of college graduates.

4-2-3. Hygiene

In the area of hygiene, environmental sanitation is much improved toward the stamping out of endemic diseases. Malaria has become a topic of the past in Towns of plain area. Each Town in the Region has a water supply system with deep-well pumping facilities, and villages have public pumping facilities. For the future, construction of new waste disposal facilities or expansion of existing facilities to accomodate population increases is being considered.

Itinerant physicians give guidances on the periodical medical examinations of the infants for the purpose of lowering infant death rate.

Medical facilities available in the Region include 29 public hospitals and 29 private hospitals. A summary of public hospitals is presented in Table 4-6. In addition, there are a total of about 230 health centers in various municipals (with 250 physicians).

Table 4-6 Public Hospitals in Region II, 1974

	Hospital	Beds	Physician	Nurse	Dentist	Others
Cagayan	9	425	38	26	7	92
Ifugao	2	100	6	9	-	19
Isabela	7	325	31	38	7	56
Kalinga-Apayao	7	250	14	35	1	44
N. Vizcaya	1	50	1	5	-	7
Quirino	3	150	11	11	3	13
Total	29	1300	101	124	15	231

4-3. Industry in Region II

4-3-1. Distribution of Working Population

The Development Council of Region II envisions the Gross Domestic Product (GDP) of the Region as shown in Table 4-7, based on the results since 1972. According to this "vision," the weight (composition ratio to total GDP) of agricultural sector will decline by 16% from 1974 to 1987, that of services (tertiary industry) will rise by 10% during the same period, and that of the secondary industry will increase by 6% in the same time span.

On the other hand, according to sectoral labor force statistics complied from the 1970 and 1975 population statistics of Isabela Province and presented on Table 4-8, agricultural population increase rate coincides approximately with the overall population increase rate, while increase in the tertiary industry exceeds the overall rate. Substantial increases are expected of agricultural products in the future, owing to the irrigation of currently unirrigated lands, the use of better fertilizer and better farming methods, and other programs for the improvement of agricultural productivity. Toward this end, agricultural activities will have to be rationalized. Particularly needed is a substantial enlargements in the scale of agricultural operations, without which agriculture will coceivably function to deter population increases. Manufacturing industry will increase as factories will be induced to the Region in the future. This will have a great effect on the increase of electric power sale, and the demands of employees and their families for electric power will also increase. On the other hand, the rapid expansion of service industry will increase power demands for lighting in their business activities.

Table 4-7 Gross Domestic Product, Region II
(In 1972 Prices)

Item \ Year	1972	1973	1974	1987	2000
GDP (million pesos)	1,603	1,602	1,653	4,315	10,096
Percentage Total (%)	100	100	100	100	100
Agriculture (%)	63.9	61.4	60.1	43.3	22.5
Manufacturing (%)	5.5	5.3	5.3	9.7	17.4
Mining (%)	0.0	0.0	0.1	0.5	2.0
Construction (%)	6.0	8.0	9.3	11.4	14.1
Utilities (Electricity gas, water) (%)	0.1	0.1	0.1	3.0	5.0
Transport, communication, storage (%)	1.1	1.2	1.1	4.0	6.0
Commerce (%)	14.7	14.4	14.0	16.0	18.0
Services (%)	8.7	9.6	10.0	12.1	15.0

4-3-2. Agriculture

Region II functions as a food base and produces various agricultural products, thanks to the adequate level of rainfall. Production of rice, which is the most predominant of the formers' economy, will be discussed first.

1) Rice

Changes in the areas of paddy fields in Region II are shown in Table 4-9. The total area of paddy fields was 337,900 hectares in 1975. This is 11% greater than the area in 1971. The total area of irrigated paddy fields has been increasing by 7.2% per year since 1971, and reached 46.4% of the total area of irrigated and non-irrigated rice fields in 1975. The area of non-irrigated paddy fields has changed little, but a

Table 4-8 Sectoral Labor Forces by Province

		Total	Agricul- tural	Min- ine	Manufac- ture	Elec., gas, water	Construc- tion	Commerce	Transport	Service	Others
1970	Cagayan	200,000	148,600	89	11,800	234	4,433	7,625	5,568	20,270	1,365
	Ifugao	43,600	38,600	78	2,300	43	301	277	174	1,878	
	Isabela	222,700	171,600	50	11,200	111	4,065	8,907	4,832	19,386	2,556
	Ka.-Ap.	58,600	52,500	70	700	45	546	715	281	3,361	372
	N. Vizcaya (Incl. Quirino)	74,600	56,500	21	3,400	118	1,580	3,059	1,712	7,604	808
	Region II	599,700	467,800	300	29,400	551	10,925	20,583	12,567	52,500	5,101
Isabela											
1975		244,100	188,400	57	12,200	102	4,439	9,779	5,239	23,785	
1975/1970		1.096	1.098	1.14	1.090	0.919	1.09	1,098	1.10	1.146	

Table 4-9 Rice Paddy in Region II, 1971 to 1975

Unit: ha

	1971	1972	1973	1974	1975
Irrigated	116,510	130,508	131,161	154,259	156,382
Non-Irrigated	173,127	168,927	167,158	165,839	166,416
Upland	14,593	14,598	14,557	14,604	14,668
Total	304,230	314,033	312,876	334,702	337,466

Table 4-10 Irrigated Rice Paddy Area by Province in Region II, 1971 to 1975

Unit: ha

Province	1971	1972	1973	1974	1975
Batanes	-	-	-	-	-
Cagayan	31,525	38,063	38,039	38,192	40,303
Ifugao	8,500	8,600	9,200	9,549	9,549
Isabela	52,400	56,760	56,760	76,375	76,375
Kalinga-Apayao	8,384	8,384	8,461	10,288	10,288
N. Vizcaya	16,900	16,900	16,900	16,900	16,912
Quirino	1,801	1,801	1,801	2,955	2,955
Pegion II	119,510	130,508	131,161	149,259	156,382

Source: Bureau of Agricultural Extension, Region II.

comparison between the area of irrigated paddy fields and the area of non-irrigated paddy fields indicates that, while the irrigated paddy fields increased by 23,000 ha from 1973 to 1974, the non-irrigated areas decreased only by 1,300 ha during the same period. This shows that dry farmlands and grass lands have been turned into wet paddy fields by irrigation.

The shift of presently non-irrigated paddy fields to irrigated paddy fields under the irrigation projects will ensure increased food production to accommodate the future population increases in the Philippines.

Table 4-12 shows the volume of annual production of rice (in terms of unhulled paddy weight) in Region II. With the improvement of agricultural method, the production per hectare increased from 2.55 metric tons in 1971 to 3.0 tons in 1974 and 1975, or by about 20%.

The balance of rice production and consumption (as converted into polished rice weight) in Region II is shown in Table 4-13. Export of rice in 1975 was about 210,000 tons, or about 2.4 times that in 1971.

2) Corn

While the cultivated area increased from 233,500 hectares in 1971 to 279,500 hectares in 1973, the production decreased from 324,000 tons in 1971 to 216,300 tons in 1973. This tendency of decline in the production of corn is partly due to the fact that fertile lands were converted into paddy fields and that the lands which were newly opened for corn were of poor soils. Yet, the volume of production was more than adequate to supply the demands within the Region, and a surplus of 88,000 tons was exported from the Region in 1973. (Table 4-14).

Table 4-11. Non-irrigated Rice Paddy Area by Province in Region II 1971 to 1975

unit: ha

Province \ Year	1971	1972	1973	1974	1975
Batanes	-	-	-	-	-
Cagayan	58,817	55,417	56,617	56,639	56,941
Ifugao	1,200	1,200	1,250	2,390	1,390
Isabela	92,170	91,370	88,153	86,130	86,130
Kalinga-Apayao	4,360	4,360	4,500	5,000	5,000
N. Vizcaya	11,400	11,400	11,400	11,430	11,430
Quirino	5,100	5,180	5,258	5,250	5,525
Region II	173,047	168,927	167,178	166,839	166,416

Table 4-12-1 Paddy Production in Region II 1971 to 1975

unit: metric ton

Year	Irrigated	Non-Irrigated	Upland	Total
1971	297,655	285,537	14,992	598,124
1972	345,656	250,309	10,659	606,324
1973	342,966	257,110	11,299	611,375
1974	455,824	272,248	12,964	741,036
1975	486,794	244,672	12,631	744,102

Source: Bureau of Agricultural Extension, Region II.

Table 4-12-2 Average Yield of Riceland in Region II, 1971 to 1975, Unit ton/ha;

Year	Irrigated	Non-Irrigated	Upland	Average
1971	2.55	1.63	1.01	1.97
1972	2.64	1.50	0.40	1.93
1973	2.60	1.54	0.79	1.96
1974	2.95	1.63	0.88	2.21
1975	3.12	1.45	0.88	2.20

Table 4-13 Rice supply and recommended food allowance for all cereals (INMT), in region II, 1971 to 1975

Unit: metric ton

	1971	1972	1973	1974	1975
Available Rice Supply	293,846	344,692	347,524	422,758	437,723
Recommended Food Allowance for Cereals*	205,231	211,047	217,051	223,348	227,807
Surplus	88,615	133,645	130,473	199,410	209,916

* 324 grams/capita/day, Food and Nutrition Research Center, Philippine Journal of Nutrition, Vol. XXII, No.2, 1969

Table 4-14 Shell Corn Production and Uses in Region II, 1971 to 1973

Unit: metric ton

Year	Crop area (hectares)	Production	Seeds	Animal feed	Available supply
1971	233,500	324,010	1,670	48,602	273,738
1972	268,300	252,983	1,771	37,947	213,265
1973	279,500	216,326	1,514	32,449	182,363

3) Tobacco

In 1973, the Region's land cultivated for tobacco growing was 26,000 hectares, representing 31% of the total cultivated land for tobacco in the Philippines, and the tobacco production of the Region was 25,100 tons, or 39% of the nation's total tobacco production. The most of the Region's tobacco production comes from Isabela Province, which produces 70%, and Cagayan Province, which produces 25%.

Warehouses for collection and selection of tobacco leaves are provided at various locations within Region II, from which the leaf tobacco is shipped out to Manila District.

4) Sugarcane

Sugarcane growing area shrunk from 718 ha in 1971 to 180 ha in 1973, and the crude sugar production, which was nearly 1,900 tons in 1971, declined substantially in 1973. But the area of sugarcane growing is expected to increase in Cagayan, Kalinga-Apayo and other Provinces again in the future, as Cagayan Sugar Corporation has been established in Piat, Cagayan Province, and raw sugar/refined sugar plant is under construction with the target of commencing operations in 1977.

5) Peanuts

Peanuts farmland in the Region was 10,000 hectares or 30% of the total peanuts farmland of the nation in 1973, and produced 5,300 tons, or 29% of the total peanuts production of the nation. Demand is strong for production of peanut oil, and price per kilogram of peanuts is comparable to that of rice. Therefore, the present level of peanuts production will be maintained in future.

6) Livestock and Pultry

Table 4-15 shows the population of livestock in the Region. Most of the carabao (buffalo) and cattle are raised by farmers as draft cattle. About 50% of the buffalo is raised in Cagayan Province and about 30% in Isabela Province. These two Provinces together raise about 50% of the cattle population, and Nueva Vizcaya and Kalinga-Apayao Provinces together, about 30%. Cattle raised for commercial purposes, such as for beef or milking, represent only 6% of the population. Horses, too, are raised chiefly for the purpose of drafting cart and are small in size. Sixty percent of the horse population are raised in Cagayan Province and 30% in Isabela Province. The horse population is on the decrease under the pressure of motorcycles and jeeps as the means of transportation.

Most of the swine and poultry are raised by farmers and only a small number of them are raised by commercial swinery or chickyard.

Table 4-15 Livestock and Poultry Population

	1971	1972	1973	1974	1975	1976
Carabao	339.9	399.3			472.0	430.7
Cattle	110.4					197.1
Swine (pig)	505.9			606.3		749.8
Horse	28.2					
Goat	22.9					
Chicken						3,072.6
Duck						347.1

7) Land Utilization by Farmers

Table 4-16 presents the area of land currently used for cultivation of various crops. A total of 338,000 ha or 47.6% of the total cultivated land is for rice, followed by 280,000 ha or 39.4% for corn.

Table 4-17 compares the irrigated and non-irrigated areas of Region II in 1972 with totals of the Philippines. The total cultivated land area in Region II is 6.7% of the nation's total, while the irrigated land area in the Region is 13.8% of the nation's total. It can be said that the Region has relatively advanced irrigation activities.

During the field survey, the Study Team noticed that there still remained land areas which would be utilized effectively with the progress of irrigation works, such as in Potia District of Ifugao, the west bank of the Cagayan River in the northern part of Isabela, the border area between Kalinga-Apayao and Cagayan, and the hilly area on the east bank of the Cagayan River in Isabela Province.

Table 4-16 Cultivated Areas by Crop

Crop	Area (ha)	Year	Crop	Area (ha)	Year
Rice, Irrigated	156,382	1975	Sugarcane	718	1971
Rice, rigated	181,084	1975	Peanuts	10,750	1973
Rice, Sub-Total	337,466	1975	Beans and Pees	3,400	1973
Corn	279,500	1973	Coffee	3,320	1973
Vegetables	21,171	1973			
Fruits	16,350	1973			
Tobacco	26,280	1973			
Coconuts	4,390	1973	Grand Total	703,345	

Table 4-17 Irrigated and Non-Irrigated Farmland, Region II, 1972

	Irrigated Farmland		Non-irrigated Farmland		Total Farmland	
	ha	%	ha	%	ha	%
Region II	130,508	25.56	380,174	74.44	510,682	100
Philippines	947,447	12.45	6,661,570	87.55	7,609,017	100
Region II/Phil	13.8 %		5.7 %		6.7 %	

4-3-3. Fishery

In the absence of large scale freezing and processing plants, only small scale coastal fishery operations are carried out not so vigorously on the northern shoreline of Cagayan Province and in Palanan on the east coast of Isabela Province. Fish farming is also of a small scale.

4-3-4. Manufacturing and Processing

Two plywood factories, one sugar plant, and one carbonated beverage bottling plant are the only large scale enterprises of the Region worthy of the name "factory." The carbonated drink bottling plant is located in Ilagan of Isabela Province, and others are scattered in Cagayan Province. The distribution of small industries is presented in Table 4-18.

Rice polishing mills have increased from 264 in 1972 to 428 in 1976 in Isabela Province, as the volume of rice production expanded. Most of them are equipped with a motor of from ten to fifty horsepower, the average being twenty horsepower. When the relationship between rice production and the number of rice mills in Isabela Province is considered, the number of rice mills in Cagayan Province, 842 in 1972, appears to be extremely large.

Table 4-18 Number of Selected Manufacturing Establishments by Province 1972, Region II

Industry description	Cagayan	Ifugao	Isabela	Ka.-Ap.	N. Vizcaya	Quirino	Total
Rice mill	842	7	264	210	81	35	1,439
Rice mill (1976)	-	-	(428)	-	-	-	-
Bakery	22	2	40	7	15	5	91
Tailor shop	153	6	229	43	63	22	516
Dress shop	93	2	70	11	33	3	212
Welding shop	101	9	200	11	67	10	398
Sawmill	24	5	15	10	5	5	64

This is probably because many small rice mills were established one after another in this Province when the road network was still undeveloped. This is taken into consideration in estimating the load.

The number of carinderias (car repair shops) in each Province is in proportion to the level of motorization of the Province. Tractor engineers or other engines are used to drive electric power generators of about five KW as the source of power for welding purposes. Saw-mills are of a large scale (from 75 to 100 horsepowers) and own some ten trucks or trailers for hauling felled timbers to the mills. As many of them are located near the end of power distribution lines, care should be used so as not to have voltage problems when the Region has been electrified.

Trailer shops and dress shops are operated with only a few trailers or seamstresses and will require only a small power, lighting being about the only demand.

4-3-5. Forestry

Timber of about 82.61×10^3 m^3 were felled, sawn or processed into plywood, and shipped out of the Region according to the record of 1974. This volume of timber accounts for 8% of the Philippines' total. (Restrictions of felling are becoming tighter, and post-felling forestation has been made mandatory.) Forests in Region II is said to have a total of 517,000 cubic meters of timber that can be felled, about 50% of which is located in Kalinga-Apayao Province.

4-3-6. Mining

Deposits of copper, iron ore, and lime stone have been reported from various Provinces of Region II, but none of them has been exploited on a full scale. Active prospecting for copper is being carried out in preparation for the exploitation of copper resources in Palanan District of Isabela Province, and in Pasil District of Kalinga-Apayao Province. According to Kalinga-Apayao authorities, a possible deposit of uranium ore is being prospected for in Pasil District.

4-4 Status of Irrigation Projects in Region II

The Four-year Development Plan places special emphasis on the budget for infrastructures for promotion of the welfare of the people and improvement of industrial basis. The budget for irrigation projects accounts for 12.7% of the total fund allocated for infrastructures, which is an indication of the government efforts to improve family income in rural areas and increase food production.

For the Four-year Development Plan, a total of 1,000 million pesos WUS$85 million) was earmarked as the project fund. Because of the inflation and deterioration of trade balance following the oil crisis, however, implementation of irrigation projects envisaged under the Four-year Plan has delayed considerably. Table 4-9 shows the status of large irrigation projects of NIA in Region II at the time of the field survey conducted in January 1977 as compared with the status in 1974.

It is clear from the table that the implementation of large irrigation projects is far behind the schedule. Of these projects, four projects are now under construction, five projects are ready to start in 1977 and nine projects are not yet ready to be started. Of the nine projects, one project requires power for pump stations. The Communal Irrigation Project which had an important bearing on the distribution system project as an irrigation load in the 1974 JICA Survey Report is now called BISA (Barrangai Irrigation Service Association). Though efforts are being made to promote BISA (including training of the staff and operators of the association) with NIA financing under the direction of FSDC (Farm System Development Committee), the number of BISA projects in January 1977 decreased considerably as compared with that in 1974 when the JICA survey was conducted as shown in Table 4-20.

Table 4-19 Large Irrigation Plans of NIA in 1974, in Region II

Plan's Name	Area (ha)	Plan		Condition in Jan. 1977
		Starting year	Completion year	
1. Magat multi-purpose dam	(NEW) 50000 (Imp) 40000	1975		Starting: 1977 Completion in 1982.
2. Tumauini	6100	1974	1976	No work
3. Sinundungan	3200	1974	1975	do.
4. Addalam	10000	1975	1977	do.
5. Bawn	3000	1975	1976	do.
6. Lanog	2000	1975	1976	do.
7. Dummon	3000	1976	1977	do.
8. Mallig	2500	1976	1977	do.
9. Magat West extention	5600	1977	1979	do.
10. Magsaysay (pump)	2000	1977	1979	do.
11. Pared river (pump)	1500	1977	1978	Will start in 1978
12. Pinacanawan river	1600	1977	1978	9.2%
13. Alacala west (pump)	600	1977	unknown	OECF Plan
14. Iguig (pump)	800	1977	do	do
15. Chico east	1400	1977	do	0.85%
16. Solana-Tuguegarao (pump)	4230	1974	1977	70%
17. Baggao	4000	No plan at first		74%
18. Lower Cagayan (pump)	11200	do		OECF Plan

On the other hand, NIA has been providing financial aids to groups of several to about 10 farm households for installation of small irrigation pumps of 5 to 15 HP which can be obtained for a relative-ly small amount of money. The number of such pumps installed is 500 in Cagayan, 1,800 in Isabela, 279 in Kalinga-Apayao, 98 in Ifugao, 60 in Quirino and 100 in N-Vizcaya, as of 1976.

Table 4-20 Status of BISA (Medium size irrigation project)

Province \ Year	1974		Jan. 1977		Future plan	
	No.	Area(ha)	No.	Area(ha)	No.	Area (ha)
Cagayan	32	5,550	10	985	7	550
Isabela	66	15,465	22	2,656	10	Unknown
N-Vizcaya	24	3,775	-	-	-	-
Quirino	6	700	-	-	-	-
	-	-	-	-	-	-
Kalinga-Apayao	-	-	-	-	-	-
Total	128	25,490	32	3,641	17	Unknown

4-5 Family Income and Expenditure in Region II

Since the results of income surveys in 1975 are not available, the family income surveyed in 1971 is used for analysis.

Table 4-21 shows a comparison of average family income and expenditure between Region II and all Philippine. The difference in family income between Region II and all Philippine had been widening since 1957 and the family income in Region II finally dropped to 52.0% of the national average in 1965. Since then, however, the income showed some improvement and reached 64% of the national average in 1971. Accordingly, family expenditure in Region II in 1971 was still as low as 58.6% of the national average and the difference in family income and expenditure between Region II and all Philippine seemed to continue to widen further for some time. However, the activities of the markets and the level of living in the farm households observed during the survey are a sign of gradual improvement of the standard of living of the people in REgion II, which may be taken as an indication of the effect of distribution economy brought about by the construction of the Japan-Philippine Friendship Highway. Therefore, the gap between Region II and all Philippine is expected to be narrowed gradually with the process of electrification in the Region.

Tables 4-22 and 4-23 show a distribution of families in 1971 by income class between Region II, all Philippine and MORESCO (1975 survey) which is located in the northern part of Mindanao Island. As shown in the table, family income in Region II in 1971 is higher than that of MORESCO in 1975. In MORESCO, electrification rate is relatively high even in the low income classes. Therefore, there is every indication that the rate of electrification in Region II will exceed that of MORESCO but will never fall behind it.

Table 4-23 is a comparison between income of wage earners in the industry (in August 1975), average income of COOP employees of ISELCO and CAGELCO and government employees (in February 1977) as surveyed by the Bureau of Census and Statistics. Those earnings ₱2,000/mo as of February 1977 in the bracket of managerial workers in government offices are equivalent to COOP managers and those earnings ₱1,000/mo are equivalent to section heads in the COOP. On the average, the income of managerial workers in 1977 showed an increase of about 50% over that in 1975. Since the income of government employees is said to have increased by about 33% from ₱4,576 in 1975 to ₱6,000 in 1977, the
industry may also have increased by about 20-30%.

Table 4-21 Average Family Income Region II & Philippines

(Unit : PESO)

	Phil.	Reg.II	Difference	Reg.II/Phil.
1957	1,471	1,273	198	86.5%
1961	1,804	1,189	615	65.9
1965	2,541	1,322	1,219	52.0
1971	3,736	2,390	1,346	64.0

Average Family Expenditure, Region II & Philippines

	Phil.	Reg.II	Difference	Reg.II/Phil.
1957	1,285	1,092	193	85.0
1961	1,793	1,284	509	71.6
1965	2,877	1,828	1,049	63.5
1971	4,479	2,626	1,853	58.6

Table 4-22 Families Income Class, 1971. (MORESCO 1975)

Number of Families Percent.

Income class	All Philis.	Region II	MORESCO
Under ₱ 500	5.2	5.6	53.0
500-999	12.1	15.4	27.2
1000-1499	12.2	23.6	9.5
1500-1999	11.8	17.6	4.4
2000-2499	9.6	9.8	1.2
7500-2999	8.1	6.7	7.0
3000-3409	12.5	8.2	0.
3500-3999	7.5	4.7	0.4
Over 4000	21.1	8.2	2.4

Note: Consumer Price Index. 1971 = 100, 1975 = 182, 1976 = 192

Table 4-23 Income of Wage Earners

Unit : Peso

	(Income surveyed by the Bureau of Census & Statistics) August, 1975 week/year	(Average income of ISELCO, CAGE-LCO employees and government employees in Region II) Feb. 1977
Agriculture, forestry, fishing	34/1,768	
Manufacturing	54/2,800	
Electricity, Gas, Water	79/4,108	395/mo. 4,740/year
Government, Community	88/4,576	6,000/year
Administrative, Executive and Managerial Workers	182 (9,464)	2,000/mo, 24,000/year
Section Heads		1,000/mo, 12,000/year

Chapter 5 NEA, COOP and NPG

Chapter 5. NEA, COOP and NPC

5-1 National Electrification Administration (NEA)

The establishment of NEA and COOP was proclaimed by the Republic Law No. 6038 in August 1969 as promoting organs of rural electrification.

In November 1972, the power of NEA was expanded by Presidential Decree No. 40 on the basis of the past experience in the operation and management so that NEA might be able to promote electrification in a more positive manner. By Presidential Decree No. 269 issued in August 1973, the power of NEA was further enhanced and additional measures were taken to give NEA favorable treatments in the financial aspect on the ground that the total electrification of the country is important as a national policy for promotion of the welfare of the people and industrialization of the nation. The new start of the NEA-COOP organization was also stipulated by the same Presidential Decree (refer to Chapter 3).

Hence, the National Electrification Administration (NEA) made a new start within the National Economic and Development Authority (NEDA) under Presidential Decree No. 269 of August 1973 as an organization responsible for financing, training and guidance of Electric Cooperatives (COOP), which are executing organs of rural electrification, for realization of total electrification of the country. The organization chart of NEA is shown in Fig. 5-1.

The top legislative organ of NEA is the Board of Administrators which comprises five directors who are chiefs of NEA, NPC and other organizations and is headed by the Minister of Construction, Transportation and Communications. The Board of Administrators is providing the necessary guidance to the subordinate organizations with its strong power.

Under the Board of Administrators, there are 543 employees assigned to the head office and 292 employees assigned to local training institutes and warehouse facilities.

Since its inauguration, NEA has put up the long-range, medium-range and short-range objectives of electrification as shown below and has been making vigorous efforts to achieve these objectives.

Long-range objective

Total electrification of the nation will be achieved in 1990. For this purpose, construction of distribution lines to cover all Barrios will be accomplished by 1984. (100% electrification)

Medium-range objective

Backbone distribution systems covering the entire nation will be completed in 1980. (Backbone line)

Short-range objective

Establishment of COOP in each province will be completed by 1977. (In Region II, 2 COOP's to be increased to 9 COOP's)

The function of NEA is prescribed in detail by Presidential Decree No. 269 and mainly includes the following.

(i) Financing of COOP

(ii) Feasibility study and other necessary supports for the establishment of COOP.

(iii) Supervision of billing and management of COOP.

(iv) Extension of loans to schools, agricultural cooperatives, fishermen's associations and small and medium industries through COOP for installation of necessary power receiving facilities.

(v) Education and training of key staff members and employees of COOP.

(vi) Purchasing of equipment and materials for distribution system and interior wiring in the lump on behalf of COOP as a means of reducing unit prices of the purchase.

Of the above-mentioned functions, training and purchasing functions showed the following achievements.

Training is being conducted for staff members of COOP's in NEA's 7 training institutes in such fields as power distribution and generation, sales activities and accounting. A complete and thorough training is being conducted especially for members of newly established COOP's. In 1976, a total of 128 training courses were provided for 4,653 trainees. The number of trainees since the start of training program exceeds 19,000.

For purchasing of equipment and materials, NEA places orders and receives delivery in the lump and then distributes the purchases to each COOP. NEA also provides guidance to the processing plants of wooden poles which are produced domestically for standard processing method and is engaged in the development of new tree species which have a higher growth rate than aption (20 years in tree age), the main material of wooden poles. The number of wooden poles purchased and distributed by NEA increased from 2,000 in 1972 to approximately 70,000 in 1976, with the total number of wooden poles purchased by NEA since its inauguration reaching 140,000.

Also, the specifications of equipment and materials to be delivered to NEA are standardized according to REA (Rural Electrification Administration) standard of the USA so as to provide interchangeability of equipment and materials between difference COOP's as part of NEA's effort to standardize the work method and simplify training of linemen from COOP's.

Table 5-1 shows the cumulative total of loans provided to COOP's by NEA up to fiscal 1975. According to the table, the amount of loans released to all COOP's in the country accounts for about 32% of the total amount of loans approved. While the rate of loan release is 39% in Luzon, 32% in Visaya and 22% in Mindanao, while that in Region II is as low as 12%.

A summary of NEA's money operation is as shown in Table 2-9 in Chapter 2.

Fig. 5-1 NATIONAL ELECTRIFICATION ADMINISTRATION ORGANIZATION CHART (1977)

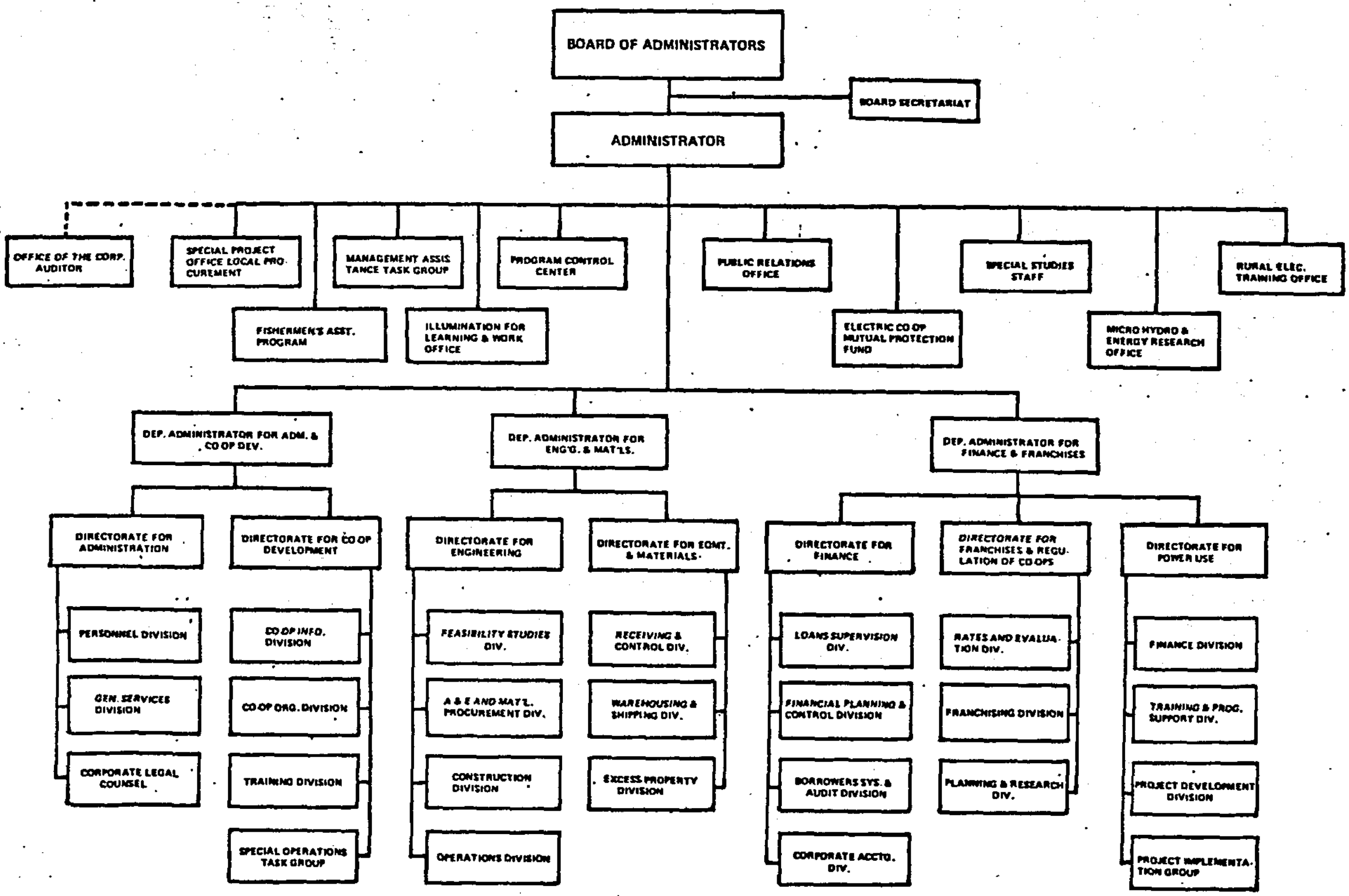


Table 5-1 Status of NEA Loans to COOP's

As of Jun. 30, 1975

Unit 10^3 ₱

Area	Approved Loan	Total Releases A=B+C	Admini-strative (1)	Const-ruction (2)	Take Over Cash (3)	Charge Non-cash (4)	Total Peso Fund Releases B=(1)+(2)+(3)+(4)	USAID Loans (5)	Japanese Repara-tions (6)	India Impor-tation (7)	Excess Prop-erty (8)	Loan Total C=(5)+(6)+(7)+(8)
Luzon	387,396	151,703 39.1%	4,644	56,872	17,796	3,847	83,159	45,799	17,550	1,228	3,967	68,544
Visaya	238,286	74,957 31.5%	2,434	38,327	7,047	605	48,413	15,093	9,039	484	1,928	26,544
Mindanao	237,367	52,983 22.3%		31,560	-	-	34,351	10,391	6,614	251	1,376	18,632
Total	863,049	279,643 32.4%	9,869	126,759	24,843	4,452	165,923	71,283	33,203	1,963	7,271	113,720
Region II	58,868	15,174 25.8%	-	-	-	-	9,135	-	-	-	-	6,039

5-2 Electric Cooperative (COOP)

The Electric Cooperative (COOP) was organized under Presidential Decree No. 269 of 1969 as an executing organ of rural electrification and is responsible for construction of distribution systems, promotion of rural electrification and sales of power to customers. As of December 1976, a total of 63 cooperatives (COOP's) were engaged in power supply. Fig. 5-2 is a standard flow chart of an electric cooperative project showing the process of preparations for organization of a COOP, signing of a loan agreement with NEA, letting of design of works, execution of construction works and start of electric power distribution operation. It takes 7 months from the through organization of a COOP, agreement with local residents, until the signing of a loan agreement with NEA, and another 27 months until the start of power supply following the completion of construction work, or a total of 34 months.

Each COOP is operated as a non-profit, non-stock membership cooperation and is placed under strict guidance and control of NEA, especially from the start of operation until the repayment of loans to NEA. The management of COOP is autonomous subject to approval of the Board of Directors which comprises 5 to 9 directors selected by members.

The Board of Directors is not a permanent organ but meets only once to several times a month. Daily administration of the COOP is the responsibility of the General Manager appointed by the Board. When a competent person is not available for appointment as General Manager at the time of organization, a person of the section head class in NEA may be temporary assigned to the COOP. When a qualified person is available, he is given management training and is then appointed as General Manager upon approval of the Board.

Hence, the pattern of daily operation differs from COOP to COOP depending on the judgement of the General Manager, and the COOP's are competing with one another for better results in operation.

Indeed, there is a difference in the number of employees between the two existing COOP's in Region II, ISELCO and CAGELCO, as shown in Table 5-4 and there is also a difference in the atmosphere of the office between these two COOP's. However, one thing common to them is that the managers are very anxious to rationalize the management and operation of their respective organizations. For example, the General Manager of ISELCO is trying to find a way to cope with future increase of customers with the present staff without increasing the number of meter inspectors, the Manager of CAGELCO is considering an improvement of operation of the power plant at midnight when load is small, and the engineers of Adrian Wilson International Associates, the Architectural & Engineering firm assigned to the Cagayan Valley, are developing an economical design of distribution lines crossing the river, in an attempt to minimize construction cost and operating and maintenance costs.

As for customer charges, the rate calculated by each COOP is examined and approval by NEA. Examples of COOP's power rate and cost by region are shown in Table 5-2. A comparison of billing rate between ISELCO and CAGELCO is shown in Table 5-3.

Details of power rate and cost are as follows.

(i) The power cost (purchasing price of power from NPC) differs from COOP to COOP depending on the power system for receiving power from NPC. For example, the power cost ranges from 0.172P/KWH to 0.195P/KWH in Region I.

(ii) The power rate (selling price) also differs from COOP to COOP. This is mainly due to the difference of operating cost per KWH depending on whether the COOP has large customers or not in its service area. In the case of Benguet in Region I, the power rate is 0.241P/KWH against the operating cost of 0.014P/KWH, while in the case of ILCOS NORTE which has a relatively small figure of sold KWH, the power rate is 0.352P/KWH against the operating cost of 0.099P/KWH.

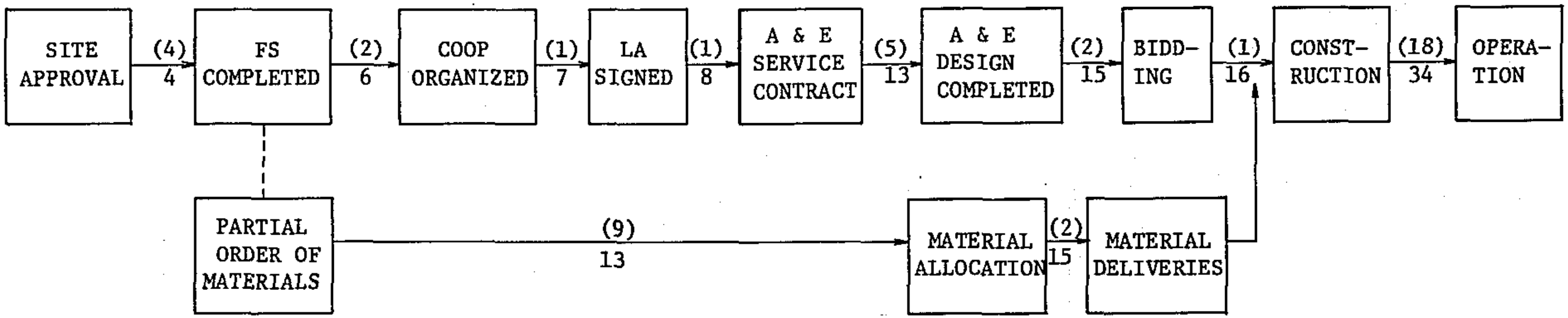
(iii) The difference of system loss ranges from 10% to 34% among COOP's, but the reason for this big difference is not known.

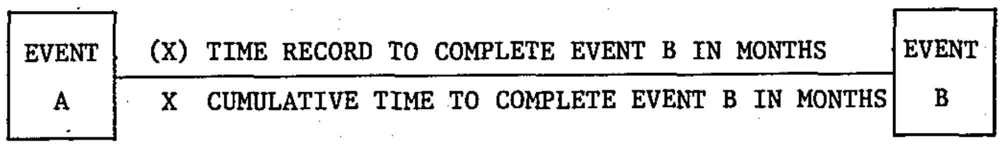
(iv) The billing rate for residential customers is also different between ISELCO I and CAGELCO I. The former charges 10P as a minimum rate for the first 15 KWH, while the later charges 8P. For the KWH exceeding the first 15 KWH, the rate of the former is 0.63P/KWH, while that of the latter is 0.77P/KWH.

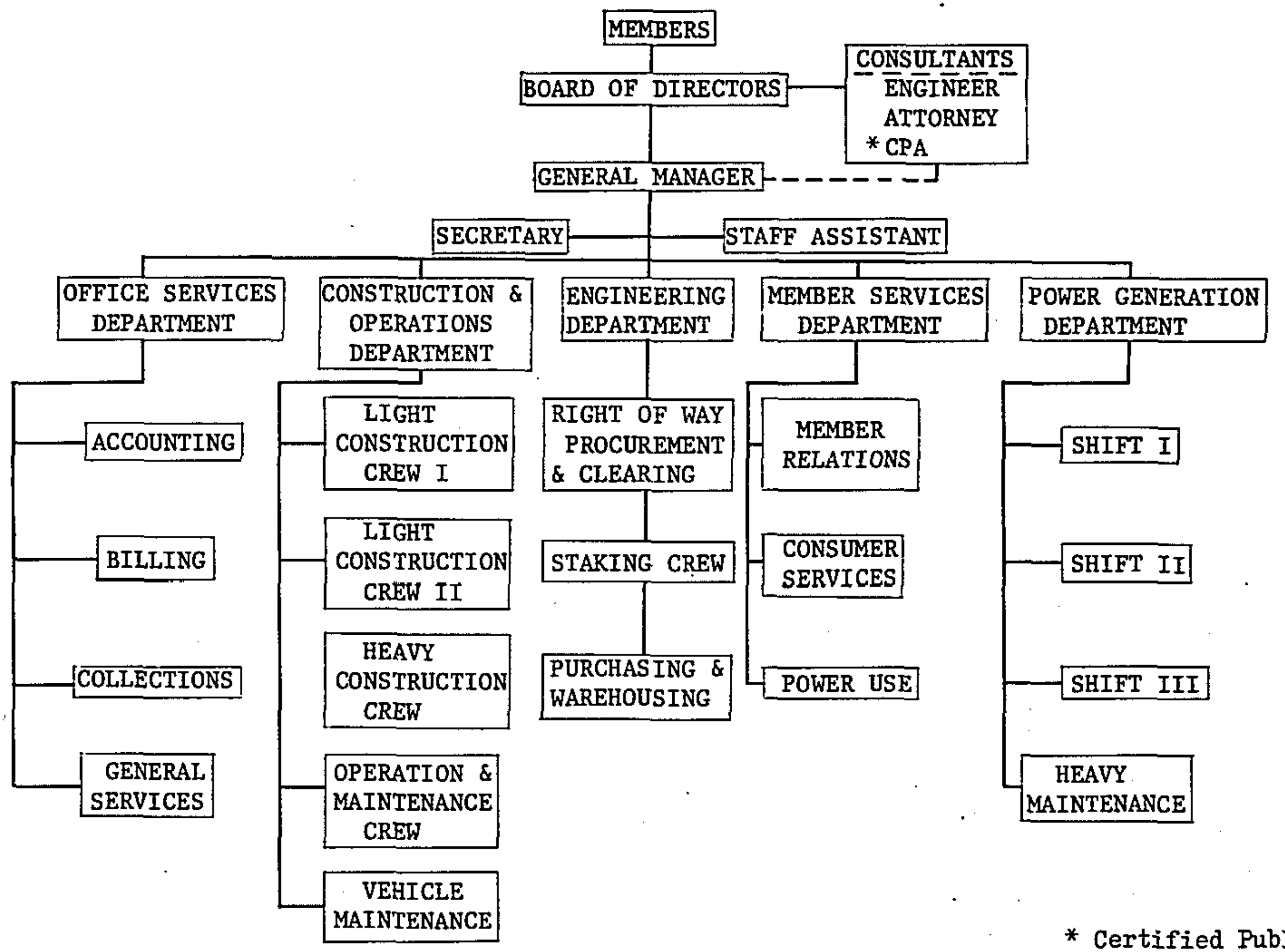
The rate of uncollected bills for the two COOP's in Region II is about 3%, which is considered reasonable.

Fig. 5-2 FLOW CHART

ELECTRIC COOPERATIVE PROJECT







* Certified Public Accountant

Source: Prepared by First Isabela Electric Cooperation Inc.

Fig. 5-3 Organization Chart of Electric Cooperative

Table 5-2 Example of Coop's power rate and cost

Region	Name of COOP	Rate in Mills/KWH (1/1000 Peso)				System loss	No. of houses	Sold MWH
		System rate	Power cost	Other Cash optg.	Gross marg.			
I	ILCOS NORTE	352	195	99	58	19	15,918	5,846
	BENGUET	241	172	14	55	18	17,148	68,612
	MT. PROVINCE	600	651	726	(777)	34	499	178
II	CAGELCO (6Mo.)	810	1,163	229	(581)	13	2,796	133
	ISELCO	893	814	209	(130)	10	4,251	1,637
III	NUEVA ECIJA I	378	215	90	75	28	21,578	13,314
IV	BATANGAS	300	146	82	72	13	12,903	7,750
	PALAWAN	955	755	94	106	17	1,584	1,269
V	CAMALINES SUR	584	621	160	(197)	10	3,217	1,073
X	MORESCO	141	39	79	23	10	8,659	7,388
		(Sold price)	(Wholesale price)	(COOP cost)	(Depr. cost)			

Note: Figures in parenthes represent deficit.

Table 5-3 Billing rate example, ISELCO and CAGELCO

		ISELCO I			CAGELCO I	
RESIDENTIAL	Minimum bill	1st	15 KWH	10.0 ₱		8.0 ₱
		Next	35	0.63 ₱/KWH	Over 15 KWH	0.77 ₱/KWH
		Next over		0.57 ₱/KWH		
COMMERCIAL	Medium	1st	30 KWH	20.0 ₱	1st 30 KWH	19.0 ₱
		Next	35	0.63 ₱/KWH	over	0.83 ₱/KWH
Industrial	Demand			13.5 ₱/KW		13.5 ₱/KW
	Watthour reading			0.55 ₱/KWH		0.73 ₱/KWH
PUBLIC BUILD.	Minimum bill		30 KWH	20.0 ₱	15 KWH	9.5 ₱
		Next	35 KWH	0.63 ₱/KWH	over	0.79 ₱/KWH
		over		0.57 ₱/KWH		
STREET LAMP	Vapor lamp			35.0 ₱/mo.		35.0 ₱/mo.

Table 5-4 Comparison of employee, ISELCO I and CAGELCO I

	ISELCO I	CAGELCO I
NO. OF EMPLOYEE	130	51
CONSTRUCTION	44	14
ENGINEER	15	9
AVERAGE PAYROLL	460 ₱	331 ₱..... Feb. 1977

5-3 Relationship between NEA and COOP

NEA is an organization which is responsible mainly for procurement and allocation of funds to COOP and is additionally responsible for purchasing of equipment and materials, supervision of administration, examination of customer charges and training of staffs of COOP, but is not an organization which actually sells power to the customers. Sales activities, and construction and maintenance of distribution lines are the responsibility of each COOP. The flow of main works between NEA and COOP including A & E and contractor is shown in Fig. 5-4.

The flow or works between the two organizations is as follows in the case of construction work.

When a COOP intends to carry out a construction work under the loan agreement with NEA, the COOP applies to NEA for allocation of funds every half year and at the same time concludes a service contract with A & E. Upon completion of engineering by A & E, the COOP request NEA for delivery of the necessary equipment and materials. Upon receipt of this request, NEA delivers materials which have already been purchased from the manufacturers. The COOP sends invitation to tender to contractors. Tenders are opened in the presence of NEA and A & E staff, a contractor is selected and a contract is signed with the successful contractor. During the construction, the work is inspected by NEA and supervised by A & E. Upon completion, the work is taken over by COOP in the presence of A & E and NEA staff.

As its experience in construction work widens, the COOP sometimes will carry out construction works in its own hand.

5-4 National Power Corporation (NPC)

The National Power Corporation (NPC) was established in 1936 as an organization responsible for the development of hydraulic power resources in the Philippines to realize stable power supply at low costs, which was essential for the development of economy and industry in the country. Later, the NPC was placed under the direct control of Presidential Office by Presidential Decree No. 380 as an organization responsible for planning, construction and operation of trunk transmission and substation systems and large hydro and thermal power plants in the Philippines. The organization chart of NPC is shown in Fig. 5-5. The top legislative organ of NPC is the Board of Directors, under which the General Manager and other department staff share the responsibility. The main departments include Administration Department, Accounting Department, Treasury Department, Engineering and Construction Department and Special Projects Group. Besides, each of the Luzon, Visaya and Mindanao Districts has a regional office which is actually engaged in construction, operation and maintenance of power facilities in each district.

Fig. 5-4 Flow Chart between NEA, COOP, A & E and CONTRACTOR

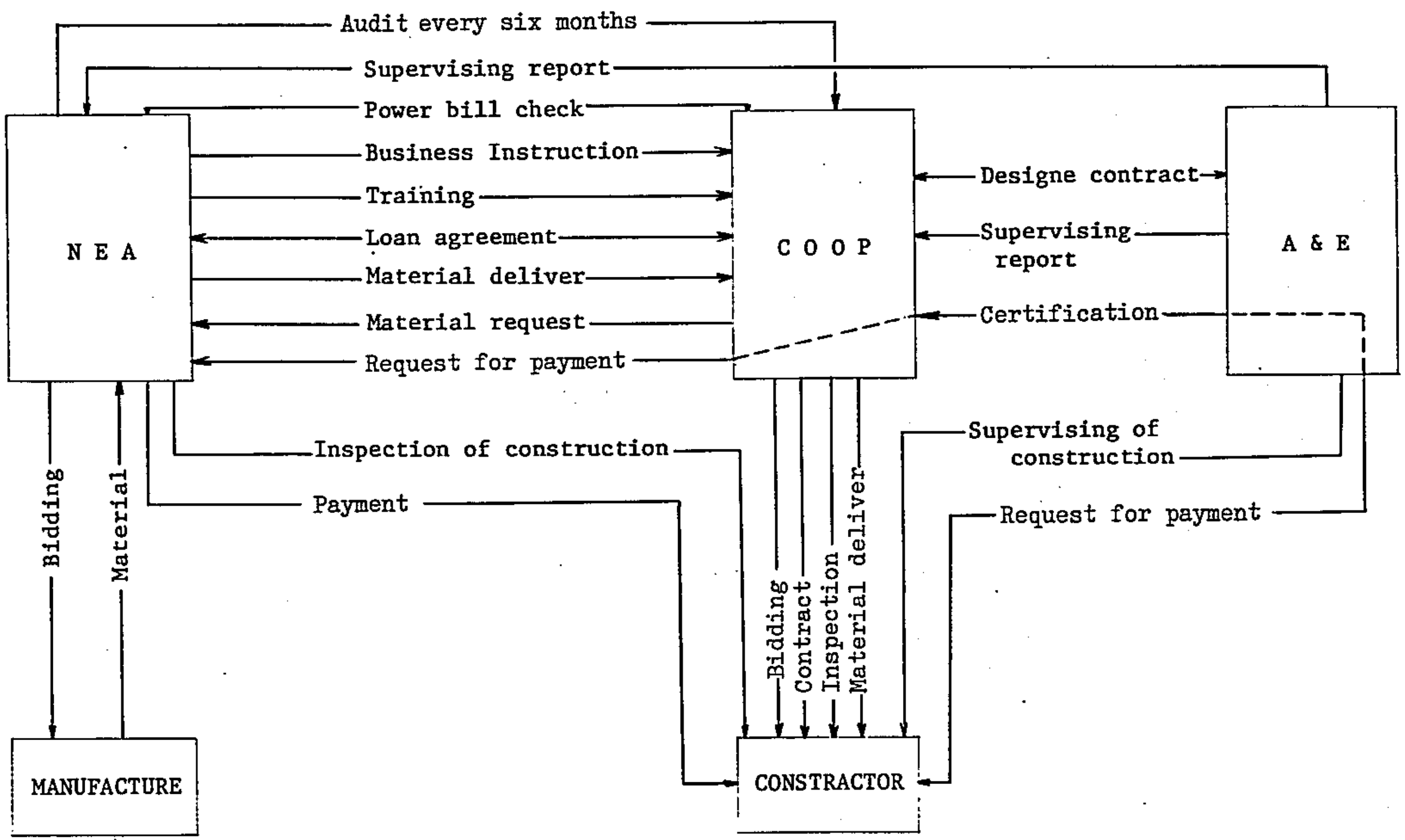
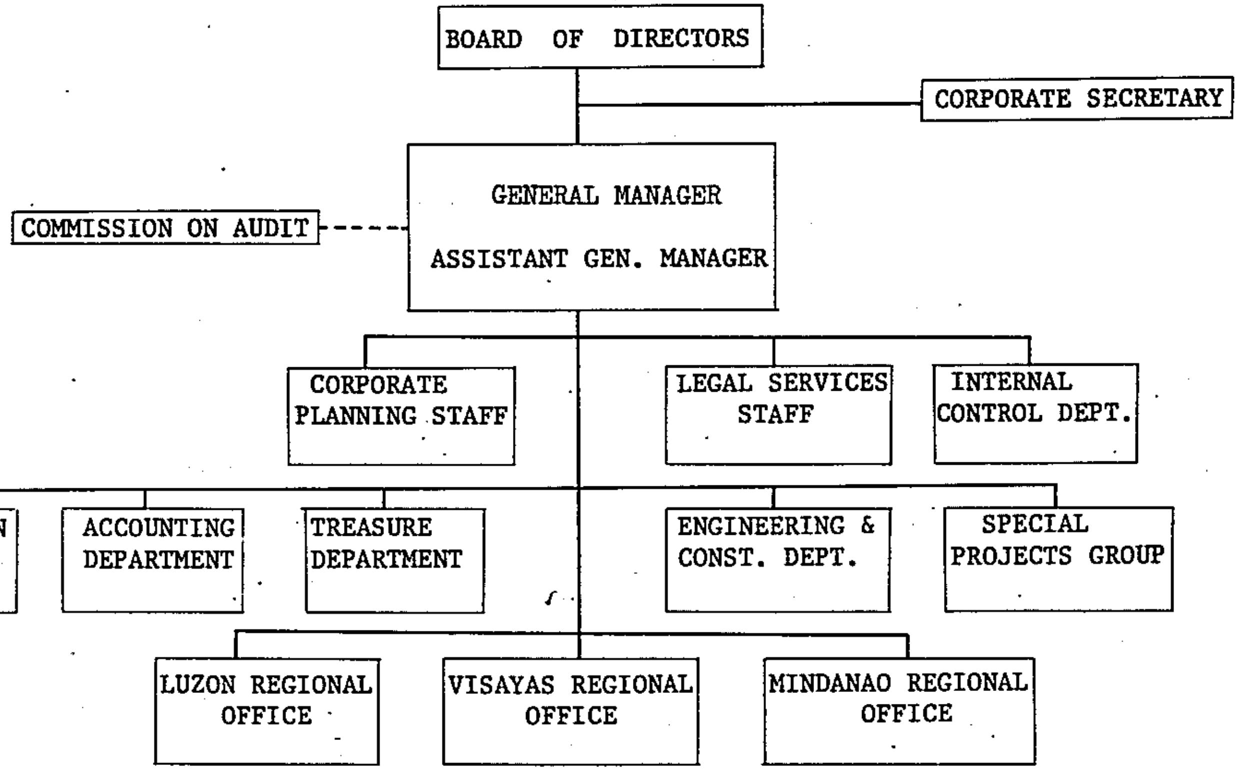


Fig. 5-5 NATIONAL POWER CORPORATION
ORGANIZATION CHART
(AS OF FEBRUARY 1977)



Chapter 6 Demand Forecast

Chapter 6. Demand Forecast

6-1 Areas to Be Electrified

The areas to be electrified by this Project are 6 provinces of Region II, excepting Batans Province. The outline of those provinces are tabulated in Table 6-1.

Table 6-1 Areas to Be Electrified by the Project

Province	Municipal	Barrio	Population (x 10^3)	Area (10^3 ha)	Population Density (persons/km^2)
Cagayan	28	757	638	900	70.9
Isabela (excl. Palanan)	33	1,024	*736	*1,066	*69.0
N. Vizcaya	14	195	211	395	53.4
Quirino	5	101	66	301	21.9
Kalinga Apayao	16	236	163	705	23.1
Ifugao	7	148	104	252	41.3
Paracelis (Mountain Province)	1	9	8		
Total	104		1,926	3,619 (excl. Paracelis)	53.0

*-Figures include Palanan

The electric power distribution in these areas will be carried out by 9 COOP's, among which 2 COOP's, ISELCO I and CAGELCO I are in operation as of January 1977. The COOP for N. Vizcaya is scheduled to be established by March 1977 and 6 other COOP's by the end of 1977.

It is noted that the administrative areas in Table 6-1 and the service areas of COOP's do not coinside exactly, because of the locations of the Municipals.

6-2. Forecast of Residential Power Demand

6-2-1. Method of Demand Forecast

For electric power demand forecast, the "Number of consumers-Unit consumption" method is adopted, and the forecast was made for the period of 6 years from 1980 to 1985 and the forecast for 1990 was also made.

The "Number of consumers-Unit consumption" method is a method of demand forecast generally adopted for areas where lighting demand is predominant among the categories of demands as the present Project area.

In this method, the population or the number of households is first estimated, and then number of consumers is obtained by multiplying the number of households by the estimated electrification rate. And on the other hand, the unit consumption, namely the KWH consumption per consumer is estimated, and the KWH demand is calculated by the multiplication of the number of consumers by the unit consumption.

And then the maximum KW demand is computed by the multiplication of the KWH demand by the estimated load factor.

6-2-2. Number of Households and Growth Rate

The numbers of households in COOP's are as given in Table 6-2. The total number of households in 9 COOP's was 325,689 in 1975 and the average size of family is 5.92 persons per family.

Since the number of households in each Town and Barrio in 1975 is known, the forecast of number of households was made based on those figures. The average size of family is assumed to remain constant because it is not considered to vary much during the forecasting period, and the rate of growth of number of households is considered to be the same as the rate of population growth.

According to the Socio-Economic Profile of Region II, the rates of population growth by Provinces are as shown in Table 6-3.

Table 6-2 Service Areas of COOP's

(As of 1975)

COOP	Service Area	No. of Municipals	No. of Households
CAGELCO I	South part of Cagayan Prov. (incl. Conner of Kalinga Apayao Prov.)	13	57,085
CAGELCO II	North part of Cagayan Prov.	16	55,015
ISELCO I	South part of Isabela Prov. (incl. Potia of Ifugao Prov.)	19	70,310
ISELCO II	North part of Isabela Prov. (excl. Palanan and incl. Paracelis of Mountain Prov.)	16	50,954
Kalinga-Apayao I	South part of Kal.-Apa. Prov.	9	17,661
Kalinga-Apayao II	North part of Kal.-Apa. Prov. (excl. Conner)	6	7,836
N. Vizcaya	N. Vizcaya Prov. (incl. Lamut of Ifugao Prov.)	15	37,848
Ifugao	Ifugao Prov. (excl. Potia and Lamut)	5	17,667
Quirino	Quirino Prov.	5	11,313
	Total	104	325,689

Table 6-3 Population Growth Rates by Provinces

	Population (10^3)			Average Annual Growth Rate (%)		
	1960	1970	1975	1960-1970	1970-1975	1960-1975
Cagayan	445.3	581.2	638.1	3.0	2.0	2.9
Ifugao	76.8	93.0	104.6	2.1	2.5	2.4
Isabela	442.1	648.1	735.9	4.7	2.7	4.4
Kalinga-Apayao	89.5	136.2	162.9	5.2	3.9	5.5
Nueva Vizcaya	113.8	172.2	211.3	5.1	4.5	5.7
Quirino	24.3	49.8	65.8	10.0	6.4	11.4
Batanes	10.3	11.4	11.8	1.0	0.8	1.0
Region II	1,202.1	1,691.4	1,930.7	4.1	2.8	4.0
Philippines	27,088.0	36,684.5	41,831.0	3.5	2.8	3.6

Based on the figures in the foregoing table, the rate of population growth (or rate of growth of number of households) was determined as follows.

COOP	CAGELCO I CAGELCO II	K.Apayao I K.Apayao II	Ifugao	Quirino	N. Vizcaya	ISELCO I ISELCO II
Growth rate of number of households (%)	1.9	3.3	2.0	4.5	3.2	2.2

The average growth rate over the whole project area is approximately 2.4%. This figure is an average figure of population growth rate in South-east Asia, and on the other hand, according to Table 6-3, the average growth rate in Region II is 4.1% over the period of 1960-1970 and 2.8% over the period of 1970-1975. Thus, in consideration of the decreasing tendency of population growth rate, the above figures are considered to be adequate figures.

In the Philippines, no effective countermeasure is taken against population increase, and if some countermeasure is taken, it would not affect the tendency very much during this forecasting period, and the above constant figures are adopted.

6-2-3. Electrification Rate

As stated in Section 7-1 Basic Plan of the Project of Chapter 7, the electrification will be carried out in steps. Namely, first the distribution trunk lines connecting all Towns will be completed and the Towns will be electrified by 1980. The electrification of Barrios will be carried out gradually, starting with those located near those trunk lines and all the Barrios will be connected by 1984, and then 100% electrification within the Region will be achieved by 1990. More precisely, the towns and barrios will be classified as follows in the promotion of electrification.

Town or Barrio	Class	Description	Electrification rate in starting year
Town	1st Class	Province Capitals and similar large Towns (Electrified in 1980)	65%
	2nd Class	Towns other than 1st class and 3rd class (Electfified in 1980)	45%
	3rd Class	Towns with small population or small population density such as in mountain areas, etc. (Electrified in 1980)	40%
Barrios	A	Barrious along distribution trunk lines connecting Towns, scheduled to be electrified in 1979.	40
	B	Ditto, scheduled to be electrified in 1980.	35
	C	Barrios relatively near to distribution trunk lines, scheduled to be electrified in 1981.	35
	D	Ditto, scheduled to be electrified in 1982.	35
	E	Barrios relatively far from distribution trunk lines, scheduled to be electrified in 1983.	30
	F	Ditto, scheduled to be electrified in 1984.	30

Table6-4 Electrification Class of Capital or Town

COOP.	No. of Town	Name of Town ( ) : № of Town		
		1st Class	2nd Class	3rd Class
CAGELCO I	13	(1) Tuguegarao	(12) Baggao, Alcala, Amulung, Iguig, Penablanca, Enile, Solana, Piat, Stanind, Tuao, Rizal, Connel	
CAGELO II	16	(3) Aparri, Lallo Claveria	(13) Sta Ana, Gonzaga, Sta Teresita, Buguei, Camalamuigan, Gattaran, Lasam, Alacapan, Baresteros, Abulug, Pamplona, Sanchegmira, Sta Praxedes	
ISELCO I	19	(5) Cauayan, Alicia, Echangue, Santiago, San Mateo	(11) San Mariano, Naguilian, Reina Marcedes, Angadanan, Jones, San Augustin, Cordon, Ramon, San Isidoro, Luna, Cabatuan	(3) San Guilimo, Potia, Bentosolven
ISELCO II	16	(2) Ilagan, Roxas	(13) Sn Pablo, Cabagan, Tumauini, Sta Maria, Sto. Tomas, Magsaysay, Gamu, Quezon Mallig, Quirino, Burugos, San Manuel, Aurora	(1) Paraceris
K.APAYAO I	9	(1) Tabuk	———	(8) Rizal, Pinkpuk, Quirino, Balbalan, Lubagan, Pasil, Inglayan, Tanudan
K.APAYAO II	6	———	———	(6) Luna, Sta Manlera, Flora, Pudtal, Kabugao, Calanasan
N.VISCAYA	15	(3) Solano, Bayombong, Bambang,	(9) Diadi, Baggabag, Villaverde, Quezon, Dupax-N, Dupax-S, Alitao, Santa-Fe, Lamut	(3) Kayapa, Kasibu, Ambuguio
IFUGAO	5	(1) Lagawei	———	(4) Mayayao, Banawei, Hungdan, Kiangan
QUIRINO	5	———	———	(5) Diffun, Sagudi, Agripay, Cabarroguis, Maddela
TOTAL	104	16	58	30

The electrification rates for the starting years are determined as shown in the foregoing table, and it is estimated that the electrification rate will be raised by 5% annually, and the rate will reach 100% in 1990 all over the region.

Table 6-4 shows the classification of Towns into 1st, 2nd and 3rd classes.

The electrification rates at the end of years are given in Table 6-5.

Table 6-5 Electrification Rates by Years

		Dec. 1980	Dec. 1981	Dec. 1982	Dec. 1983	Dec. 1984	Dec. 1985	1990
Town	1st Class	65%	70%	75%	80%	85%	90%	100%
	2nd Class	45	50	55	60	65	70	100
	3rd Class	40	45	50	55	60	65	100
Barrio	A (1979)	40	45	50	55	60	65	100
	B (1980)	35	40	45	50	55	60	100
	C (1981)	--	35	40	45	50	55	100
	D (1982)	--		35	40	45	50	100
	E (1983)	--			30	35	40	100
	F (1984)	--				30	35	100

Note: For the Towns or Barrios already electrified, the electrification rate by the foregoing table was applied to the number of households not yet electrified, and the number of households to be electrified was obtained.

The above classification of Barrios were made with reference to the 1/50,000 scale maps, and the numbers of households by Municipals and by classes (A, B, C .... E and F) were calculated based on the figures in 1975.

6-2-4. Unit Consumption

In the project area, the Towns and Barrios are mostly scattered over wide plains, and the Towns do not take the form of large cities, and there is not much difference in the levels of living between Towns and Barrios, as seen in Table 6-7. And further, since this demand forecast is made to serve for the preparation of distribution program for those scattered loads, it is sufficient to use common unit consumptions for Towns and Barrios.

The yearly estimated unit consumption is tabulated in the following Table 6-6.

Table 6-6 Unit Consumption by Years

KWH/consumer/month

year	1980	1981	1982	1983	1984	1985	1990
Unit Consumption	40	45	51	58	68	76	100

The basis of the estimation is explained in the following.

(1) Distribution of Classes of Residences

In 1973, NEA classified the residences in Region II into Class X (relatively large residences), Class Y (medium sized residences) and Class Z (small residences), and made survey of the number of residences by the classification. Table 6-7 shows random excerpt from the survey.

Table 6-7 Number of Residenses by Classes

	Name of Town or Barrio	X	Y	Z	Total	Remarks
Town	San Manuel	7	133	644	784	
	Cabagan	85	201	431	717	
	St Tomas	15	43	249	307	
	Cauayan	43	332	398	773	
	Luna	22	68	152	242	
	Alicia	76	249	417	742	
	Echague	34	233	520	787	
	Jones	58	179	344	581	
	Santiago	189	711	697	1,597	
	San Mateo	38	264	778	1,080	
	Total	567	2,413	4,630	7,610	
	(%)	(7.5)	(31.7)	(60.8)	(100)	
Barrio	Harana	7	28	82	117	Near Cauayan
	Bani	2	40	82	124	Near Angadanan
	Loria	--	45	145	190	Near Echegue
	Nangartugut	58	179	344	581	Near Jones
	Napaliong	--	76	150	226	Near San Agstin
	Ozariz	12	50	176	238	Near Ramon
	Rizal Centro	7	103	478	588	Neas Sntiago
	Sanjose	--	2	66	68	Near Santiago
	Bagong Tanza	2	45	172	219	Near Aurora
	Total	88	568	1,695	2,351	
	(%)	(3.8)	(24.2)	(72.0)	(100)	

Based on the foregoing table and in consideration of the improving trends of the residences as described in Section 4-13 of Chapter 4, the class-distribution of residences is assumed as follows.

Table 6-8 Class-Distribution of Residences

(%)

Year / Class	1979		1982		1984		1990	
	Town	Barrio	Town	Barrio	Town	Barrio	Town	Barrio
Class X	8	4	10	6	12	8	18	10
Class Y	32	25	35	30	40	35	55	40
Class Z	60	71	55	64	48	57	27	50

(2) Unit Consumption by Classes of Residences

The unit consumption by residence classes is assumed as shown in the following Table 6-9.

Table 6-9 Unit Consumption by Residence Classes

(KWH/month)

Year / Class	1980	1982	1984	1990
Class X	70	95	120	180
Class Y	50	65	80	120
Class Z	32	40	50	70

Note: 1. Unit consumptions for Class X, Class Y and Class Z are expressed by W_X, W_Y and W_Z, respectively.

2. Unit consumptions for Class Z of 32 KWH/m in 1980 and 50 KWH/m in 1984 are considered adequate, judging from the actual figure in 1975 of 40 KWH/m for Town and 24 KWH/m for Barrio in MORESCO where the living standard is lower than in the Project Area.

(3) Method of Obtaining Overall Unit Consumption for Town and Barrio

Percentage distribution of X, Y and Z is expressed by α , β and γ and Town and Barrio are expressed with suffixes T and B.

The overall unit consumption for Town and Barrio is obtained by the following formula.

$$\left\{(W_X \cdot \alpha_T + W_Y \beta_T + W_Z \gamma_T) + (W_X \alpha_B + W_Y \beta_B + W_Z \gamma_B) \times m\right\} / (1 + m)$$

where W: Unit consumption KWH/month

m: Ratio of the number of electrified households of Barrios to that of Towns. According to Table 6-14-1, m for overall Region II is 100% in 1980, 200% in 1982, 300% in 1984 and 500% in 1990, but as there are provinces where the m-value is smaller, the m-values of 50% in 1980, 150% in 1982, 200% in 1984 and 500% in 1990 were assumed.

The calculation by the above formula resulted the overall unit consumption of 40 KWH in 1980, 51 KWH in 1982, 68 KWH in 1984 and 100 KWH in 1990, and the unit consumptions for the other years were obtained by the curve of the foregoing values.

6-2-5. Load Factor

Since the residential demands are mostly lighting demand in the initial years of electrification and all the consumers are meter-rate lighting consumers, the load factor is low. The load factor was estimated at 33% in 1979.

In the future, it is expected that the use of electric fans, TV, refrigerators, etc. will become more popular, and as the living standard rises, more use of air conditioners and water heaters is expected. The load factor will be improved gradually and is assumed to reach 39% in 1984. The estimated load factor values by years are as shown in the following.

Year	1980	1981	1982	1983	1984	1985	1990
Load factor %	34	35.5	37	38	39	40	41

6-3 Forecast of General Power Demand

6-3-1 Irrigation Power Demand

The irrigation projects are described in Section 4-4 of Chapter 4, and the irrigation power demands can be classified into the large pumping stations under direct control of NIA, the medium-scale irrigation called BISA and the small-scale irrigation. The large pumping stations under NIA were planned from the beginning to use electric power, but the electrification of power for the other irrigation schemes have not been decided. The power demand for irrigation was estimated as follows.

(1) Power for Large-scale Irrigation under NIA

a. Cagayan Integrated Agricultural Development Pumping Stations

Iguig (225 KW) and Alcala-Amulung (750 KW) in CAGELCO I Area

Lower Cagayan (4,800 KW) in CAGELCO II Area

Total of 5,775 KW

Start of operation is scheduled for 1980 and the operating hours are expected to be 4,000 hours/years. (Annual load factor: 46%)

b. Solano Pumping Stations

One each of 1,500 KW and 500 KW pumping stations or a total of 2,000 KW in CAGELCO I area.

Start of operation is scheduled for 1980 and the operating hours are expected to be 2,100 hours/year. (Annual load factor: 24%)

The above pumping stations will be operated at full load 24 hours daily during the irrigating period, and therefore, the above planned power was taken as the maximum power demand and the KWH corresponding to the planned operating hours was taken as the KWH demand.

(2) Other Irrigation Power Demand

a. BISA

There are 11 BISA's for approximately 1,000 ha of irrigated area in Cagayan Province, 22 BISA's for approximately 2,600 ha of irrigated area in Isabela Province, and their pumping power is mostly between 50 HP and 100 HP (37 ~ 75 KW). The above figure include some pumps now under construction. As for the future plan, 550 ha in Cagayan Province has been decided, but there are no other decided plans.

b. Other small-scale Irrigation

There are small-scale irrigation with diesel pumps by individual farmers or jointly by several farmers under financial aid from NIA. Pumps of 7.5 HP capacity are used in most cases.

The existing number of units and future plan are as tabulated below.

Province	Existing (Unit)	Planned (per year) (Units)
Cagayan	500	100
Isabela	1,800	200
K. Apayao	279	27
Ifugao	98	15
Quirino	60	20
N. Vizcaya	100	30
Total	2,837	392

c. Demand Forecast

As for BISA demand, since the distribution of BISA by municipals is known, it is assumed that 70% of the number of BISA's will be electrified by 1980 and 100% by 1984. The details are shown in Table 6-16-1.

As for other small-scale irrigation, since the locations are not known, it was assumed that they are distributed uniformly in Municipals, and the progress of electrification will be 10% in 1980 and increase by 5% each year until 1985, and reach 50% in 1990. The details are shown in Table 6-16-2.

As for the operating hours, the areas are divided roughly into two types, one type of area where 24-hour continuous operation is made for approximately 100 days annually, and another type of area where 10-hour operation is continued for about 150 days annually. Therefore, the operating hours of 1,800 hours is assumed on an average.

6-3-2 Rice Mill Power

As the project area is a granary area, there are many rice mills all over the area. The number of rice mills was 1,400 in 1972, but as there are very small mills in some of the provinces, the number of rice mills are assumed as follows based on an assumed 20 kW average capacity basis.

Province	N. Vizcaya	Ifugao	Quirino	ISELCO I	ISELCO II	CAGELCO I	CAGELCO II	K. Apayao I	K. Apayao II
No. of Mills	105	26	24	232	166	123	119	40	15

In the provinces where the latent demand distribution by Municipals is known, such demand values are adopted, and where such distribution is not known, the latent demands are computed by dividing the above numbers of rice mills proportionally to the cultivated areas.

It is assumed that 30% of the rice mills will be electrified by 1980 and the remaining 70% by 1985.

Based on the result of survey in Isabela Province, the operating hours are assumed to be 8 hours per day and 25 days per month. The demand is estimated to increase by 10% from 1985 through 1990.

6-4 Public and Other Demands

As the public demand and other demand, the following demands are counted.

(1) Public offices, stores, hospitals, street lighting, etc.

(2) Saw mills

There were 64 saw mills in 1972 in the Project area, and their average power was 80 HP (60 KW).

(3) Other small power

In the Project area, there were 398 small factories in 1972, such as repair shops, carpentry shops, welding shops, etc., and the average power requirement was 5 KW.

The distribution of these public and other power demands differ by areas and data for estimation of such demand were not available during the present survey. Therefore, 10% of the total of residential demand and rice mill demand is assumed for this category of demand. And on the assumption that the increase of this demand will come to be limited after 1985, 95% of thus computed value is adopted as demand in 1985 and 48% in 1990.

6-5 Large Industrial Demand

There are the following large industries in operation or under construction, and their electric power demands are estimated as follows.

(1) Tropical Plywood Factory (Near Magapit in Cagayan Prov. - CAGELCO II)

The electric power requirement of 2,500 KW is now supplied by its own 2,500 KW diesel power plant. The operation is 16 hours per day and 25 days per month. An expansion of factory requiring another 2,500 KW is planned in 1985 and since the factory desires to stop the operation of the diesel generator when they can receive electric power from the system, 2,500 KW demand is expected in 1980 and 5,000 KW in 1985.

(2) Piat Sugar Refinery (Near Piat in Cagayan Prov. - CAGELCO I)

The facilities of the refinery have been nearly completed as of February 1977 with a 5,000 KW steam power plant and a 1,500 KW diesel generator. The steam power plant will be operated from December through March each year when the crude sugar is produced, and the refinery desires to buy electric power during the rest of the period of the year when the sugar is refined. Therefore, 1,500 KW demand is estimated from 1980 on. And since operation will be 24-hour operation by 3 shifts, 90% of load factor is estimated during the power receiving period.

(3) Magat Dam Construction Power (Ifugao Prov. - ISELCO I)

The 1st stage construction of 360 MW of the Magat Power Plant will require a maximum construction power of 2,000 KW. Therefore, maximum power of 2,000 KW at 60% load factor is estimated in 1980 through 1982.

(4) Port Airen Loading & Unloading Facilities
(East of Gonzaga in Cagayan Prov. - CAGELCO II)

This port was built as an international port, and 10,000 ton class vessels can be accommodated. A national road to the port is now under construction and when this road is completed, this port will become a major port in north Luzon. Maximum power of 500 KW at 20% load factor is estimated from 1980 on.

(5) Claveria Saw Mill (Near Claveria in Cagayan Prov. - CAGELCO II)

This is a large saw mill with a 5,000 KW steam power plant and a 300 KW diesel generating unit. The saw mill has its own port, from where most of the products are exported. The 5,000 KW steam power plant fires the sawdust and scraps from the mills and will be operated into the future. Therefore, maximum power of 200 KW at 70% load factor, corresponding to the diesel generator load, is counted in the demand forecast from 1980 on.

(6) Lal-lo Saw Mill (Near Aparri in Cagayan Prov. - CAGELCO II)

The saw mill has a 200 KW diesel generator, but desires to receive 200 KW from the system from 1980.

(7) There are plans of cement factory and mining development near Ilagan, but the plan is not yet definite. Therefore, their demands are not counted in the present demand forecast.

Table 6-17-2 shows the yearly demand by the above-mentioned large industries.

6-6. Results of Demand Forecast

6-6-1. Residential Demand

The results of the residential demand forecast for each COOP are shown in Table 6-14-2 through Table 6-14-10, and the total in Table 6-14-1.

The results are summarized as follows.

(1) Electrification rate

The increases of residential electrification rates by COOP's are shown in Table 6-10. The residential electrification rate will be about 20% in 1980, about 35% in 1982 and about 50% in 1984. The electrification rate is highest in N. Vizcaya Province, namely 26.5% in 1980 and 40.6% in 1982, and the rate is lowest in Ifugao, with 9.8% in 1980 and 23.7% in 1982.

(2) Maximum power and annual energy demand

The forecast of the maximum power demand and the annual energy demand are shown in Table 6-11.

The total of the maximum power demands will be 11,076 KW in 1980, 24,740 KW in 1982 and 48,729 KW in 1984, namely the maximum power demand will be doubled every 2 years.

6-6-2. Total Demand (including industrial and other demands)

(1) Maximum power demand at substation sending end

The maximum power demand at the substation sending end by COOP's is shown in Table 6-12-1, that by demand categories is shown in Table 16-12-2, and that by substations is shown in Table 6-12-3. The distribution loss is estimated at 10% based on the calculation with the model system.

The maximum power demand at the substation sending end will be 42 MW in 1980, 69 MW in 1982 and 106 MW in 1984.

As for the maximum power demand by COOP's, the demand in CAGELCO II which has large irrigation pumps and large industries is the largest of all COOP's and will be 13 MW in 1980, 17MW in 1982 and 23MW in 1984.

Table 6-10 Electrification Rate by Year in Region II

COOP	1980			1982			1984		
	No. of electrified households	Electrification rates	Total No. of households	No. of electrified households	Electrification rates	Total No. of households	No. of electrified households	Electrification rates	Total No. of households
N. VIZCAYA	11,743	26.5	44,320	19,164	40.6	47,196	27,782	55.3	50,262
IFUGAO	1,905	9.8	19,504	4,813	23.7	20,229	9,280	44.0	21,112
QUIRINO	2,097	14.9	14,096	4,678	30.4	15,397	7,943	47.2	16,811
ISELCO I	15,577	19.9	78,396	28,284	34.5	81,911	43,420	50.8	85,497
ISELCO II	10,813	19.0	56,814	20,535	34.6	59,361	31,309	50.5	61,960
CAGELCO I	9,790	15.6	62,736	21,242	32.6	65,134	33,010	48.8	67,646
CAGELCO II	10,996	18.2	60,461	20,533	32.7	62,772	32,057	49.2	65,193
K. APAYAO I	3,643	17.5	20,769	7,187	32.4	22,165	11,581	49.0	23,649
K. APAYAO II	1,218	13.2	9,215	2,791	28.4	9,834	4,835	46.1	10,492
Total	67,782	18.5	366,311	129,227	33.6	384,069	201,217	50.0	402,622

Note: 9,368 households already electrified by ISELCO I and CAGELCO I as of end of 1976 are included.

Table 6-11 Power Demand and Annual Power Consumption by COOP, by Years

Receiving End (for Residential)

Year / Item / COOP	1980		1982		1984	
	Max. power kW	Annual MWH	Max. power kW	Annual MWH	Max. power kW	Annual MWH
N. VIZCAYA	1,919	5,637	3,669	11,728	6,728	22,670
IFUGAO	311	914	921	2,946	2,247	7,572
QUIRINO	343	1,007	896	2,863	1,924	6,481
ISELCO I	2,545	7,477	5,415	17,310	10,515	35,431
ISELCO II	1,767	5,190	3,931	12,567	7,582	25,548
CAGELCO I	1,600	4,699	4,067	13,000	7,994	26,936
CAGELCO II	1,797	5,278	3,931	12,566	7,763	26,159
K. APAYAO I	595	1,749	1,376	4,398	2,805	9,450
K. APAYAO II	199	585	534	1,708	1,171	3,945
Total	11,076	32,536	24,740	79,086	48,729	164,192

The demand in ISELCO I is similar to that in CAGELCO II, but will be a little larger in 1984. The smallest demand occurs in K. APAYAO II, the demand being 0.4 MW in 1980, 1.0 MW in 1982 and 2.0 MW in 1984. In 1984, the total of demands in ISELCO I and II and CAGELCO I and II will account for 77% of the total demand.

As for the maximum power demand by demand categories, the residential demand will be 11 MW (29.1%) in 1980, 25 MW (39.7%) in 1982 and 49 MW (50.4%) in 1984, and the percentage of the residential demand in the total power demand increases year after year. The irrigation demand will be 13 MW (35%) in 1980, 17 MW (27.8%) in 1982 and 22 MW (22.9%) in 1984.

The transformer utility factor will reach 49% in 1982, and if the 10 substations remain as they are, the utility factor will become 59.7% in 1983. On the overall, it looks that there still will be good margin of transformer capacities, but individually Solano, Cauayan and Ilagan Substations will suffer capacity shortages. Therefore, Ifugao Substation (10,000 KVA) and Roxas Substation (15,000 KVA) will be added in 1983 and Echague Substation (15,000 KVA) in 1984 as the 2nd Stage of the project, and will relieve a part of the load from Solano, Cauayan and Ilagan Substations, respectively.

The typical daily load curve in the irrigation period in 1982 is shown in Fig. 6-1.

(2) Energy demand

The energy demand forecas is shown in Table 6-13.

The decrease of industry demand in 1983 and 1984 is the result of completion of the Magat Dam construction works, and the increase in 1985 is due to increase of demand by Tropical Plywood Factory.

Since demand by new industries is not considered in the energy demand forecast, the demand in and after 1983 is on the lower side, and the weight of residential demand increases year after year, or 32,536 MWH (27.8%) in 1980, 79,086 MWH (41.2%) in 1982 and 164,192 MWH (54.6%) in 1984.

On the other hand, the weight of the irrigation demand decreases year after year, namely 37,265 MWH (31.8%) in 1980, 44,443 MWH (23.2%) in 1982 and 53,090 MWH in 1984.

Basis of Load Curve Preparation

Residential:	Average 9,151 KW, Max. 24,740 KW, load factor 37%.
Rice mill:	Peak operation 10 hours, starting-up 1 hour each in the morning and in the afternoon, lighting only in midnight and noon recess hours.
Public & Others:	Street lighting: 12 hours at night with 3,770 lamps. Public: 140 KW for 9 hours for public offices in the day time, 200 KW for 5 hours for schools and public halls in the evening. Security lighting only in midnight hours. Others: Stores and small industries 2,580 1,300 KW, variable, for 15 hours, and security lighting only in midnight hours.
Irrigation:	BISA: 10 hours in night hours only. Private: 24 hours full operation. Solana and Tuguegorao (NIA): 24 hours continuous operation. Magapit Pump Station: Full operation for 10 hours in low tide hours. 2 other pump stations in Lower Cagayan: 24 hours full operation.
Large Industries:	Sugar mills: 24 hours operation, load reduced to 1,350 KW at shift change time. Wood factories: 10 hours full operation and security lighting only midnight hours. Magat hydro const. power: 11 hours full operation in daytime hours, reduced to 600 1,000 KW at noon recess and other hours, and 400 KW of security power and lighting in midnight hours. Plywood: 16 hours operation and security power and lighting only in midnight hours.

Note: Noon recess is assumed to be 2 3 hours.

Fig. 6-1 Typical Daily Load Curve in Region II
Dry Season (JAN - JUN) 1982

Load factor 50.9%
(without Irrigation 39.7%)

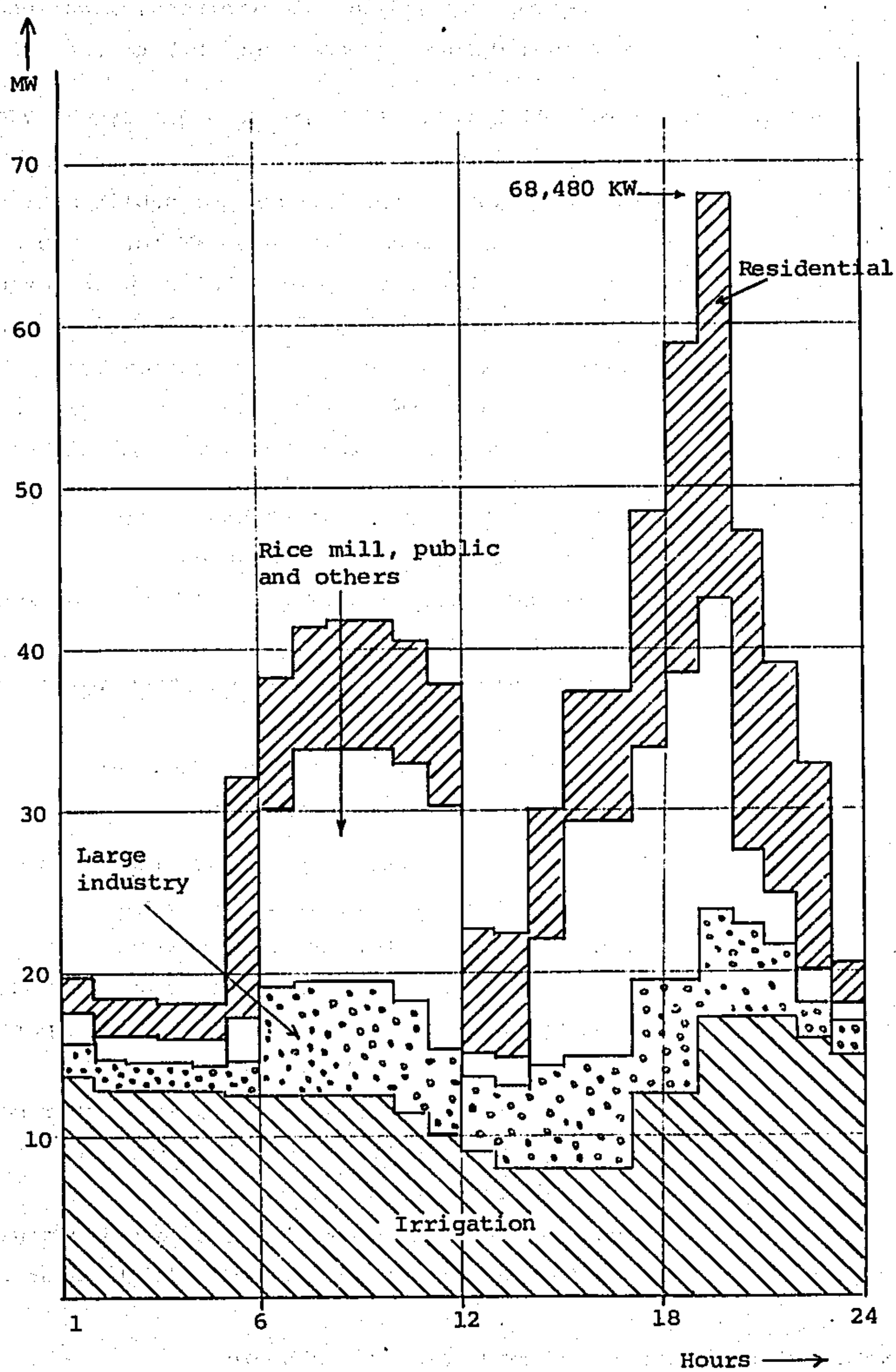


Table 6-12-1 COOP's Maximum Power Demand, at Substation Sending End (KW)

	1980	1981	1982	1983	1984	1985	1990
N. VIZCAYA	3,189	4,646	6,434	8,565	11,409	13,621	28,227
IFUGAO	645	1,102	1,670	2,477	3,595	4,390	10,678
QUIRINO	656	1,069	1,596	2,253	3,158	3,907	9,939
ISELCO I	9,705	12,739	16,330	18,310	23,689	27,775	53,648
ISELCO II	5,080	7,291	9,911	12,891	16,718	19,813	38,878
CAGELCO I	8,455	10,352	12,693	15,298	18,784	21,479	40,476
CAGELCO II	12,518	14,230	16,313	18,864	22,276	27,679	46,047
K. APAYAO I	1,145	1,768	2,534	3,478	4,748	5,790	13,313
K. APAYAO II	414	677	1,004	1,418	1,980	2,426	5,880
TOTAL	41,807	53,874	68,485	83,554	106,357	126,880	247,086

Table 6-12-2 Maximum Power Demand at Substation Sending End, by Year

(For User Category) (KW)

Item		1980	1981	1982	1983	1984	1985	1990
Residencial		11,076	16,966	24,740	34,550	48,729	59,681	157,379
Ricemill		5,100	7,480	9,860	12,240	14,620	17,000	18,700
Public and Others		1,619	2,444	3,460	4,680	6,335	7,286	8,452
Irrigation	BISA	3,529	4,107	4,727	5,325	5,956	5,956	6,849
	Private	2,007	3,304	4,797	6,487	8,372	10,248	18,068
	NIA	7,775	7,775	7,775	7,775	7,775	7,775	7,775
	Subtotal	13,311	15,186	17,299	19,587	22,103	23,979	32,692
Large Industry		6,900	6,900	6,900	4,900	4,900	7,400	7,400
Loss		3,801	4,898	6,226	7,597	9,670	11,534	22,463
Total		41,807	53,874	68,485	83,554	106,357	126,880	247,086

Table 6-12-3 Substation's Maximum Power Demand (KW), by Year

Substation	Capacity (KVA)	1980 (KW)	1981 (KW)	1982 (KW)	1983 (KW)	1984 (KW)	1985 (KW)
Solano SS (4)	15,000	3,834	5,748	8,104	11,042	15,004	18,011
Santiago SS (4)	15,000	6,931	8,887	11,233	11,924	15,647	18,474
Cauayan SS (3)	10,000	3,430	4,921	6,693	8,639	11,200	13,208
Ilagan SS (4)	15,000	5,080	7,291	9,911	12,891	16,718	19,813
Tuguegarao SS (4)	15,000	5,793	6,610	8,122	9,740	11,750	13,425
Piat SS (2)	15,000	2,662	3,742	4,571	5,558	7,034	8,054
Tabuk SS (2)	10,000	1,145	1,768	2,534	3,478	4,748	5,790
Camalaniugan SS (4)	15,000	2,398	3,225	4,158	5,351	7,169	8,057
Abulug SS (3)	15,000	2,096	3,068	4,131	5,395	7,045	8,449
Magapit SS (3)	15,000	8,438	8,614	9,028	9,536	10,042	13,599
Total Load 10 SS		41,807	53,874	68,485	83,554	106,357	126,880
Total Capacity 10 SS		140,000	140,000	140,000	165,000	180,000	180,000
Total Load/Total Capacity (%)		30	38	49	51	59	70

Number of Substations: NPC Project 6, NEA Project 4 Number of total feeders: 34
( ): Number of feeders
New construction of Substation at 2nd Stage: 1983 - Ifugao (10,000 KVA), Raxas (15,000 KVA)
1984 - Echague (15,000 KVA)

Table 6-13 Energy Demand Forecast

Unit: MWH

	1980	1981	1982	1983	1984	1985	1990
Residential	32,536	52,036	79,086	113,433	164,192	206,262	557,495
Rice mill	12,240	17,952	23,664	29,376	35,088	40,800	44,800
Others	6,994	10,558	14,947	20,218	27,367	31,476	36,513
Irrigation BISA, Private	9,965	13,340	17,143	21,262	25,790	29,167	44,851
Irrigation large (NIA)	27,300	27,300	27,300	27,300	27,300	27,300	27,300
Irrigation Subtotal	37,265	40,640	44,443	48,562	53,090	56,467	72,151
Industry	28,080	29,808	29,808	21,168	21,168	31,968	31,968
Total	117,115	150,994	191,948	232,757	300,905	366,973	743,007

Table 6-14-1 Residential Demand Total

				1975 (a)	1980	1981	1982	1983	1984	1985	1990
Grand House holds				325,689	366,311	374,538	384,069	393,248	402,622	412,280	464,579
Potential Households	Town		1st (A)	21,133	23,924	24,518	25,147	25,776	26,423	27,088	30,707
			2nd (B)	23,108	25,781	26,348	26,940	27,535	28,144	28,765	32,116
			3rd (C)	6,832	8,059	8,331	8,615	8,909	9,211	9,529	11,284
			Subtotal	51,073	57,764	59,197	60,702	62,220	63,778	65,382	74,107
	Barrio		A	40,135	45,104	46,166	47,274	48,396	49,539	50,720	57,094
			B	40,022	44,948	46,037	47,141	48,260	49,400	50,576	56,935
			C	49,504		56,914	58,276	59,655	61,062	62,511	70,350
			D	49,456			58,222	59,595	61,001	62,447	70,282
			E	47,768				57,582	58,942	60,346	67,930
			F	47,731					58,900	60,298	67,881
			Subtotal	274,616	90,052	149,117	210,913	273,488	338,844	346,898	390,472
	total (P)			325,689	147,816	208,314	271,615	335,708	402,622	412,280	464,579
planned to serve Households	with electricity	Town	1st (A)		7,591	7,591	7,591	7,591	7,591	7,591	7,591
			2nd (B)		1,777	1,777	1,777	1,777	1,777	1,777	1,777
			Subtotal		9,368	9,368	9,368	9,368	9,368	9,368	9,368
	Connecting Households	Town	1st (A)		10,616	11,849	13,167	14,547	16,007	17,548	23,116
			2nd (B)		10,802	12,287	13,841	15,455	17,138	18,890	30,339
			3rd (C)		3,224	3,750	4,309	4,901	5,525	6,194	11,284
			Subtotal		24,642	27,886	31,317	34,903	38,670	42,632	64,739
		Barrio	A		18,041	20,774	23,638	26,618	29,725	32,969	57,094
			B		15,731	18,415	21,214	24,133	27,170	30,345	56,935
			C			19,922	23,311	26,843	30,534	34,380	70,350
			D				20,379	23,838	27,450	31,226	70,282
			E					17,276	20,630	24,138	67,930
			F						17,670	21,106	67,881
			Subtotal		33,772	59,111	88,542	118,708	153,179	174,164	390,472
		total(Connecting)			58,414	86,997	119,859	153,611	191,849	216,796	455,211
	Grandtotal (Q)				67,782	96,365	129,227	162,979	201,217	226,164	464,579
Elec-ratio % (Q/P×100)					18.5	25.7	33.6	41.4	50.0	54.9	100
Unit Consumption	KWH/mo				40	45	51	58	68	76	100
Annual	MWH				32,536	52,036	79,086	113,433	164,192	206,262	557,495
Load factor	%				34	35.5	37	38	39	40	41
Demand	KW				11,076	16,966	24,740	34,550	48,729	59,681	157,379

Table 6-14-2 Residential Demand N. VIZCAYA

				1975 (a)	1980	1981	1982	1983	1984	1985	1990
Grand House holds				37,848	44,320	45,720	47,196	48,710	50,262	51,852	60,708
Potential Households	Town		1st (A)	6,612	7,743	7,987	8,245	8,510	8,780	9,058	10,606
			2nd (B)	3,078	3,604	3,718	3,838	3,961	4,088	4,217	4,937
			3rd (C)	326	382	394	406	420	433	447	523
			Subtotal	10,016	11,729	12,099	12,489	12,891	13,301	13,722	16,066
	Barrio		A	4,434	5,192	5,356	5,529	5,707	5,888	6,075	7,112
			B	4,424	5,181	5,344	5,517	5,694	5,875	6,061	7,096
			C	4,992	–	6,030	6,225	6,425	6,629	6,839	8,007
			D	4,983	–	–	6,214	6,413	6,618	6,827	7,993
			E	4,495	–	–	–	5,785	5,969	6,158	7,210
			F	4,504	–	–	–	–	5,982	6,170	7,224
			Subtotal	27,832	10,373	16,730	23,485	30,024	36,961	38,130	44,642
	total (P)			37,848	22,102	28,829	35,974	42,915	50,262	51,852	60,708
planned to serve Households	with electricity	Town	1st (A)		2,806	2,806	2,806	2,806	2,806	2,806	2,806
			2nd (B)		115	115	115	115	115	115	115
			Subtotal		2,921	2,921	2,921	2,921	2,921	2,921	2,921
	Connecting Households	Town	1st (A)		3,209	3,627	4,079	4,563	5,078	5,627	7,800
			2nd (B)		1,570	1,802	2,048	2,308	2,582	2,871	4,822
			3rd (C)		153	177	203	231	260	291	523
			Subtotal		4,932	5,606	6,330	7,102	7,920	8,789	13,145
		Barrio	A		2,077	2,410	2,765	3,139	3,533	3,949	7,112
			B		1,813	2,138	2,483	2,847	3,231	3,637	7,096
			C		–	2,111	2,490	2,891	3,315	3,761	8,007
			D		–	–	2,175	2,565	2,978	3,414	7,993
			E		–	–	–	1,736	2,089	2,463	7,210
			F		–	–	–	–	1,795	2,160	7,224
			Subtotal		3,890	6,659	9,913	13,178	16,941	19,384	44,642
		total(Connecting)			8,822	12,265	16,243	20,280	24,861	28,173	57,787
	Grandtotal (Q)				11,743	15,186	19,164	23,201	27,782	31,094	60,708
Elec. ratio % (Q/P×100)					26.5	33.2	40.6	47.6	55.3	59.9	100
Unit Consumption	KWH/mo				40	45	51	58	68	76	100
Annual	MWH				5,637	8,200	11,728	16,148	22,670	28,358	72,850
Load factor	%				34	35.5	37	38	39	40	41
Demand	KW				1,919	2,674	3,669	4,918	6,728	8,205	20,565

Table 6-14-3

Residential Demand IFUGAO

			1975 (a)	1980	1981	1982	1983	1984	1985	1990
Grand House holds			17,667	19,504	19,893	20,299	20,706	21,112	21,536	23,780
Potential Households	Town	1st (A)	494	545	556	568	579	590	602	665
		2nd (B)	–	–	–	–	–	–	–	–
		3rd (C)	949	1,048	1,069	1,090	1,112	1,134	1,157	1,277
		Subtotal	1,443	1,593	1,625	1,658	1,691	1,724	1,759	1,942
	Barrio	A	1,381	1,525	1,555	1,587	1,619	1,650	1,684	1,859
		B	1,378	1,491	1,552	1,583	1,615	1,647	1,680	1,855
		C	2,712	–	3,054	3,116	3,178	3,241	3,306	3,650
		D	2,709	–	–	3,113	3,175	3,237	3,302	3,646
		E	4,024	–	–	–	4,716	4,809	4,905	5,416
		F	4,020	–	–	–	–	4,804	4,900	5,412
		Subtotal	16,224	3,016	6,161	9,399	14,303	19,388	19,777	21,838
	total (P)		17,667	4,609	7,786	11,057	15,994	21,112	21,536	23,780
planned to serve Households	with electricity — Town	1st (A)		–	–	–	–	–	–	–
		2nd (B)		–	–	–	–	–	–	–
		Subtotal		–	–	–	–	–	–	–
	Connecting Households — Town	1st (A)		354	389	426	463	502	542	665
		2nd (B)		–	–	–	–	–	–	–
		3rd (C)		419	481	545	612	680	752	1,277
		Subtotal		773	870	971	1,075	1,182	1,294	1,942
	Connecting Households — Barrio	A		610	700	794	890	990	1,095	1,859
		B		522	621	712	808	906	1,008	1,855
		C		–	1,069	1,246	1,430	1,621	1,818	3,650
		D		–	–	1,090	1,270	1,457	1,651	3,646
		E		–	–	–	1,415	1,683	1,962	5,416
		F		–	–	–	–	1,441	1,715	5,412
		Subtotal		1,132	2,390	3,842	5,813	8,098	9,249	21,838
	total(Connecting)			1,905	3,260	4,813	6,888	9,280	10,543	23,780
	Grandtotal (Q)			1,905	3,260	4,813	6,888	9,280	10,543	23,780
Elec-ratio % (Q/P×100)				9.8	16.4	23.7	33.3	44.0	49.0	100
Unit Consumption		KWH/mo		40	45	51	58	68	76	100
Annual		MWH		914	1,760	2,946	4,794	7,572	9,615	28,536
Load factor		%		34	35.5	37	38	39	40	41
Demand		KW		311	574	921	1,460	2,247	2,782	8,056

Table 6–14–4

Residential Demand QUIRINO

				1975 (a)	1980	1981	1982	1983	1984	1985	1990
Grand House holds				11,313	14,096	14,730	15,397	16,087	16,811	17,569	21,891
Potential Households	Town		1st (A)		–	–	–	–	–	–	–
			2nd (B)		–	–	–	–	–	–	–
			3rd (C)	2,249	2,802	2,928	3,061	3,198	3,342	3,493	4,352
			Subtotal	2,249	2,802	2,928	3,061	3,198	3,342	3,493	4,352
	Barrio		A	1,045	1,302	1,361	1,422	1,486	1,553	1,623	2,022
			B	1,043	1,300	1,358	1,420	1,483	1,550	1,620	2,018
			C	1,761	–	2,293	2,397	2,504	2,617	2,735	3,407
			D	1,758	–	–	2,393	2,500	2,612	2,730	3,402
			E	1,729	–	–	–	2,459	2,569	2,685	3,346
			F	1,728	–	–	–	–	2,568	2,683	3,344
			Subtotal	9,064	2,602	5,012	7,632	10,432	13,469	14,076	17,539
	total (P)			11,313	5,404	7,940	10,693	13,630	16,811	17,569	21,891
planned to serve Households	with electricity	Town	1st (A)		–	–	–	–	–	–	–
			2nd (B)		–	–	–	–	–	–	–
			Subtotal		–	–	–	–	–	–	–
	Connecting Households	Town	1st (A)		–	–	–	–	–	–	–
			2nd (B)		–	–	–	–	–	–	–
			3rd (C)		1,121	1,318	1,531	1,759	2,005	2,270	4,352
			Subtotal		1,121	1,318	1,531	1,759	2,005	2,270	4,352
		Barrio	A		521	612	711	817	932	1,055	2,022
			B		455	543	639	742	853	972	2,018
			C		–	803	959	1,127	1,309	1,504	3,407
			D		–	–	838	1,000	1,175	1,365	3,402
			E		–	–	–	738	899	1,074	3,346
			F		–	–	–	–	770	939	3,344
			Subtotal		976	1,958	3,147	4,424	5,938	6,909	17,539
		total(Connecting)			2,097	3,276	4,678	6,183	7,943	9,179	21,891
	Grandtotal (Q)				2,097	3,276	4,678	6,183	7,943	9,179	21,891
Elec.ratio % (Q/P×100)					14.9	21.6	30.4	38.4	47.2	51.88	100
Unit Consumption	KWH/mo				40	45	51	58	68	76	100
Annual	MWH				1,007	1,769	2,863	4,303	6,481	8,371	26,269
Load factor	%				34	35.5	37	38	39	40	41
Demand	KW				343	577	896	1,311	1,924	2,422	7,416

Table 6-14-5 . Residential Demand ISELCO I

				1975 (a)	1980	1981	1982	1983	1984	1985	1990
Grand House holds				70,310	78,396	80,083	81,911	83,669	85,497	87,396	97,450
Potential Households	Town		1st (A)	5,995	6,685	6,828	6,984	7,134	7,290	7,452	8,309
			2nd (B)	5,299	5,908	6,036	6,173	6,306	6,444	6,587	7,344
			3rd (C)	922	028	1,050	1,075	1,097	1,121	1,146	1,278
			Subtotal	12,216	13,621	13,914	14,232	14,537	14,855	15,185	16,931
	Barrio		A	8,409	9,376	9,578	9,796	10,607	10,225	10,452	11,655
			B	8,342	9,301	9,502	9,718	9,927	10,144	10,369	11,562
			C	10,287	–	11,717	11,984	12,242	12,509	12,787	14,258
			D	10,276	–	–	11,972	12,228	12,496	12,773	14,243
			E	10,394	–	–	–	12,369	12,639	12,920	14,406
			F	10,386	–	–	–	–	12,629	12,910	14,395
			Subtotal	58,094	18,677	30,797	43,470	56,773	70,642	72,211	80,519
	total (P)			70,310	32,298	44,711	57,702	71,310	85,497	87,396	97,450
planned to serve Households	with electricity	Town	1st (A)	2,471	2,471	2,471	2,471	2,471	2,471	2,471	2,471
			2nd (B)	532	532	532	532	532	532	532	532
			Subtotal	3,003	3,003	3,003	3,003	3,003	3,003	3,003	3,003
	Connecting Households	Town	1st (A)		2,739	3,050	3,385	3,730	4,096	4,483	5,838
			2nd (B)		2,419	2,752	3,103	3,464	3,843	4,239	6,812
			3rd (C)		411	473	538	603	673	745	1,278
			Subtotal		5,569	6,275	7,026	7,797	8,612	9,467	13,928
		Barrio	A		3,750	4,310	4,898	5,504	6,135	6,794	11,655
			B		3,255	3,801	4,373	4,964	5,579	6,221	11,562
			C		–	4,101	4,794	5,509	6,255	7,033	14,258
			D		–	–	4,190	4,891	5,623	6,387	14,243
			E		–	–	–	3,711	4,424	5,168	14,406
			F		–	–	–	–	3,789	4,519	14,395
			Subtotal		7,005	12,212	18,255	24,579	31,805	36,122	80,519
		total(Connecting)			12,574	18,487	25,281	32,376	40,417	45,589	94,447
	Grandtotal (Q)				15,577	21,490	28,284	35,379	43,420	48,592	97,450
Elec-ratio % (Q/P×100)					19.9	26.8	34.5	42.3	50.8	55.6	100
Unit Consumption	KWH/mo				40	45	51	58	68	76	100
Annual	MWH				7,477	11,605	17,310	24,624	35,431	44,316	116,940
Load factor	%				34	35.5	37	38	39	40	41
Demand	KW				2,545	3,783	5,415	7,500	10,515	12,823	33,012

Table 6-14-6 Residential Demand ISELCO II

				1975 (a)	1980	1981	1982	1983	1984	1985	1990
Grand House holds				50,954	56,814	58,037	59,361	60,635	61,960	63,336	70,622
Potential Households	Town		1st (A)	3,458	3,856	3,939	4,029	4,115	4,205	4,298	4,793
			2nd (B)	5,030	5,608	5,729	5,860	5,986	6,116	6,252	6,971
			3rd (C)	118	132	134	137	140	144	147	164
			Subtotal	8,606	9,596	9,802	10,026	10,241	10,465	10,697	11,928
	Barrio		A	6,855	7,643	7,808	7,986	8,157	8,336	8,521	9,501
			B	6,848	7,636	7,800	7,978	8,149	8,327	8,512	9,492
			C	7,600	-	8,656	8,854	9,044	9,242	9,447	10,533
			D	7,594	-	-	8,847	9,037	9,234	9,439	10,525
			E	6,731	-	-	-	8,010	8,185	8,367	9,329
			F	6,720	-	-	-	-	8,171	8,353	9,314
			Subtotal	42,348	15,279	24,264	33,665	42,397	51,495	52,639	58,694
	total (P)			50,954	24,875	34,066	43,691	52,638	61,960	63,336	70,622
planned to serve Households	with electricity	Town	1st (A)		-	-	-	-	-	-	-
			2nd (B)		-	-	-	-	-	-	-
			Subtotal		-	-	-	-	-	-	-
	Connecting Households	Town	1st (A)		2,506	2,757	3,022	3,292	3,574	3,868	4,793
			2nd (B)		2,524	2,865	3,223	3,592	3,975	4,376	6,971
			3rd (C)		53	60	69	77	86	96	164
			Subtotal		5,083	5,682	6,314	6,961	7,635	8,340	11,928
		Barrio	A		3,057	3,514	3,993	4,486	5,002	5,539	9,501
			B		2,673	3,120	3,590	4,075	4,580	5,107	9,492
			C		-	3,030	3,542	4,068	4,621	5,196	10,533
			D		-	-	3,096	3,615	4,155	4,720	10,525
			E		-	-	-	2,403	2,865	3,347	9,329
			F		-	-	-	-	2,451	2,924	9,314
			Subtotal		5,730	9,664	14,221	18,647	23,674	26,833	58,694
		total(Connecting)			10,813	15,346	20,535	25,608	31,309	35,173	70,622
	Grandtotal (Q)				10,813	15,346	20,535	25,608	31,309	35,173	70,622
Elec-ratio % (Q/P×100)					19.0	26.4	34.6	42.2	50.5	55.5	100
Unit Consumption	KWH/mo				40	45	51	58	68	76	100
Annual	MWH				5,190	8,287	12,567	17,823	25,548	32,078	84,746
Load factor	%				34	35.5	37	38	39	40	41
Demand	KW				1,767	2,702	3,931	5,429	7,582	9,282	23,923

Table 6-14-7 Residential Demand CAGELCO I

				1975 (a)	1980	1981	1982	1983	1984	1985	1990
Grand House holds				57,085	62,736	63,479	65,134	66,390	67,646	68,901	75,695
Potential Households	Town		1st (A)	2,205	2,423	2,470	2,516	2,564	2,613	2,661	2,924
			2nd (B)	4,383	4,817	4,909	5,001	5,097	5,194	5,290	5,812
			3rd (C)	–	–	–	–	–	–	–	–
			Subtotal	6,588	7,240	7,379	7,517	7,661	7,807	7,951	8,736
	Barrio		A	6,474	7,115	7,251	7,387	7,529	7,672	7,814	8,585
			B	6,464	7,104	7,240	7,375	7,518	7,660	7,802	8,571
			C	10,573	–	11,842	12,064	12,296	12,529	12,762	14,020
			D	10,571	–	–	12,062	12,294	12,526	12,759	14,017
			E	8,211	–	–	–	9,549	9,730	9,911	10,888
			F	8,204	–	–	–	–	9,722	9,902	10,878
			Subtotal	50,497	14,219	26,333	38,888	49,186	59,839	60,950	66,959
	total (P)			57,085	21,459	33,712	46,405	56,847	67,646	68,901	75,695
planned to serve Households	with electricity	Town	1st (A)		1,157	1,157	1,157	1,157	1,157	1,157	1,157
			2nd (B)		565	565	565	565	565	565	565
			Subtotal		1,722	1,722	1,722	1,722	1,722	1,722	1,722
	Connecting Households	Town	1st (A)		823	919	1,019	1,126	1,238	1,354	1,767
			2nd (B)		1,913	2,172	2,440	2,719	3,009	3,306	5,247
			3rd (C)		–	–	–	–	–	–	
			Subtotal		2,736	3,091	3,459	3,845	4,247	4,660	7,014
		Barrio	A		2,846	3,263	3,694	4,141	4,603	5,079	8,585
			B		2,486	2,896	3,319	3,759	4,213	4,681	8,571
			C		–	4,145	4,826	5,533	6,265	7,019	14,020
			D		–	–	4,222	4,918	5,637	6,380	14,017
			E		–	–	–	2,865	3,406	3,964	10,888
			F		–	–	–	–	2,917	3,466	10,878
			Subtotal		5,332	10,304	16,061	21,216	27,041	30,589	66,959
		total(Connecting)			8,068	13,395	19,520	25,061	31,288	35,249	73,973
	Grandtotal (Q)				9,790	15,117	21,242	26,783	33,010	36,971	75,695
Elec-ratio % (Q/P×100)					15.6	23.8	32.6	40.3	48.8	53.7	100
Unit Consumption	KWH/mo				40	45	51	58	68	76	100
Annual	MWH				4,699	8,163	13,000	18,641	26,936	33,718	90,834
Load factor	%				34	35.5	37	38	39	40	41
Demand	KW				1,600	2,661	4,067	5,678	7,994	9,756	25,642

Table 6-14-8

Residential Demand CAGELCO II

				1975 (a)	1980	1981	1982	1983	1984	1985	1990
Grand House holds				55,015	60,461	61,617	62,772	63,982	65,193	66,403	72,950
Potential Households	Town		1st (A)	1,476	1,622	1,653	1,684	1,716	1,749	1,781	1,957
			2nd (B)	5,318	5,844	5,956	6,068	6,185	6,302	6,419	7,052
			3rd (C)	-	-	-	-	-	-	-	-
			Subtotal	6,794	7,466	7,609	7,752	7,901	8,051	8,200	9,009
	Barrio		A	8,007	8,800	8,968	9,136	9,312	9,488	9,665	10,617
			B	7,997	8,789	8,957	9,125	9,301	9,476	9,652	10,604
			C	7,851		8,793	8,958	9,131	9,303	9,476	10,410
			D	7,842		-	8,948	9,120	9,293	9,465	10,398
			E	8,266		-	-	9,613	9,795	9,977	10,961
			F	8,258		-	-	-	9,787	9,968	10,951
			Subtotal	48,221	17,589	26,718	36,167	46,477	57,142	58,203	63,941
	total (P)			55,015	25,055	34,327	43,919	54,378	65,193	66,403	72,950
planned to serve Households	with electricity	Town	1st (A)		1,157	1,157	1,157	1,157	1,157	1,157	1,157
			2nd (B)		565	565	565	565	565	565	565
			Subtotal		1,722	1,722	1,722	1,722	1,722	1,722	1,722
	Connecting Households	Town	1st (A)		302	347	395	447	503	562	800
			2nd (B)		2,376	2,696	3,027	3,372	3,729	4,098	6,490
			3rd (C)		-	-	-	-	-	-	
			Subtotal		2,678	3,043	3,422	3,819	4,232	4,660	7,287
		Barrio	A		3,520	4,035	4,568	5,122	5,693	6,282	10,617
			B		3,076	3,583	4,106	4,651	5,212	5,791	10,604
			C		-	3,079	3,583	4,109	4,652	5,212	10,410
			D		-	-	3,132	3,648	4,182	4,733	10,398
			E		-	-	-	2,884	3,428	3,991	10,961
			F		-	-	-	-	2,936	3,489	10,951
			Subtotal		6,596	10,696	15,389	20,414	26,103	29,498	63,941
		total(Connecting)			9,274	13,739	18,811	24,233	30,335	34,158	71,228
	Grandtotal (Q)				10,996	15,461	20,533	25,955	32,057	35,880	72,950
Elec-ratio % (Q/P×100)					18.2	25.1	32.7	40.6	49.2	54	100
Unit Consumption			KWH/mo		40	45	51	58	68	76	100
Annual			MWH		5,278	8,349	12,566	18,065	26,159	32,723	87,540
Load factor			%		34	35.5	37	38	39	40	41
Demand			KW		1,797	2,722	3,931	5,502	7,763	9,468	24,712

Table 6-14-9

Residential Demand K・APAYAO I

				1975 (a)	1980	1981	1982	1983	1984	1985	1990
Grand House holds				17,661	20,769	21,458	22,165	22,906	23,649	24,442	28,734
Potential Households	Town		1st (A)	893	1,050	1,085	1,121	1,158	1,196	1,236	1,453
			2nd (B)	–	–	–	–	–	–	–	–
			3rd (C)	1,380	1,623	1,677	1,732	1,790	1,848	1,910	2,245
			Subtotal	2,273	2,673	2,762	2,853	2,948	3,044	3,146	3,698
	Barrio		A	2,622	3,083	3,186	3,291	3,401	3,511	3,629	4,266
			B	2,620	3,081	3,183	3,288	3,398	3,503	3,626	4,263
			C	2,503		3,041	3,141	3,246	3,352	3,464	4,072
			D	2,501	–		3,139	3,243	3,349	3,461	4,069
			E	2,573	–	–		3,337	3,445	3,561	4,186
			F	2,569	–	–	–		3,440	3,555	4,180
			Subtotal	15,388	6,164	9,410	12,859	16,625	20,605	21,296	25,036
	total (P)			17,661	8,837	12,172	15,712	19,573	23,649	24,442	28,734
planned to serve Households	with electricity	Town	1st (A)		–	–	–	–	–	–	–
			2nd (B)		–	–	–	–	–	–	–
			Subtotal		–	–	–	–	–	–	–
	Connecting Households	Town	1st (A)		683	760	841	926	1,016	1,112	1,453
			2nd (B)						–	–	–
			3rd (C)		649	755	866	985	1,108	1,241	2,245
			Subtotal		1,332	1,515	1,707	1,911	2,124	2,353	3,698
		Barrio	A		1,233	1,434	1,645	1,871	2,107	2,359	4,266
			B		1,078	1,273	1,480	1,699	1,929	2,176	4,263
			C		–	1,064	1,256	1,461	1,676	1,905	4,072
			D		–	–	1,099	1,297	1,507	1,730	4,069
			E		–	–	–	1,001	1,206	1,424	4,186
			F		–	–	–		1,032	1,244	4,180
			Subtotal		2,311	3,771	5,480	7,329	9,457	10,838	25,036
		total(Connecting)			3,643	5,286	7,187	9,240	11,581	13,191	28,734
	Grandtotal (Q)				3,643	5,286	7,187	9,240	11,581	13,191	28,734
Elec-ratio % (Q/P×100)					17.5	24.6	32.4	40.8	49	54.0	100
Unit Consumption	KWH/mo				40	45	51	58	68	76	100
Annual	MWH				1,749	2,854	4,398	6,431	9,450	12,030	34,481
Load factor	%				34	35.5	37	38	39	40	41
Demand	KW				595	931	1,376	1,959	2,805	3,481	9,734

Table 6-14-10

Residential Demand K-APAYAO II

				1975 (a)	1980	1981	1982	1983	1984	1985	1990
Grand House holds				7,836	9,215	9,521	9,834	10,163	10,492	10,845	12,749
Potential Households	Town		1st (A)	-	-	-	-	-	-	-	-
			2nd (B)	-	-	-	-	-	-	-	-
			3rd (C)	888	1,044	1,079	1,114	1,152	1,189	1,229	1,445
			Subtotal	888	1,044	1,079	1,114	1,152	1,189	1,229	1,445
	Barrio		A	908	1,068	1,103	1,140	1,178	1,216	1,257	1,477
			B	906	1,065	1,101	1,137	1,175	1,213	1,254	1,474
			C	1,225	-	1,488	1,537	1,589	1,640	1,695	1,993
			D	1,222	-	-	1,534	1,585	1,636	1,691	1,989
			E	1,345	-	-	-	1,744	1,801	1,862	2,188
			F	1,342	-	-	-	-	1,797	1,857	2,183
			Subtotal	6,948	2,133	3,692	5,348	7,271	9,303	9,616	11,304
	total (P)			7,836	3,177	4,771	6,462	8,423	10,492	10,845	12,749
planned to serve Households	with electricity	Town	1st (A)		-	-	-	-	-	-	-
			2nd (B)		-	-	-	-	-	-	-
			Subtotal		-	-	-	-	-	-	-
	Connecting Households	Town	1st (A)		-	-	-	-	-	-	-
			2nd (B)		-	-	-	-	-	-	-
			3rd (C)		418	486	557	634	713	799	1,445
			Subtotal		418	486	557	634	713	799	1,445
		Barrio	A		427	496	570	648	730	817	1,477
			B		373	440	512	588	667	752	1,474
			C		-	521	615	715	820	932	1,993
			D		-	-	537	634	736	846	1,989
			E		-	-	-	523	630	745	2,188
			F		-	-	-		539	650	2,183
			Subtotal		800	1,457	2,234	3,108	4,122	4,742	11,304
		total(Connecting)			1,218	1,943	2,791	3,742	4,835	5,541	12,749
	Grandtotal (Q)				1,218	1,943	2,791	3,742	4,835	5,541	12,749
Elec-ratio % (Q/P×100)					13.2	28.4	28.4	36.8	46.1	51.1	100
Unit Consumption			KWH/mo		40	45	51	58	68	76	100
Annual			MWH		585	1,049	1,708	2,604	3,945	5,053	15,299
Load factor			%		34	35.5	37	38	39	40	41
Demand			KW		199	342	534	79.3	1,171	1,462	4,319

Table 6-15 Maximum Power Demand at the Substation Sending End, by Year

(Details for COOP)

(KW)

Item			1980	1981	1982	1983	1984	1985	1990
N. VIZCAYA	Residential		1,919	2,674	3,669	4,918	6,728	8,205	20,565
	Ricemill		630	924	1,218	1,512	1,806	2,100	2,310
	Public and Others		255	360	489	643	853	979	1,098
	Irrigation	BISA	--	101	223	363	520	520	598
		Private	95	165	250	350	465	579	1,090
		NIA	--	--	--	--	--	--	--
		Subtotal	95	266	473	713	985	1,099	1,688
	Large Industry		--	--	--	--	--	--	--
	Loss		290	422	585	779	1,037	1,238	2,566
	Total		3,189	4,646	6,434	8,565	11,409	13,621	28,227
IFUGAO	Residential		311	574	921	1,460	2,247	2,782	8,056
	Ricemill		156	229	302	374	447	520	572
	Public and Others		47	80	122	183	269	314	414
	Irrigation	BISA	--	--	--	--	--	--	--
		Private	72	119	173	235	305	375	665
		NIA	--	--	--	--	--	--	--
		Subtotal	72	119	173	235	305	375	665
	Large Industry		--	--	--	--	--	--	--
	Loss		59	100	152	225	327	399	971
	Total		645	1,102	1,670	2,477	3,595	4,390	10,678
QUIRINO	Residential		343	577	896	1,311	1,924	2,422	7,416
	Ricemill		144	211	278	346	413	480	528
	Public and Others		49	79	117	166	234	276	381
	Irrigation	BISA	--	--	--	--	--	--	--
		Private	60	105	160	225	300	374	710
		NIA	--	--	--	--	--	--	--
		Subtotal	60	105	160	225	300	374	710
	Large Industry		--	--	--	--	--	--	--
	Loss		60	97	145	205	287	355	904
	Total		656	1,069	1,596	2,253	3,158	3,907	9,939

(KW)

Item			1980	1981	1982	1983	1984	1985	1990
ISELCO I	Residential		2,545	3,783	5,415	7,500	10,515	12,823	33,012
	Ricemill		1,392	2,042	2,691	3,341	3,990	4,640	5,104
	Public and Others		394	583	811	1,084	1,451	1,659	1,830
	Irrigation	BISA	1,860	2,146	2,453	2,745	3,052	3,052	3,510
		Private	632	1,027	1,475	1,975	2,527	3,076	5,315
		NIA	--	--	--	--	--	--	--
		Subtotal	2,492	3,173	3,928	4,720	5,579	6,128	8,825
	Large Industry		2,000	2,000	2,000	--	--	--	--
	Loss		882	1,158	1,485	1,665	2,154	2,525	4,877
	Total		9,705	12,739	16,330	18,310	23,689	27,775	53,648
ISELCO II	Residential		1,767	2,702	3,931	5,429	7,582	9,282	23,923
	Ricemill		996	1,461	1,926	2,390	2,855	3,320	3,652
	Public and Others		276	416	586	782	1,044	1,197	1,324
	Irrigation	BISA	1,011	1,126	1,242	1,343	1,444	1,444	1,660
		Private	568	923	1,325	1,775	2,273	2,769	4,785
		NIA	--	--	--	--	--	--	--
		Subtotal	1,579	2,049	2,567	3,118	3,717	4,213	6,445
	Large Industry		--	--	--	--	--	--	--
	Loss		462	663	901	1,172	1,520	1,801	3,534
	Total		5,080	7,291	9,911	12,891	16,718	19,813	38,878
CAGELCO I	Residential		1,600	2,661	4,067	5,678	7,994	9,756	25,642
	Ricemill		738	1,082	1,427	1,771	2,116	2,460	2,706
	Public and Others		234	374	549	745	1,011	1,161	1,361
	Irrigation	BISA	456	509	561	606	652	652	750
		Private	184	310	460	632	828	1,022	1,862
		NIA	2,975	2,975	2,975	2,975	2,975	2,975	2,975
		Subtotal	3,615	3,794	3,996	4,213	4,455	4,649	5,587
	Large Industry		1,500	1,500	1,500	1,500	1,500	1,500	1,500
	Loss		768	941	1,154	1,391	1,708	1,953	3,680
	Total		8,455	10,352	12,693	15,298	18,784	21,479	40,476

(KW)

Item			1980	1981	1982	1983	1984	1985	1990
CAGERCO - II	Residential		1,797	2,722	3,931	5,502	7,763	9,468	24,712
	Ricemill		714	1,047	1,380	1,714	2,047	2,380	2,618
	Public and Others		251	377	531	722	981	1,126	1,312
	Irrigation	BISA	202	225	248	268	288	288	331
		Private	216	365	540	743	972	1,201	2,188
		NIA	4,800	4,800	4,800	4,800	4,800	4,800	4,800
		Subtotal	5,218	5,390	5,588	5,811	6,060	6,289	7,319
	Large Industry		3,400	3,400	3,400	3,400	3,400	5,900	5,900
	Loss		1,138	1,294	1,483	1,715	2,025	2,516	4,186
	Total		12,518	14,230	16,313	18,864	22,276	27,679	46,047
K. APAYAO - I	Residential		595	931	1,376	1,959	2,805	3,481	9,734
	Ricemill		240	352	464	576	688	800	880
	Public and Others		84	128	184	254	349	407	509
	Irrigation	BISA	--	--	--	--	--	--	--
		Private	122	196	280	373	474	576	980
		NIA	--	--	--	--	--	--	--
		Subtotal	122	196	280	373	474	576	980
	Large Industry		--	--	--	--	--	--	--
	Loss		104	161	230	316	432	526	1,210
	Total		1,145	1,768	2,534	3,478	4,748	5,790	13,313
K. APAYAO - II	Residential		199	342	534	793	1,171	1,462	4,319
	Ricemill		90	132	174	216	258	300	330
	Public and Others		29	47	71	101	143	167	223
	Irrigation	BISA	--	--	--	--	--	--	--
		Private	58	94	134	179	228	276	473
		NIA	--	--	--	--	--	--	--
		Subtotal	58	94	134	179	228	276	473
	Large Industry		--	--	--	--	--	--	--
	Loss		38	62	91	129	180	221	535
	Total		414	677	1,004	1,418	1,980	2,426	5,880

Table 6-16-1 BISA Irrigation Power Demand, by COOP

Unit: KW

COOP	1980	1981	1982	1983	1984	1985	1990
N. Vizcaya	--	130	260	390	520	520	598
ISELCO I	2,657	2,752	2,852	2,952	3,052	3,052	3,510
ISELCO II	1,444	1,444	1,444	1,444	1,444	1,444	1,660
CAGELCO I	652	652	652	652	652	652	750
CAGELCO II	288	288	288	288	288	288	331
Total	5,041	5,226	5,496	5,726	5,956	5,956	6,849
Electrification rate (%)	70	78	86	93	100	100	100
Demand KW	3,529	4,107	4,727	5,325	5,956	5,956	6,849

Note: BISA program in N. Vizcaya is not known, and it is assumed that one 130 KW pumping station will be built in 1981, two 130 KW stations in 1982, three 130 KW stations in in 1983 and four 130 KW stations in 1984, respectively. And for 1990, 15% increase of demand from 1985 is assumed in consideration of increase of irrigation points.

Table 6-16-2 Small Irrigation Power Demand, by COOP

Unit: KW

COOP	Existing pumps in 1977 (units)	Pumps added Units/year	No. of pumps *						
			1980	1981	1982	1983	1984	1985	1990
N. Vizcaya	100	30	190	220	250	280	310	331	436
Ifugao	98	15	143	158	173	188	203	214	266
Quirino	60	20	120	140	160	180	200	214	284
ISELCO I	950	105	1,265	1,370	1,475	1,580	1,685	1,758	2,126
ISELCO II	850	95	1,135	1,230	1,325	1,420	1,515	1,582	1,914
CAGELCO I	230	46	368	414	460	506	552	584	745
CAGELCO II	270	54	432	486	540	594	648	686	875
K. Apayao I	190	18	244	262	280	298	316	329	392
K. Apayao II	89	9	116	125	134	143	152	158	189
Total	2,837	392	4,013	4,405	4,797	5,189	5,581	5,856	7,227
Electrification rate (%)	--	-	10	15	20	25	30	35	50

Note: 1. * Number of pumps is assumed to increase at the rate shown in the table up to 1985, but after 1985 it is assumed that the rate of increase is limited to 70%.

2. The pump capacity is assumed to be 5 KW/unit.

Table 6-17-1 Power Consumption by Irrigation and Public & Others

Item			Load Condition h/Year	Unit	1980	1981	1982	1983	1984	1985	1990
Irrigation	NIA	Cagayan Agricultural Development	4,000	KW	5,775	5,775	5,775	5,775	5,775	5,775	5,775
				MWH	23,100	23,100	23,100	23,100	23,100	23,100	23,100
		Solano Irrigation	2,100	KW	2,000	2,000	2,000	2,000	2,000	2,000	2,000
				MWH	4,200	4,200	4,200	4,200	4,200	4,200	4,200
		Subtotal		KW	7,775	7,775	7,775	7,775	7,775	7,775	7,775
				MWH	27,300	27,300	27,300	27,300	27,300	27,300	27,300
	BISA Irrigation		1,800	KW	5,536	7,411	9,524	11,812	14,328	16,204	24,917
	Small Irrigation			MWH	9,965	13,340	17,143	21,262	25,790	29,167	44,851
	Total		---	KW	13,311	15,186	17,299	19,587	22,103	23,979	32,692
				MWH	37,265	40,640	44,443	48,562	53,090	56,467	72,151
Rice Mill			2,400	KW	5,100	7,480	9,860	12,240	14,620	17,000	18,700
				MWH	12,240	17,952	23,664	29,376	35,088	40,800	44,880
Public & Others			LF 50%	KW	1,619	2,444	3,460	4,680	6,335	7,286	8,452
				MWH	6,994	10,558	14,947	20,218	27,367	31,476	36,513

Table 6-17-2 Power Consumption by Large Industry

Name of Large Industry / Item		Max. Power (KW)	Load Condition	Power Consumption (MWH)	Annual Power Consumption (MWH)						
					1980	1981	1982	1983	1984	1985	1990
Magat Dam Const. Power	1980	2,000	LF 40%	6,912	6,912	8,640	8,640	---	---	---	---
	1981 1982	2,000	LF 50%	8,640							
Piat Sugar Factory		1,500	5,760 h/Year LF 90%	7,776	7,776	7,776	7,776	7,776	7,776	7,776	7,776
Tropical Plywood Factory		2,500	4,800 h/Year	10,800	10,800	10,800	10,800	10,800	10,800	21,600	21,600
		5,000	LF 90%	21,600							
Port Airen Lift		500	LF 20%	864	864	864	864	864	864	864	864
Claveria Wood Factory		200	LF 50%	864	864	864	864	864	864	864	864
Lal-lo Wood Factory		200	LF 50%	864	864	864	864	864	864	864	864
Total		---	---	---	28,080	29,808	29.808	21,168	21,168	31,968	31,968

Chapter 7 Planning of Electric Distribution System Project

Chapter 7

Chapter 7. Planning of Electric Distribution System Project

7-1. Basic Plan of the Project

As stated in the section for demand forecast in Chapter 6, electrification in Region II should be promoted in stages because of the composition of municipals (Town and Barrio) in the region.

The basic plan of the Electric Distribution System Project in the Cagayan Valley is outlined in the following.

(1) An economic and efficient project planning must be made on the basis of the 1974 JICA survey report, with reference to the electrification program revealed to the survey team by NEA during the feasibility survey.

(2) Except provincial capitals and adjoining districts, this region is scantily populated with an extremely low demand factor. For this reason, a long distance trunk distribution system must be established with the number of substations held to a minimum in the initial stage of the development project. In such a case, step voltage regulators will be provided at appropriate locations to cope with the anticipated voltage drop in the system and maintain the system voltage at a constant level.
It will be economically advantageous to expand the transmission system and substation facilities at a later stage accoring to the growth of demand.

(3) The Project will be implemented according to the following basic pattern of electrification which was plotted according to the above-mentioned basic plan of the Project.

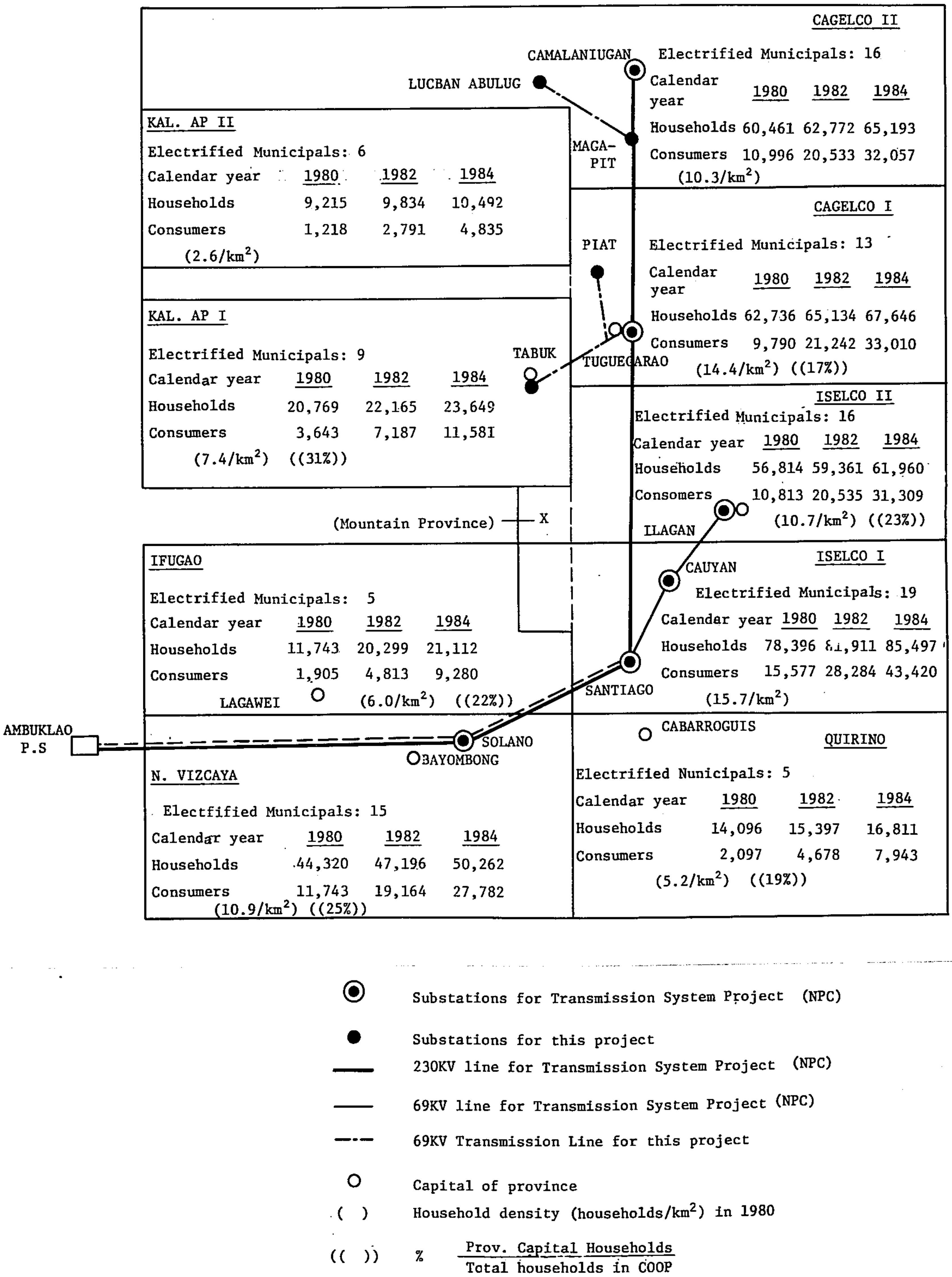
(4) With this basic pattern of project implementation as a basis, the development program for the Electric Distribution System Project in the Cagayan Valley has been formulated as follows.

With the 230KV - 69 KV transmission system and six substations to be provided in Region II by NPC as the principal axis, one circuit of 69KV transmission lines (148km) will be branched off from the NPC system and extended to cover Municipals in the western service area of CAGELCO II, service area of CAGELCO I adjoining Kalinga-Apayao Province and service area of Kalinga-Apayao I, all of which are located far from the NPC system, and four 69KV/13.8KV substations (Magapit, Lucban-Abulug, Piat and Tabuk) will be constructed in the 1st stage of the project. Then, from this transmission system, 13.2KV 3-phase 4-wire trunk distribution lines will be extended to the capital of each province and Towns in the Municipal in the service area of each COOP (for a total length of 1,274km). In the next step, 13.2KV single-phase or V-phase high-voltage branch distribution lines will be extended to groups of Barrios located within 500 m on both sides of the trunk distribution lines. The extension of 13.2KV single-phase or V-phase high-voltage branch distribution lines to the remaining 50% of Barrios located outside the 500 m range from the trunk distribution lines will be completed by 1982 when the 1st stage of the Project is scheduled to be completed. (The total length of 13.2KV single-phase or V-phase distribution line will be 2,213 km.)

From the Capital or Town and main groups of Barrios, to which the 13.2KV distribution lines have been extended, 240V low-voltage distribution lines (480V lines in part) will be extended to each consumer. (Average electrification rate will be 33.6% and the total length of 240V or 480V distribution lines will be 3,824km).

Table 7-1 Basic Pattern of Project Implementation

(i) Number of electrified households along transmission systems categorized by COOP and year

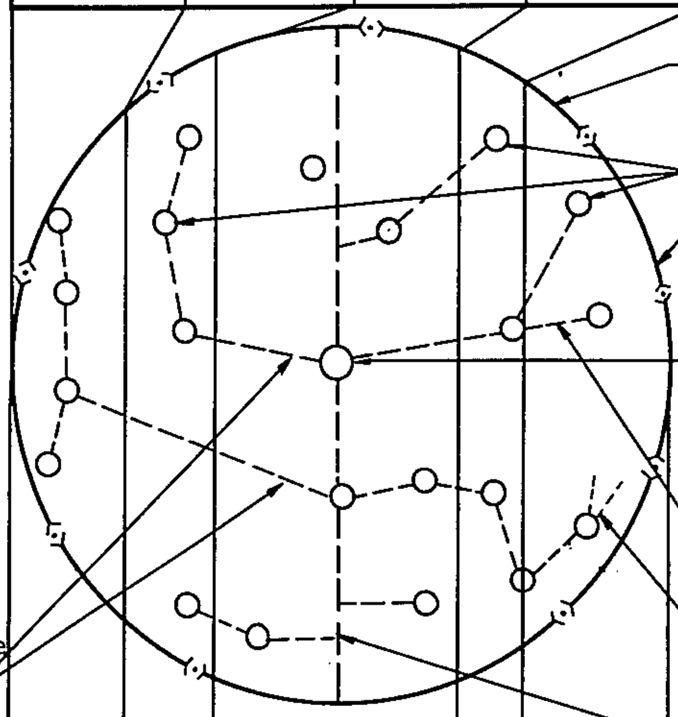


(ii) Standard electrification method for municipals

The ideal electrification method for a municipal having a capital or town located almost in the center will be as shown below.

Fig. 7-1

Classification by start year of electrification (Barrio)					
1983 : E 1984 : F	1981 : C 1982 : D	1979 : A 1980 : B	1981 : C 1982 : D	1983 : E 1984 : F	Electrification rate of Barrios A, B, C and E is to be 35% in the initial year and is to be increased by 5% annually. Electrification rate of Barrios D and F is to be 30% in the initial year and is to be increased by 5% annually.



Capital or Town

Expansion of 13.2KV trunk distribution lines (Backbone line) to Capital or Town will be completed by 1980.

13.2KV high voltage branch line

240V low voltage dist. line

13.2KV high-voltage trunk line (Back bone line)
To be completed by 1980

1979 ∿ 1980

Approximately 35 - 40% of the Total households in Barrios located within 500m on each side from 13.2KV trunk line (Back bone line) are to be electrified. Electrification rate of capital or Town is to be 40 ∿ 65%.

1981 ∿ 1982

1st stage of project

Approximately 30 ∿ 40% of the households in the remaining 50% of Barrios which are not erectrified by 1980, are to be electrified. Electrification rate in Barrio which is elecfrified by 1980 is to be increased to 45 - 50%. Electrification rate of Capital or Town is to be increased to 50 ÷ 75% (Average electrification rate is to be 33.6%)

1982 ∿ 1984

2nd stage of project

All the remaining Barrios are to be electrified to 30 - 40%. The electrification rate in Barrio where electrification started by 1982 is to be increased to 40 - 60% and that in Capital or Town is to be increased to 60 - 85%.(Average electrification rate is to be 50.0%.)

1985 ∿ 1990

3rd stage of project

Region II, including Capital or Town and all Barrios, is to be electrified 100%.

(Note)

In actuality, the Capital or Town is not always located in the center of Municipal as shown in the above chart but is often located at the fringe of Municipal as illustrated below. Therefore, it is often necessary to provide a long distance 13.2KV high-voltage branch line network to cover the entire area of municipal.
In such a case, the speed of electrification is relatively slow.

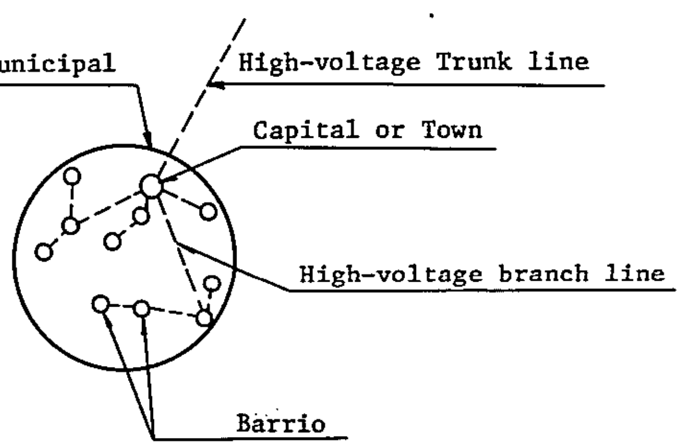
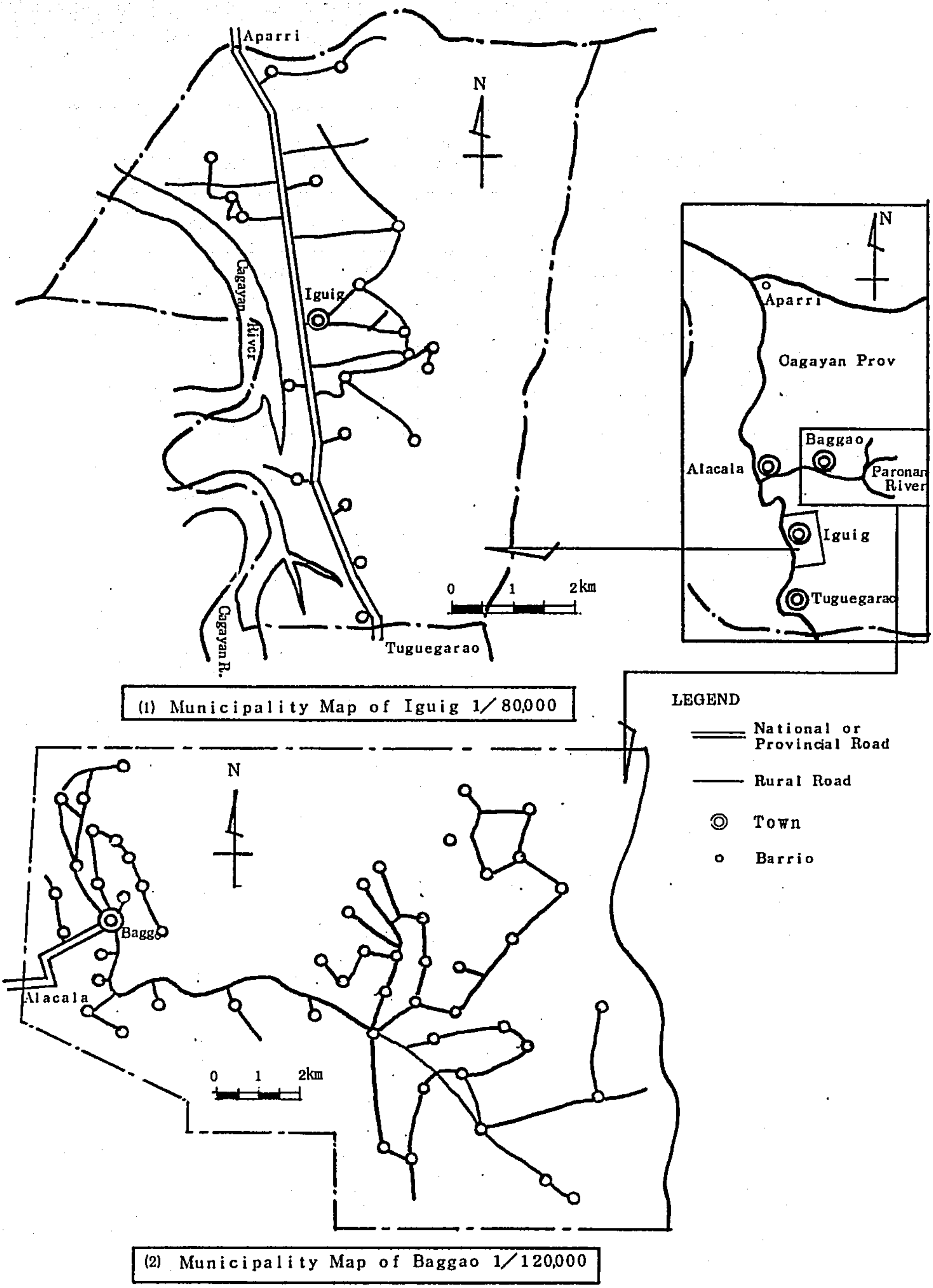


Table 7-2 Number of Electrified Municipals

Name of COOP	Service area	No. of municipals	Substation
CAGELCO I	South district of Cagayan Province (Conner of Kalinga-Apayao Province included)	13	Supply from Tuguegarao S/S
CAGELCO II	North district of Cagayan Province	16	Supply from Camal-aniugan S/S Magapit and Lucban Abulug S/S
ISELCO I	South district of Isabela Province (Potia of Ifugao Province included)	19	Supply from Santiago S/S and Cauayan S/S
ISELCO II	North district of Isabela Province (Palanan excluded but Paracelis of Mountain Province included)	16	Supply from Ilagan S/S
Kalinga-Apayao I	South district of Kal.-Apa. Province	9	Supply from Tabuk S/S
Kalinga-Apayao II	North district of Kal.-Apa Province (Conner excluded)	6	Supply from Lucban-Abulug
N. Vizcaya	N. Vizcaya Province incl. Lamut of Ifugao Prov.	15	Supply from Solano S/S
Ifugao	Ifugao Province (Potia excluded)	5	Supply from Solano S/S
Quirino	Quirino Province including Cabarroguis.	5	Supply from Santiago S/S

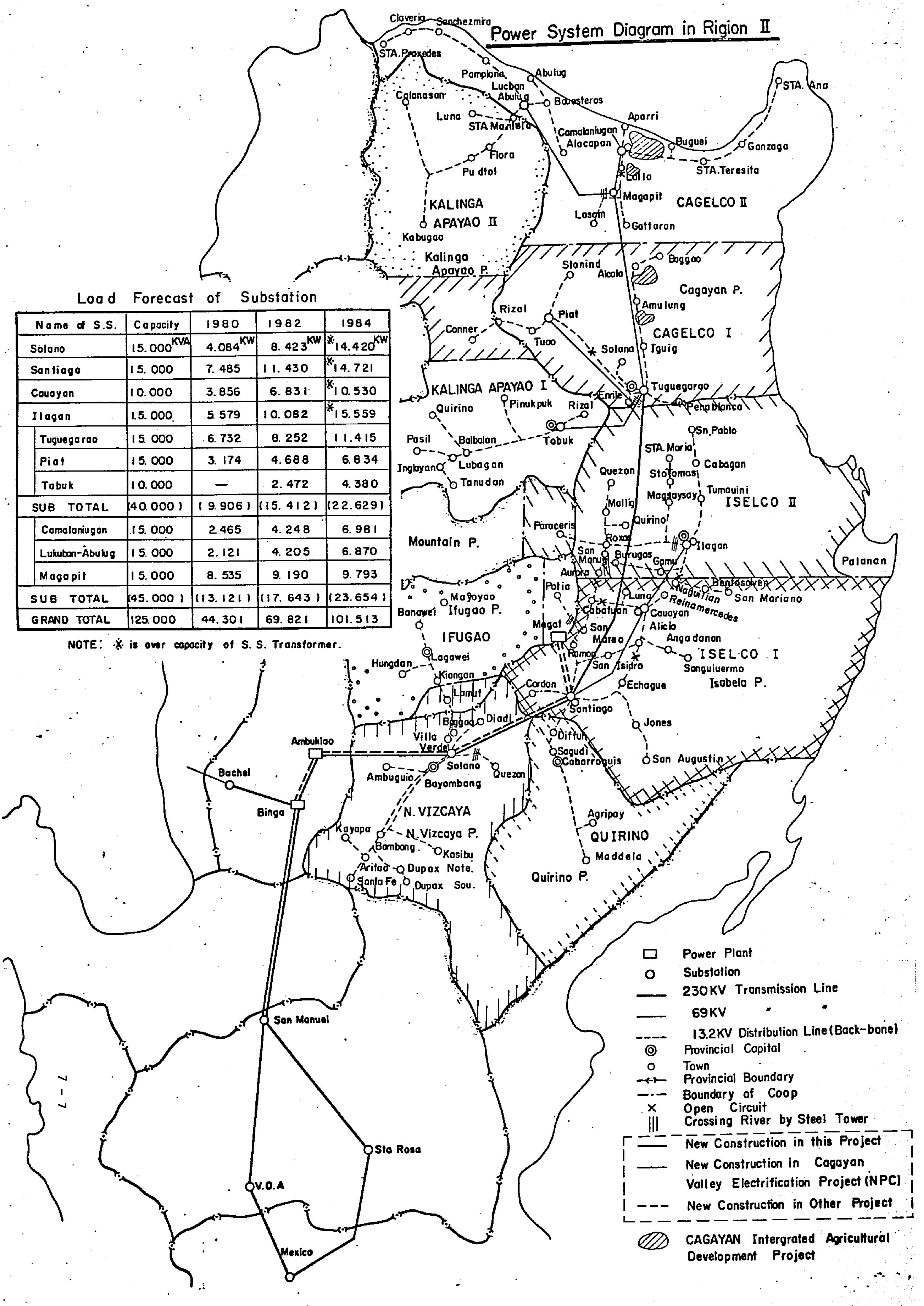


(1) Municipality Map of Iguig 1/80,000

(2) Municipality Map of Baggao 1/120,000

Fig. 7-2 Example of Location of Town in Municipal

Power System Diagram in Rigion II



Load Forecast of Substation

Name of S.S.	Capacity	1980	1982	1984
Solano	15.000 KVA	4.084 KW	8.423 KW	※14.420 KW
Santiago	15.000	7.485	11.430	※14.721
Cauayan	10.000	3.856	6.831	※10.530
Ilagan	15.000	5.579	10.082	※15.559
Tuguegarao	15.000	6.732	8.252	11.415
Piat	15.000	3.174	4.688	6.834
Tabuk	10.000	—	2.472	4.380
SUB TOTAL	(40.000)	(9.906)	(15.412)	(22.629)
Camalaniugan	15.000	2.465	4.248	6.981
Lukuban-Abulug	15.000	2.121	4.205	6.870
Magapit	15.000	8.535	9.190	9.793
SUB TOTAL	(45.000)	(13.121)	(17.643)	(23.654)
GRAND TOTAL	125.000	44.301	69.821	101.513

NOTE: ※ is over capacity of S. S. Transformer.

Power supply to large irrigation pump stations, sugar refineries and saw mills at six locations will be by 13.2KV 3-phase 4-wire distribution lines. (These distribution lines are included in the afore-mentioned total length of trunk distribution lines.)

(5) Facilities excluded from this Project

(a) Power supply lines to the Cagayan Integrated Agricultural Development Project (3 districts, namely, the Lower Cagayan District surrounded by Aparri, Lalo and Buguey, the Alcala-Amulung District and the Iguig District) situated in the area of CAGELCO I and II, for which preparations are now under way for construction with the Japanese Loan, are included in the said project and are, therefore, excluded from this Project. (Maximum load: Lower Cagayan - 4,800KW, Alcala-Amulung - 750KW and Iguig - 225KW)

(b) Part of trunk distribution lines and low voltage lines (high-voltage - 180.5km and low voltage - 125.6km) to be extended from the Santiago S/S in the service area of ISELCO I and part of trunk distribution lines and low-voltage lines (high-voltage - 124km and low voltage - 101km) from Tuguegarao S/S in the service area of CAGELCO I have already been completed or are under construction by these COOP's and are, therefore, excluded from this Project.

The basic plan of development discussed so far, may be summarized as shown in Fig. 7-3.

7-2. Development Plan

The development plan for the 1st stage of electrification program, which is especially important in the electrification program in Region II, will be described in detail in the following.

7-2-1. Design Criteria

The following design criteria will be adopted according to the existing standards in the Philippines and Japan. For the main equipment and materials to be covered by the foreign currency, the Japanese standard will be applied in principle, but the US standard may be applied to part of such equipment and materials.

1. Voltage and others

Transmission lines: (In accordance with NEA standard and 1974 JICA report)

69KV

Distribution line : (In accordance with NEA standard)

High voltage: 7.6/13.2KV - 3 phase, 4-wire system
Multiple grounding system

Low voltage : Lighting - 240V single-phase, 2-wire system or 480V single-phase, 3-wire system

Motor - 240V 3-phase, 3-wire system or 480V 3-phase, 3-wire system

2. Meteorological conditions

The following statistical data in the Philippines will be used as meteorological conditions for design purpose.

(1) Ambient temperature

Maximum : 40°C
Minimum : 5°C
Average : 30°C

(2) Relative humidity

Average : 79%

(3) Maximum wind velocity : 40m/sec.

(4) Seismic force (lateral seismic coefficient) 0.2G

3. Minimum Height of Strung Wires (In accordance with NEA standard)

Table 7-3

Item	69KV Transmission line	13.2KV High voltage distribution line	Low-voltage distribution line (including neutral conductor)	Lead-in wire
On trunk road	8.8m (29')	6.1m (20')	5.5m (18')	5.5m (18')
On local road	7.6m (25')	6.1m (20')	4.6m (15')	3.7m (12')
Along road	7.0m (23')	6.1m (20')	4.6m (15')	-
Others (farm land, etc.)	6.1m (20')			

4. Safety factor

Wooden pole - More than 2

Foundation - More than 2

7-2-2. Transmission and Substation Facilities

A. Outline of Transmission and Substation Scheme

It was originally planned to extend 13.2KV trunk distribution lines from the six substations (Solano, Santiago, Tuguegarao, Cauayan, Ilagan and Camalaniugan) according to the basic plan of the development program mentioned in Section 7-1. Because of the length of the planned trunk distribution lines, however, it was feard that some of the distribution lines would not be able to maintain the required voltage even when SVR's were provided in the line and that main transformers of some of the substations would be overloaded. As a result of an economic comparative study of alternative plans for power supply to these districts, it was considered advantageous in some cases to construct additional substations as follows.

(1) Lucban-Abulug S/S

This substation is intended for supply of power to the northwestern district of Cagayan Province and the northern district of Kalinga-Apayao Province (area newly added to the Project), and justifications for construction of this substation are as follows.

a. The distance between the Camalaniugan S/S and the site of the planned substation is 80km and the distance between the planned substation and the end of distribution line is 80km, or a total of 160km. Even when two circuits of 13.2KV distribution lines are provided, the total voltage drop between the Camalaniugan S/S and the end of distribution lines in 1980 will reach 5,040V and stable power supply cannot be expected even when voltage improvement is attempted by installing SVR.

b. Without a new substation, the load of main transformers at the Camalaniugan S/S is expected to reach 15,300KW in 1981. An economic comparison shows the advantages of constructing a new substation.

(2) Piat S/S

This substation is intended to supply power to the southwestern district of Cagayan Province and part of the southern district of Kalinga-Apayao Province, and justifications for this substation are as follows.

a. A sugar refinery is now under construction (plant facilities have almost been completed) near Piat.
This sugar plant which will be equipped with 5,000KW private generating facilities, desires to stop the operation of its own generating facilities and receive 1,500KW of power during the period of nearly two-thirds of the year.

If this seasonal demand of 1,500KW is to be supplied, the voltage drop over a distance of 70km from the Tuguegarao S/S to the end of distribution lines will reach 5,746V in 1980.

b. Without a new substation, meanwhile, there will be an overload of transformers at the Tuguegarao S/S, the load reaching 15,400KW in 1982. It was concluded, therefore, that the construction of this substation, together with the Tabuk S/S which will be described next, was more advantageous than the expansion of the distribution system.

(3) Tabuk S/S

This substation is required to supply power mainly to the southern district of Kalinga-Apayao Province, and justifications for its construction are as follows.

a. If the 13.2KV distribution line is extended from the Taguegarao S/S to cover this district, the total length of distribution lines will reach 120km and voltage drop over this distance will amount to 37,46V in 1980. Voltage improvement with SVR will not solve this problem.

b. A comparison between the construction of a new substation and the expansion of distribution system shows the advantage of the former.

(4) Magapit S/S

Construction of this substation is planned mainly to meet large power demand and to promote electrification in and around Magapit. Justifications for this substation are as follows.

a. An irrigation project requiring a power of 4,800KW is planned in the area near Magapit under the Cagayan Integrated Agricultural Development Project (1976 JICA Survey Report.)

Besides, a plywood factory of Tropical Plywood Co. has been established in this area and is now in operation with its 2,500KW private diesel power plant. The load of this factory is expected to be increased to 5,000KW in the future (around 1985) and the company desires to purchase power to meet this requirement. The load of large consumers alone amounts to 7,300KW at present (9,800KW in the future). If 13.2KV distribution lines are to be used to supply power to these large consumers and general households for lighting, 3 circuits of distribution line having a total length of 20km will have be extended from the Camalaniugan S/S and voltage drop will reach 3,065V in 1980.

b. Overload of transformers at the Camalaniugan S/S will be unavoidable in 1985. As the 69KV transmission lines from Tuguegarao to Camalaniugan run through Magapit, construction of new 69KV transmission lines is not planned for this area. A comparison between the construction of a new substation (only one circuit of distribution line is required) and construction of 3 circuits of distribution lines shows the advantage of the former.

Notes: 1. The above-mentioned 4 substations will be constructed with the target of commissioning in 1980.

2. A summary of system expansion is shown in Fig. 7-4 and the routes of transmission and distribution lines planned under this Project are shown in Fig. 7-5.

B. Preliminary Design of Transmission Lines

B-1. Outline of Preliminary Design

(1) Route planning for transmission lines

Since the planned transmission lines run through flat plains of the Cagayan Valley the route planning is relatively easy. However, route planning for crossing of the Cagayan River needs careful study.

For the Lucban-Abulug S/S transmission line, river crossing with a span of less than 400m is possible if the crossing point is selected near Magapit. For the Piat-Tabuk S/S transmission line, crossing of the river near the western part of Tuguegarao is convenient but this will require a span of about 1,500m. Therefore, the crossing point of the river has been selected near the boundary of Cagayan Province and Isabela Province where a span of 400m can cross the river, even though the total length of transmission lines increases by 13km.

Note: The cost of suspension of cables on the bridge between Tuguegarao and Solano is almost the same as the cost of detouring the transmission lines. When the future maintenance is considered, detouring the transmission lines will be advantageous.

A straight course has been selected along the road whenever possible as the transmission line route for convenience of future maintenance.

(2) Conductor

The type of conductor will be 170mm^2 ACSR (336.4KCM). Reasons for selection of this type are as follows.

a. This conductor, with an allowable current capacity of 580A, is most suitable when the future growth of power demand is considered.

Fig. 7-4 230KV & 69KV SYSTEM DIAGRAM

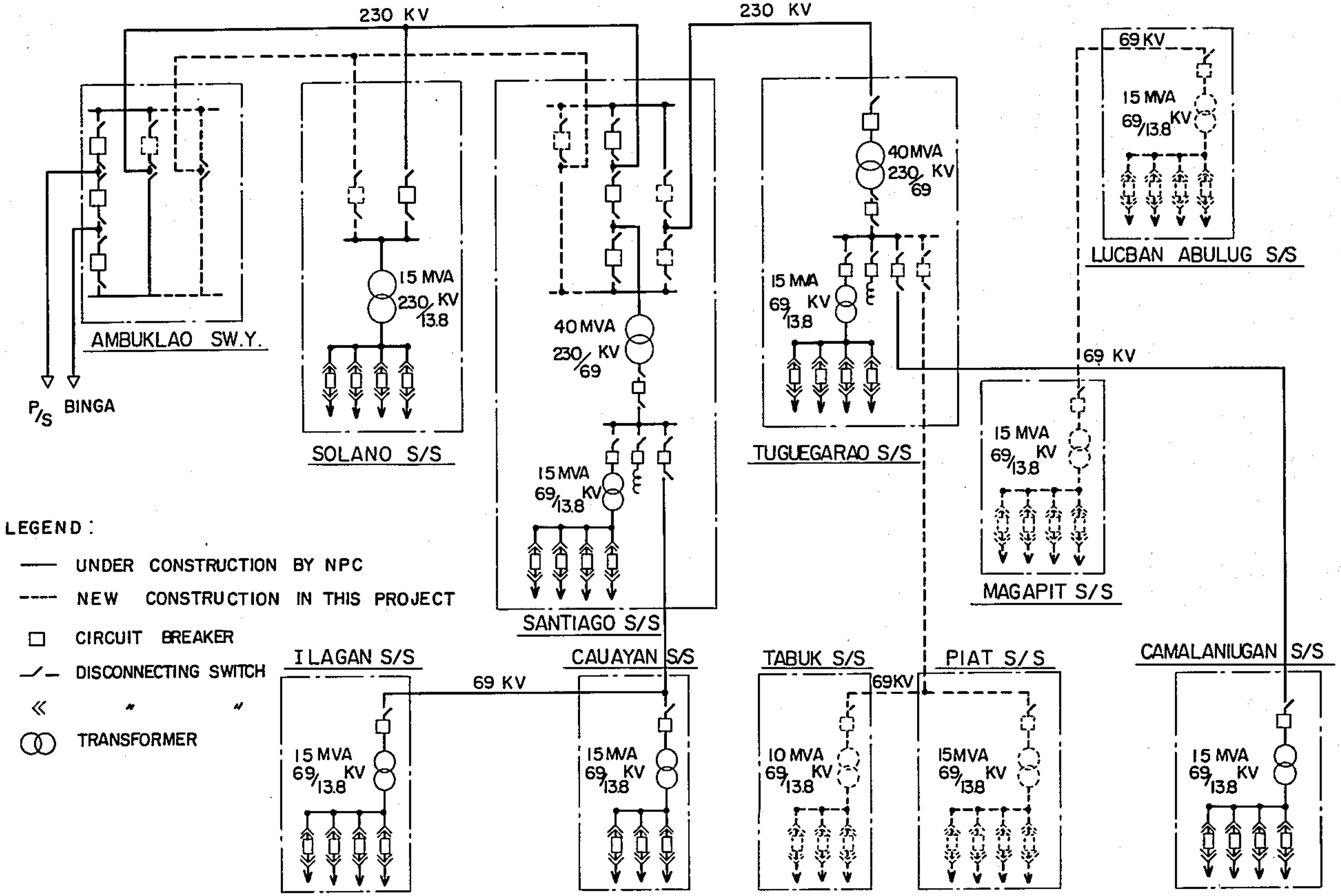
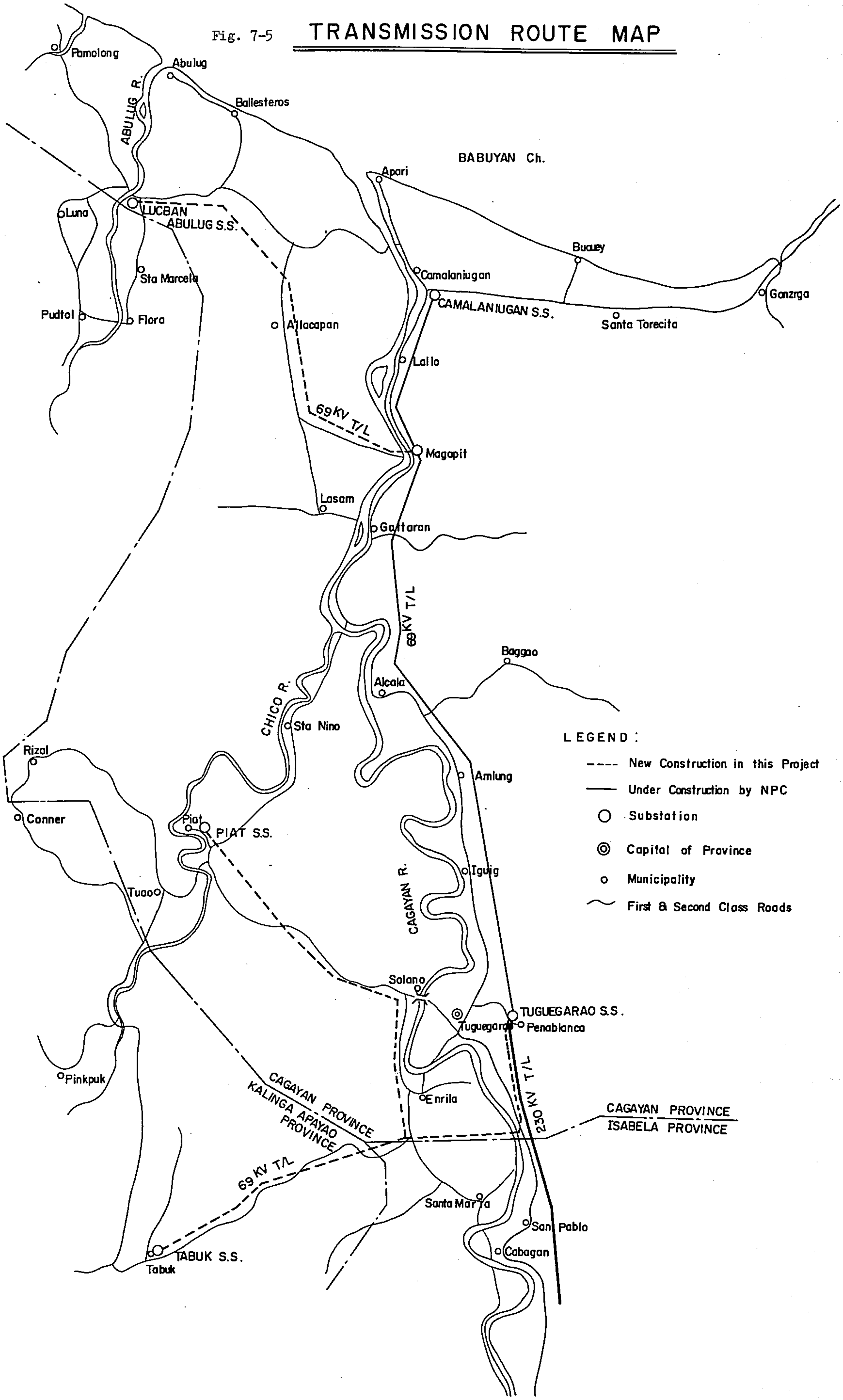


Fig. 7-5 TRANSMISSION ROUTE MAP



b. The conductor having an ultimate tensile strength of 6,360kg and a maximum working tension of 2,400kg affords a safety factor of 2.8.

c. Interchangeability of spare parts, accessories and tools can be ensured because the same conductor is used for the 69KV transmission line now under construction by NPC.

Besides, armor rods will be provided for protection of conductor mounting points.

(3) Insulation design

The internal abnormal voltage developed in the 69KV transmission system is estimated at 172KV and the required insulation strength allowing the insulation decrease factor is estimated at 206KV. To provide this insulation strength, three insulators will be required. With the addition of one insulator for maintenance purpose, a total of four 250mm standard insulators will be adopted. Since the distance between the transmission line and the nearest coast line is about 13km, no specific measures will be taken against salt damage.

(4) Lightning design

According to the statistics, the frequency of lightning in this region is 45 days per year in Aparri and 35 days in Tuguegarao, which is equivalent to the rate in the frequent lightning district in Japan. For protection from lightning, one overhead ground wire will be provided.

(5) Support

To minimize the initial investment and make effective use of domestically produced materials, supports of transmission lines will be wooden poles except for two river crossing points of long spans where steel towers will be constructed.

Based on the maximum wind velocity of 40m/sec as mentioned previously, the design wind pressure is determined as follows.

Wooden pole	80kg/m^2
Steel tower	290kg/m^2
Insulator	140kg/m^2
Strung wire	100kg/m^2

B-2. Outline of Transmission Lines and Accessories

(1) Lucban-Abulug transmission line

Section :	Between Lucban - Abulug S/S and branch-off point in Camalaniugan transmission line
Line length :	46Km
Voltage :	69KV
Electric system:	3-phase, 3-wire system, 60Hz
No. of circuits:	1
Conductor :	170mm^2 (336.4KCM) ACSR.
Overhead ground wire :	55mm^2(3/8") stranded galvanized steel wire
Insulator :	254mm suspension insulator, four insulators in string
Support :	Wooden pole (2 steel towers will be constructed for river crossing)

(2) Piat transmission line

Section :	Between Tuguegarao S/S and Piat S/S
Line length :	66km
Voltage :	69KV
Electric system:	3-phase, 3-wire system, 60Hz
No. of circuits:	1
Conductor :	170mm^2(336.4KCM) ACSR.
Overhead ground wire :	55mm^2(3/8") stranded galvanized steel wire
Insulator :	254mm suspension insulator, four insulators in string
Support :	Wooden pole (2 steel towers will be constructed for river crossing)

(3) Tabuk transmission line

Section	:	Between Lucban - Abulug S/S and branch-off point in Piat transmission line
Line length	:	36km
Voltage	:	60KV
Electric system	:	3-phase, 3-wire system, 60Hz
No. of circuits	:	1
Conductor	:	170mm^2(336.4KCM) ACSR.
Overhead ground wire	:	55mm^2(3/8") stranded galvanized steel wire
Insulator	:	254mm suspension insulator, 4 insulators in string
Support	:	Wooden pole

Note: Since Magapit S/S may be installed immediately below the Camalaniugan transmission line, construction of a branch line is not necessary.

C. Preliminary Design of Substation Facilities

C-1. Outline of preliminary design

(1) Selection of substation capacity

Substation capacity will be 15MVA and 10MVA because of the anticipated load of substations and the weight limit of transformers for transportation. In selecting the substation capacity, consideration was also given to the requirement for the capacity which will be adequate for at least five years following the installation.
A preliminary study shows that in many cases construction of a new substation is more economical than installation of additional transformers when the overload of transformers occurs in the future.

However, consideration was given to the design to allow installation of one additional transformer, if necessary, in the future.

(2) Insulation design

Insulation strength of transformers will be as follows to provide coordination of insulation with transmission lines.

69KV transformer	BIL	350KV
13.2KV transformer	BIL	110KV

Rated voltage of lightning arrestors will be 60KV for 69KV lines and 12KV for 13.2KV lines.

For protection from lightening, overhead ground wires will be provided.

C-2. Specifications of major equipment

(1) Main transformer

In this region, it is necessary to provide voltage regulators because of the length of transmission lines and large voltage variation at receiving end. For this purpose, main transformers will be equipped with a ±10% on-load tap changer. Since the multiple grounding system is used for the 13.2KV distribution lines, connection of main transformers will be Δ - Y. The type of transformer will be three-phase transformer.

(2) Circuit breaker

Rated breaking current of circuit breakers will be as follows which has been determined by the fault current calculation and according to the standard.

69KV	12.5KA	(1,600MVA)
13.2KV	12.5KA	(500MVA)

(3) Equipment for 13.2KV distribution line

For incoming line equipment of 13.2KV distribution lines, outdoor type cubicles will be used to save floor space and for simplity of installation work. For distribution lines, the system of reclosing one time automatically will be adopted.

C-3. Outline of substation facilities

Table 7-4

Description \ Substation	Lucban-Abulug S/S	Piat S/S	Tabuk S/S	Magapit S/S	Tuguegarao S/S
(1) Incoming line equipment for 69KV transmission line	1 circuit	1 circuit	1 circuit	1 circuit	1 circuit
72KV 12.5KA OCB	1 unit	1 unit	1 unit	1 unit	1 unit
72KV disconnecting switch	1 unit	1 unit	1 unit	1 unit	1 unit
(2) 69/13.2KV main transformer (Three-phase, with ±10% OLTC)	1 unit	1 unit	1 unit	1 unit	-
Capacity	15 MVA	15 MVA	10 MVA	15 MVA	
(3) Incoming line equipment for 13.2KV distribution lines (outdoor type cubicle with built-in circuit breaker, disconnecting switch, instruments and relays)	4 circuits	4 circuits	3 circuits	4 circuits	-
(4) House power facilities (outdoor type cubicle with built-in fu-ed disconnecting switch, house transformer and switches)	1 set	1 set	1 set	1 set	-

Note: Incoming line equipment for 13.2KV distribution line include one spare circuit to meet the increase of load in the future.

D. Preliminary Design of Communication Facilities between Substations

D-1. Outline of preliminary design

A power line carrier telephone system will be provided for load dispatching between substations and maintenance of transmission and substation facilities. For simplification of facilities and saving of initial investment, the following method will be used for power line carrier communication system.

(1) Line coupling method

The one line-to-ground coupling system, which has been proved to be sufficient as a result of calculation of transmission loss will be adopted (Line-to-line coupling system planned by NPC will be used between Tuguegarao and Camalaniugan).

(2) Number of channels and propagation mode

Since the planned transmission and substation system requires no power line carrier relaying and telemeters, one-channel will be used for the communication system. Also, the multi-terminal power line carrier telephone will be used to save construction cost.

D-2. Outline of facilities

(1) Tuguegarao S/S

One-channel power line carrier telephone system for communication with Lucban-Abulug S/S and with Magapit S/S - 1 set

One channel power line carrier telephone system for communication with Piat S/S and Tabuk S/S - 1 set

(2) Magapit S/S and Lucban-Abulug S/S

One-channel power line carrier telephone system - 1set for each substation.

(3) Piat S/S and Tabuk S/S

One-channel power line carrier telephone system for each substation.

7-2-3. Distribution Facilities

A. Basic Plan

(1) Voltage and distribution system

High voltage line	:	7.62/13.2KV, 3-phase, 4-wire, multiple grounding system	
Low voltage line	:	Lighting -	240V single-phase 2-wire system or
			480V single-phase 3-wire system
		Motor -	240V 3-phase 3-wire system or
			480V 3-phase 3-wire system

(2) Limit of voltage drop in distribution system

High voltage line	:		10%
Low voltage line	:	Lighting -	6%
		Motor -	10%

(3) Voltage regulation

Voltage variation of lamp circuit for consumers will be maintained within ±6% through voltage adjustment with on-load tap changer (OLTC) provided at substations, step voltage regulators (SVR) installed on high voltage distribution lines and pole transformers equipped with 2.5% taps.

(4) Improvement of supply reliability

a. Each circuit will be provided with two or three reclosers for reclosing at time of a fault and automatic separation of the fault section.

Branch distribution lines will be equipped with line fuses to prevent the propagation of fault to the trunk line system.

b. For protection from lightning, transformers, reclosers and other equipment will be equipped with lightning arresters. Overhead ground wire will not be installed.

B. Outline of Preliminary Design

(1) Supports

a. Wooden poles will be used for supports except for special sections such as extremely long spans. The standard span will be 90 m for high voltage lines and 60 m for low voltage lines, with a lateral stay against wind pressure provided for every 5 spans and longitudinal stay provided every 10 spans. Steel towers will be used for river crossing points with a span of more than 300 m.

b. For crossarm, wooden crossarms will be used.

c. For high voltage pin insulators, solid core insulators will be used and 2-string strain insulators will be used.

d. In principle, high voltage lines will be in horizontal arrangement and low voltage lines will be in vertical arrangement.

(2) Conductor

a. High voltage trunk lines will be 3-phase, 4-wire 7.62/13.2KV system and the type of conductor will be ACSR 120 mm^2 (237 KCM), 58 mm^2 (114 KCM) and 25 mm^2 (49.3 KCM) bare conductors depending on load conditions.
Neutral conductors will be of two sizes, 58 mm^2 and 25 mm^2.
The volume of work for high voltage trunk lines was determined on the basis of route planning mainly through field surveys and partly through a study of maps on a scale of 1/50,000.

b. High voltage branch lines will be of V-phase, 3-wire system and will be able to supply power for both lighting and motive power. Bare conductor of 58 mm^2 (114 KCM) and 35 mm^2 (49.3 KCM) ACSR will be used. The volume of work for all high voltage branch lines was determined through a study of maps on a scale of 1/50,000.

c. For high voltage feeder lines which will be extended to transformers in Town or Barrio, V-phase and single-phase will be used for motive power and lighting, respectively. Bare conductor of 25mm^2 (49.3 KCM) ACSR will be used for these feeder liner. The volume of work was calculated for each Municipal by referring to the ratio of the volume of work to the number of consumers in the design for model districts and also referring to the design drawings for 8 districts of ISELCO and CAGELCO. The share of V-phase and single-phase was determined to be 17% and 83%, respectively, in consideration of the composition of load.

d. For low voltage lines, 58 mm^2 and 25 mm^2 ACSR and OW (Outdoor Weather Proof Polyvinyl Chloride Insulated Wires) will be used. (For neutral conductor, 25 mm^2 ACSR bare wires will be used.) The volume of work was calculated for each Municipal by referring to the design for model districts and design drawings of ISELCO and CAGELCO.

As a result of model calculation, the size of low voltage line in relation to transformer capacity was determined to be 25 mm^2 signle-phase 2-wire system for 5-10KVA, 25mm^2 single-phase 3-wire system for 15-30KVA and 58 mm^2 single-phase 3-wire system for 50KVA or over.
The component ratio of low voltage lines, will be 13.5% for 25 mm^2 single-phase 2-wire system, 77 % for 25 mm^2 single-phase 3 wire system and 9.5 % for 58 mm^2 single-phase 3-wire system.

(3) Transformer

a. Standard capacities of transformers will be 5KVA, 10KVA, 15KVA, 20KVA, 30KVA, 50KVA and 100KVA and the type of transformer will be single-phase transformer.

b. No-load tap changers (25%, 5 taps) will be provided.

c. As a result of model calculations, the composition of transformers by capacity was determined as follows.

5KVA	13.4%
10KVA	37.8%
15KVA	18.8%
20KVA	18,1%
30KVA	8.9%
50,100KVA	3,0%

d. The number of transformers required was calculated with the following formula after deducting the high voltage load such as the load of large irrigation pump stations from the estimated load of each COOP.

$$\text{No. of transformers required by capacity} = \text{Load(KW)} \times \frac{1}{0.48} \times \text{component ratio of transformers by capacity}$$

where 0.48 : The ratio of electrified households to total households covered by distribution lines in 1982. The utility rate of transformers in 1990 will be about 160% because of the increase of electrification rate and KWH/customer.

(4) Drop wire

a. Lighting

Two core 2.0 mm^2 standed DV wire (Polyvinyl Chloride Insulated Drop Service Wires) will be used.
The drop wires will be financed by the domestic fund.

b. Motor

Three-conductor 2.0mm^2, 2.6mm^2, 3.2mm^2, 4mm^2 and 5mm^2 DV wires will be used. The component ratio of wires was determined as follows by referring to the actual load of motors in the service area of ISELCO.

2.0mm^2	30%
2.6mm^2	20%
3.2mm^2	20%
4.0mm^2	15%
5.0mm^2	15%

c. The average length of drop wire per household was determined to be 35m from the experience in the service area of ISELCO.

d. An allowance of 10% was considered in determining the length of drop wires in view of possible changes in the requirement of consumers (changes in the design of drop wires due to modification of buildings, for example).

(5) Watthour meter

a. The number of WH meters required was calculated for low voltage lighting and motive power according to the number of customers.

b. Use of high voltage WH meters for high voltage consumers and for inter-COOP transactions was also considered.

c. An allowance of 10% was considered in determining the number of WH meters required in view of possible changes in the requirement of consumers (changes in the design of lead-in due to modification of buildings, for example).

(6) Street light

a. One street light will be provided for every 30 households in Town (Poblacion).

b. Two street lights will be provided for each Barrio.

Note: NEA leases street light equipment to Town (Poblacion) and Barrio.

(7) Other distribution equipment

a. Recloser

Reclosers will be installed in the middle of high voltage trunk lines and on the long distance branch lines at a rate of 2 to 3 reclosers per feeder.

Rated voltage:	15KV
Rated current:	50 - 200A
No. of reclosing times:	4

b. Line fuse

Line fuse will be installed on high voltage branch lines.

c. Air break switch

Air break switches will be provided at appropriate locations of high voltage trunk lines and high voltage branch lines for load division and also for limiting the range of power outage at time of maintenance work.

d. Capacitor

One 50KVA capacitor will be provided for every 2,000 KW of ordinary load for compensation of reactance of pole transformers.

e. Step voltage regulator (SVR)

Step voltage regulators (SVR) will be provided for voltage improvement of feeders in which phase voltage drop exceeds 760V. Specifications will be ± 760V (with 15 taps) and the capacity will be 1,000KVA, 2,000KVA and 3,000KVA.

C. Outline of Distribution Facilities

The required quantity of distribution equipment is as follows.

Table 7-5

Description		Unit	Quantity	Remarks
1. High voltage distribution line	3-phase 120 mm^2 ACSR	km	565.5	3-phase 1,273.9km others 2,213.1km
	3-phase 120 mm^2 ACSR (joint tuse)	"	132.6	
	3-phase 58 mm^2 ACSR	"	505	
	3-phase 25 mm^2 ACSR	"	70.8	
	V-phase 58 mm^2 ACSR	"	792.6	
	V-phase 25 mm^2 ACSR	"	906.8	
	Single-phase 25 mm^2 ACSR	"	513.7	
	(Subtotal)	"	3,487	
	Steel tower	each	8	4 river crossing points
	Substation outgoing cable	Circuit	34	
2. High voltage equipment	Recloser	each	69	
	Capacitor	"	39	50 kVA/ unit
	Air break switch	"	138	
	Line fuse	"	138	
	SVR 1000 kVA	"	4	
	2000 kVA	"	20	
	3000 kVA	"	13	
3. Pole transformer		"	6,320	Total Capacity 93,530KVA

Description		Unit	Quantity	Remarks
4. Low voltage line	Under-built with high voltage line	km	1,330	
	New installation	"	2,494	
	Subtotal	"	3,824	
5. Drop wire	2-wire system	place	128,276	
	3-wire system	"	2,314	
	Subtotal		130,590	
6. WH Meter	Low-voltage, single-phase	each	128,276	
	Low-voltage, 3-phase	"	2,303	
	High-voltage, 3-phase	"	17	
	Subtotal	"	130,596	
7. Street light		"	3,764	

Notes: 1. Figures shown in the table above do not include the quantities of existing facilities and the work under construction of ISELCO I and CAGELCO I and facilities planned under the Cagayan Integrated Agricultural Development Project shown below.

Table 7-6

	ISELCO I	CAGELCO I	Integ. Agr. Dev. Project	Total
High voltage distribution line	180.5 km	124 km	60.5 km	365 km
Low voltage line	125.6 km	101 km	140 km	366.5 km
Transformer	282 ea (6,277KVA)	135 ea (2,355KVA)	70 ea (1,050KVA)	485 ea (9,682KVA)
Drop wire and WH meter	5,702	2,843	6,000	14,545

Notes: 2. Interior wiring, which will be covered by domestic currency, is not included in this table.

The outline of distribution facilities classified by COOP is shown in Table 7-7.

Table 7-7. Outline of Distribution Facilities Classified by COOP

Description		Unit	N.VIZKAYA	IFUGAO	QURINO	ISABELA.I	ISABELA.II	CAGAYAN.I	CAGAYAN.II	K.APAYAO I	K.APAYAO II	Total
1. High voltage distribution conductor	3-phase 120mm ACSR	km	46.5	44	15.8	35.2	154.7	23.4	131.8	70	44.1	565.5
	3-phase 120mm ACSR (under built)	"	39.2	-	-	3.5	23.2	30.8	35.9	-	-	132.6
	3-phase 58mm ACSR	"	141.4	21.4	13.4	42.3	38.6	38.5	71.5	95.9	42	505
	3-phase 25mm ACSR	"	9.2	16.1	10.4	9.2	-	6.0	-	4.6	15.3	70.8
	V-phase 58mm ACSR	"	95.0	42.8	37.7	162.4	111.2	132.7	105.2	63	42.6	792.6
	V-phase 25mm ACSR	"	110.6	46.8	42.4	186.8	129.7	152.8	122.9	69.5	45.3	906.8
	Single-phase 25mm ACSR	"	75.6	21.4	22.4	93.5	90.7	79.1	85.6	32.2	13.2	513.7
	Subtotal	"	517.5	192.5	142.1	532.9	548.1	463.3	552.9	335.2	202.5	3407
2. High voltage equipment	Recloser	each	11	4	3	16	10	7	10	4	4	69
	Capacitor	"	4	1	1	12	6	6	6	2	1	39
	Air break switch	"	22	8	6	32	20	14	20	8	8	138
	Line fuse	"	22	8	6	32	20	14	20	8	8	138
	SVR 1000KVA	"	1	1	-	-	2	-	-	-	-	4
	2000KVA	"	2	1	1	3	3	4	5	1	-	20
	3000KVA	"	1	1	-	4	3	3	1	-	-	13
3. Pole transformer		"	815	198	209	1,562	1,273	916	902	316	129	6,320
4. Low voltage conductor	Under-built with high V. line	km	207.8	59.3	61.7	261	238.8	209.5	162.3	90.5	39.1	1330
	New installation	"	375.8	108.7	112.6	469.9	410.1	400.5	342.7	168.8	77.9	2494
5. Drop wire	2-wire system	place	21910	4853	5124	24914	22981	20979	16549	7913	3053	128276
	3-wire system	"	184	12	64	544	415	452	456	152	35	2314
6. WH Meter	Low voltage, single-phase	each	21910	4853	5124	24914	22981	20979	16549	7913	3053	128276
	Low voltage, 3-phase	"	184	12	64	533	415	452	456	152	35	2303
	High voltage, 3-phase	"	1	-	-	2	-	7	7	-	-	17
7. Street light		"	378	156	162	907	687	575	595	208	96	3764

7-2-4. COOP Facilities

A. Office Building

NEA plans to construct a headquarter building (called the General Plant) for each COOP. The General Plant has already been constructed for CAGELCO and ISELCO. Therefore, the General Plant will be provided for each of remaining seven COOP's under the project.

Headquarter	- One building	(7 in all)
Warehouse	- One "	(7 in all)
Maintenance shop	- One "	(7 in all)
G.M. residence	- One "	(7 in all)
Multi-purpose office	- One "	(7 in all)

All of these buildings will be one-story concrete block structures.

B. Communication Facilities

(1) NEA-COOP communication facilities

Since the public telephone system is not well developed in this region except a few city areas, communication between NEA and COOP will have to depend on telegram for the time being. In order to ensure smooth and efficient progress of construction work and general administration, it is essential to provide some means of communication between NEA and each COOP.

For this purpose, the desk type SSB radio telephone system has been selected because of its low installation cost and simplicity of operation and also because of the fact that there is a long distance between NEA and each COOP and that there is no requirement for data transmission other than telephone conversation for the time being under the existing condition.

Outline of specifications:

Frequency band - Short wave band (4-23 MHz) 1 channel

Communication system - Press-to-talk system

Side-band wave - Upper side-band wave

Transmitter output - 100 W

Receiver output - 3 W

Quantity required: 9 (including antenna and emergency power source)

(2) Intra-COOP intercommunication facilities

A desk type VHF/FM radio telephone set will be provided in each COOP for communication with maintenance vehicles and mobile radio stations in an emergency or at time of maintenance work.

Outline of specifications:

Frequency range - 142-162 MHz
Operating system - Press-to-talk system
Transmitter output - 50 W
Receiver output - 0.5 W

Quantity required:

Fixed station - 9 (one station for each COOP)
Mobile station - 54 (6 stations for each COOP)

The VHF/FM radio communication system with a coverage of 20-50 km, which varies depending on topography, is not sufficient to cover the entire area of a COOP.

Additional communication facilities will be required for communication between the COOP and a branch offices to be established in major Towns in the future. For this purpose, installation of relay stations and addition of mobile and portable stations may be necessary. These facilities, however, can be provided in the 2nd stage of the project, and are, therefore, excluded from this project.

C. Transport Facilities

The following vehicles will be provided for use in construction work and maintenance work.

Distribution work car	14 units	- two vehicles each for 5 main COOP's* and one vehicle each for the remaining 4 COOP's.
Truck (large)	9 units	- one for each COOP
Truck (small)	14 units	- two vehicles each for 5 main COOP's and one vehicle each for the remaining 4 COOP's.
Jeep	18 units	- two for each COOP
Service car	9 units	- one for each COOP

* 5 main COOP's = CAGELCO I, II, ISELCO I, II, and NUVELCO.

D. Measuring Instruments and Tools

Measuring instruments and tools required for construction work and maintenance will be provided. Main items are as follows.

(1) Meter

Voltmeter, ammeter, megger, WHM tester, oil tester, hot line current detector, earthing resistance meter and others.

(2) Tools

Oil pressure compression device, stringing tools, chain block, chain saw and others.

E. Office Equipment

Two accounting calculators for billing will be provided for each of 5 main COOP's and one each will be provided for remaining for COOP's. One copying machine will be provided for each COOP.

7-3. Technical Conditions Associated with The Development Program

7-3-1. Transmission Line and Distribution Line Routes

The project area is a wide plain surrounded by the mountains on the east, west and south, and the selection of the transmission line and distribution line routes is relatively easy. The soil in the area is mainly sandy clay or clay, and is generally solid and strong, and therefore, no problem will be encountered with respect to the soil bearing capacity for the wooden pole lines.

The present field survey was made by jeep all over the 1st stage project area, excepting K. Apayao Province where the survey was made by a light plane, and it was found that there would be no particular problem in the construction of the lines, and the transportation of equipment and materials would be relatively easy.

Special attention should be paid to the following points when the route selection is made in the detailed design.

1) In the mountain areas of a part of N. Vizcaya Province (Kayapa, Kasibu and Ambuguio), Benawei in Ifugao Province and K. Apayao Province, the distribution lines have to pass through steep slopes of mountains. For such locations, the route selection should be made carefully under the guidance of experienced engineers.

2) The Cagayan River and the Magat River run from south to north through nearly the center of the project area, and the transmission lines and distribution lines have to cross these rivers. Where steel towers are needed for the river crossing (cf. next section 7-3-2), the most advantageous crossing points should be selected after careful study of the span lengths, the flood levels and the soil conditions.

   There are 5 locations where the distribution lines will be laid along the national highway bridges across the river, and for those points negotiation with DPH for permission of laying the distribution lines along the bridges will be needed.

7-3-2. River Crossings Requiring Steel Towers

Among the river crossing points, the following 6 points need be by steel towers. (cf. sketches of river crossing points in Fig 7-34)

Transmission Lines

Between	Span length
Magapit - Looan	350 m
Tuguegarao - Sta Maria	380 m

Distribution Lines

Roman - Potia	270 m
Ilagan - Magsaysay	410 m
Cabatuan - Aurora	300 m
Solano - Quezon	300 m

For the above-listed river crossing points, the routes should be selected after detailed topographic and geological survey, as pointed out in the foregoing section. Especially for the river crossing between Tuguegarao and Sta Maria, if the crossing point could be selected further downstream of the point shown in the sketch, the length of the transmission line would become shorter. Therefore, it is necessary to make re-study of the river crossing points.

The outline of the preliminary design of the river-crossing steel towers is as described below.

1) There are two types of river-crossing tower design, the one is the adoption of strain towers and the other is the adoption straight-line towers with strain towers built separately. In the present Project, since all the other supports are wooden poles, the former type of adoption of strain towers is more advisable with about 2 tons of tower steel required less per one crossing point.

2) The preliminary design of river-crossing towers was made on the following design criteria.

Design Criteria for River-crossing Towers

Item	Type I	Type II	Type III
Span length	380 m	400 m	350 m
No. of circuits*	2 cct	2 cct	2 cct
Conductors	170 mm^2 ACSR	120 mm^2 ACSR	120 mm^2 ACSR
Overhead ground wire	55 mm^2 GSW	120 mm^2 ACSR	120 mm^2 ACSR
Clearance above water	8 m	8 m	8 m
Wind load			
Towers	290 kg/cm^2		
Insulators	140 kg/cm^2		
Overhead wires	100 kg/cm^2		
Max. working tension	2,210 kg	2,000 kg	

* 1 circuit for future addition

For the above design criteria, Tower Type 3V-3 of the Japanese Electric Power Standard is applicable, and the adjustment to the topography of the individual locations will be made in the length of the leg portion of the towers. Fig. 7-12 shows the outline of Type I tower. (Tower weight: 8.1 tons)

As for the foundation, since the top layers are relatively good in soil conditions but the deeper soil conditions are not known, the preliminary design was made on the assumption that 8 pieces of 20 m steel pipe piles would be used per tower for a half of the total number of the steel towers, and the foundation without piles (allowable soil bearing capacity: 40 t/m^2) would be adopted for the other half of the towers.

Notes: i) Soil survey was made at several locations by the use of the cone penetrometer, and the data at the river crossing point between Tuguegarao and Sta Maria are as follows:

Depth	Cone bearing capacity
95 cm	5 kg/cm^2
195 cm	5.5 kg/cm^2
276 cm	5.8 kg/cm^2

ii) The Survey Team visited the Highway Offices and asked for soil data at the bridge locations, but could not get the data.

iii) There was a bridge under construction near Magapit, and according to an engineer in charge, 30 m steel pipe piles were used on the left bank only.

iv) According to the survey made by the Survey Team, the soil conditions at the river crossing points were generally good, and the soil conditions looked better on the right bank than on the left bank.

v) The ground water level is generally low, and the survey with wells of general dwelling houses near the rivers revealed that the water level was 6 m or more.

7-3-3. Existing Distribution Lines and Distribution Lines under Other Projects

As can be seen in Table 3-1, there are 9,626 KW of diesel engine generators in the project area,which are supplying to the customers by high voltage or low voltage lines.

Among these distribution lines, those of ISELCO I and CAGELCO I are new and are based on almost the same design criteria as the ones in this report, and therefore, they can be accepted into the system as they are, without any improvement.

The distribution lines owned by other private enterprises are operated at 2,000 V or low voltages, and the facilities are generally poor, and therefore, they cannot be accepted into this Project.

In the area along the Cagayan River in Cagayan Province, there is a distribution system for pumping and general electrification planned under the Cagayan Integrated Agricultural Development Project by the Japanese aid.

The following principle is adopted for the treatment of these existing distribution lines and the distribution lines planned under the other projects in the Project area.

1) Distribution lines of ISELCO I and CAGELCO I

Since the distribution lines of ISELCO I and CAGELCO I are acceptable as they are, as stated in the foregoing, all of the existing facilities and the confirmed plans are excluded from the present Project.

The outline of facilities are shown on Table 7-6, and the route length of the high voltage distribution line is 180.5 m with ISELCO I and 124 m with CAGELCO I.

2) Distribution lines of Cagayan Integrated Agriculturel Development Project

Since the distribution lines under this project are designed by the same design criteria as those adopted in the present Project, the planned quantities of distribution lines under this project are excluded from the quantities of the present Project.

The outline of the facilities is shown in Table 7-6, and the route length of the high voltage distribution lines is 60.5 m.

3) Other existing distribution lines

As stated in the foregoing, the other existing distribution lines are of different voltages and poor in the maintenance conditions, and they cannot be accepted into the system of the present Project.

Therefore, the new distribution lines are planned in the present Project independently from those existing distribution lines, and the supply will be made by the new distribution lines to the consumers, inclusive of the existing consumers.

7-4. Division of Procurement of Equipment and Materials

In the present report, the division of procurement into the foreign currency and the domestic currency of the necessary equipment and materials for the Project is made as follows.

Facility	Foreign currency	Domestic currency
69 KV transmission lines	1) Steel bracing 2) Bolts, nuts and other steel materials for pole assembly 3) Conductors, overhead ground wires, and accessory metals 4) Insulators and accessory metals 5) Grounding conductor and accessory metals 6) Guy materials 7) Steel towers and steel pipe piles 8) Stringing tools	1) Wooden poles 2) Arms 3) Wooden bracing 4) Kickblocks 5) Foundation materials, cement, reinforcing bars, sand, gravel
Substations and PLC telephones	1) Transformers, circuit breakers, and all other equipment 2) Conductors, insulators and accessories (incl. control cables, etc.) 3) Grounding materials 4) Outdoor steel 5) Tools and measuring instruments	1) Buildings (incl. water supply and drainage, fences and other appurtenant facilities) 2) Foundation materials, cement, reinforcing bars, sand, gravel 3) Tools and misc. materials available locally
Distribution facilities	1) Steel bracing 2) Bolts, nuts and other steel materials for pole assembly 3) Conductors and accessory metals 4) Insulators and accessory metals	1) Wooden poles 2) arms 3) part of bolts and nuts 4) Wooden bracing 5) Kickblocks 6) Drop wire

Facility	Foreign currency	Domestic currency
Distribution facilities	5) Grounding conductor and accessory metals 6) Pole transformers 7) Switches, lightning arresters and other equipment 8) SVR 9) Guy materials 10) Steel towers and steel pipe piles	7) Foundation materials 8) Tools and misc. materials available locally
Office facilities	1) Radio sets 2) Automobiles 3) Tools and measuring instruments 4) Accounting computers and copying machines	1) Buildings (incl. water supply and drainage, fences and other appurtenant facilities 2) Tools available locally 3) Office furniture and utensils

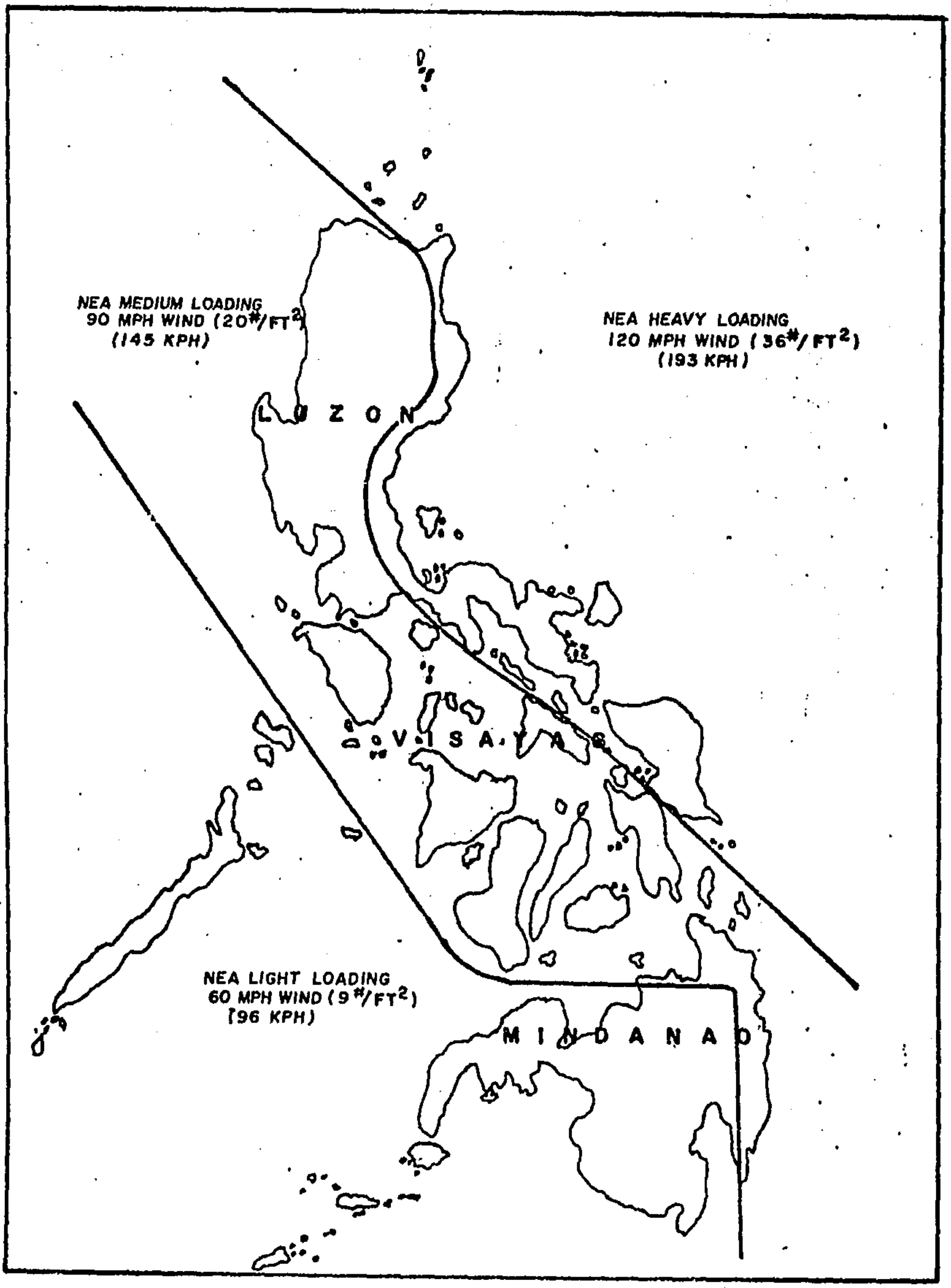
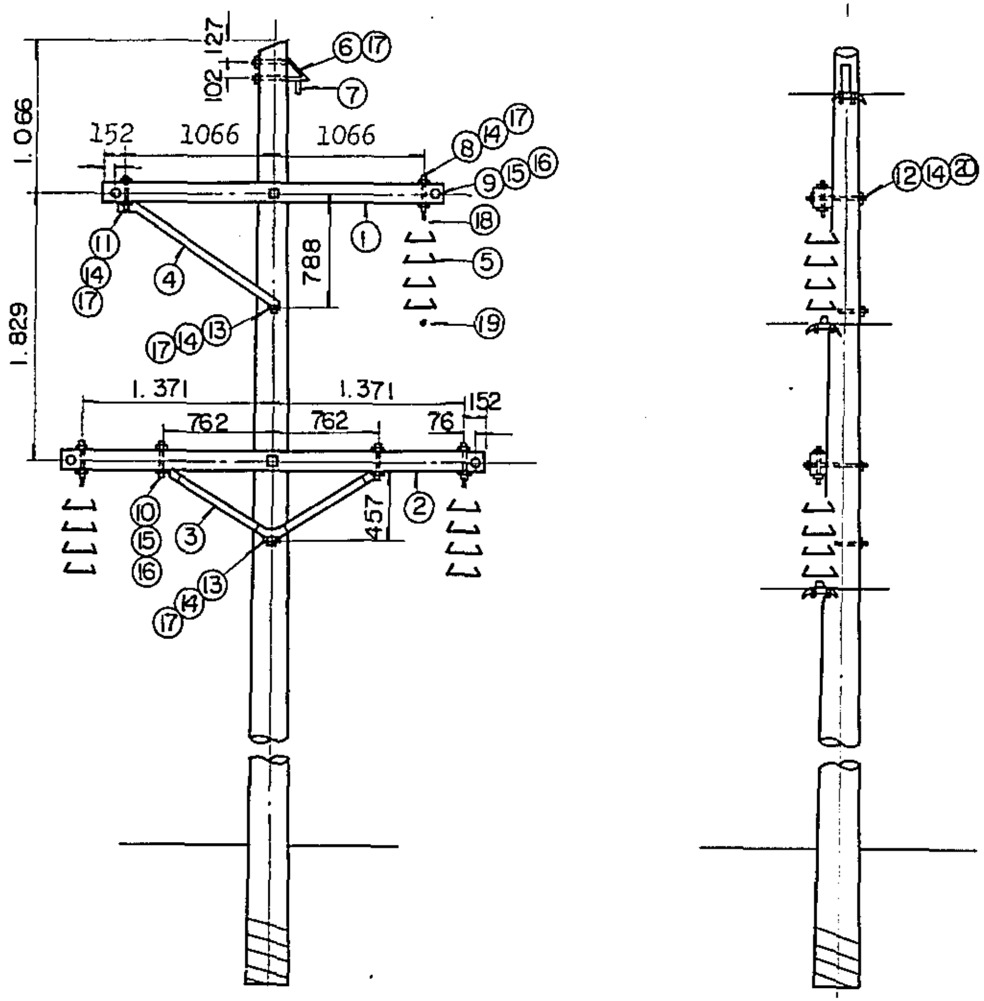


Fig. 7-6 MAP SHOWING WIND LOADING DISTRICTS IN THE PHILIPPINES

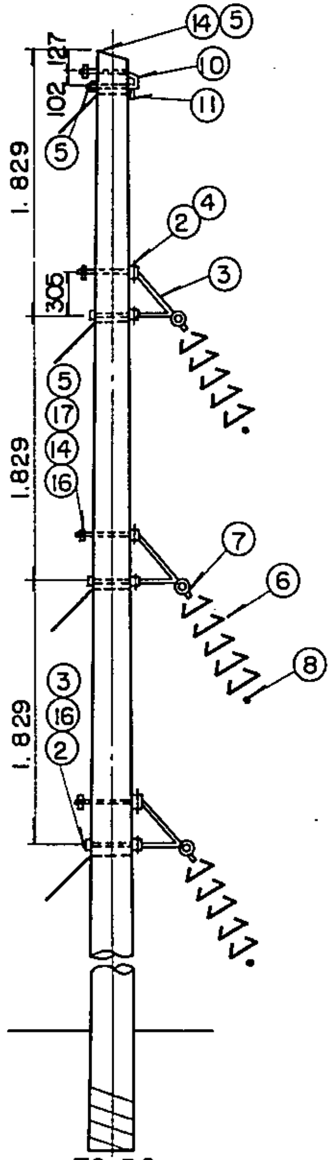
Fig. 7-7

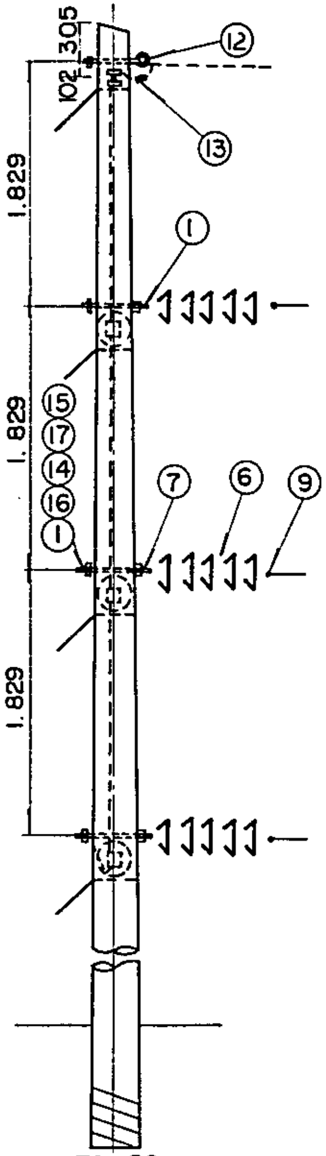


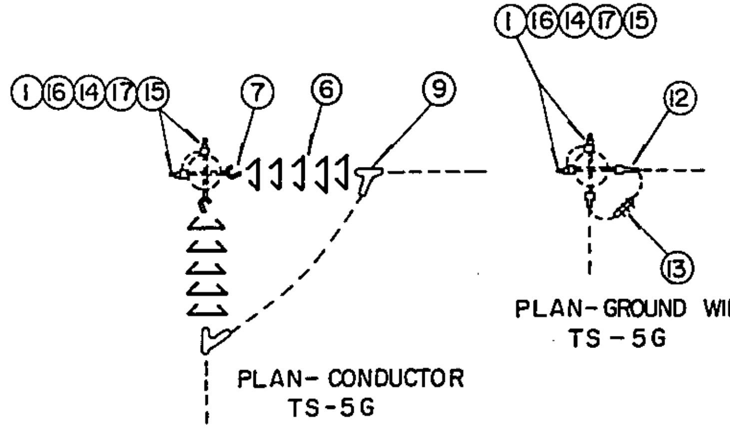
DRG. REF.	REQ'D	DESCRIPTION
1	1	45/8"x 55/6"x8'-0" Wood Crossarms
2	1	45/8"x 55/6"x10'-0" Wood Crossarms
3	1	60" Wood Crossarm Brace
4	1	48" Alley Arm Brace
5	12	53/4"x10" Suspension Insulator
6	1	Ground Wire Cable Support
7	1	Ground Wire Suspension Clamp
8	3	5/8"x8" Eye Bolt
9	4	1/2"x6" Machine Bolt
10	2	1/2"x8" Machine Bolt
11	1	5/8"x8" Machine Bolt
12	2	3/4"x18" Machine Bolt
13	2	5/8"x14" Machine Bolt
14	13	21/4"x21/4"x 3/16"Galv.Sq.Washer,13/16" Hole
15	10	13/8" Galv. Round Washer 9/16" Hole
16	6	Locknuts for 1/2" Bolt
17	8	Locknuts for 5/8" Bolt
18	3	Suspension Hook
19	3	Suspension Clamp and Connecting Piece
20	2	Locknuts for 3/4" Bolts
21	3	Armor Rod - Single Support

TRANSMISSION LINE TANGENT STRUCTURE
69 KV. SINGLE POLE SUSPENSION

Fig. 7-8







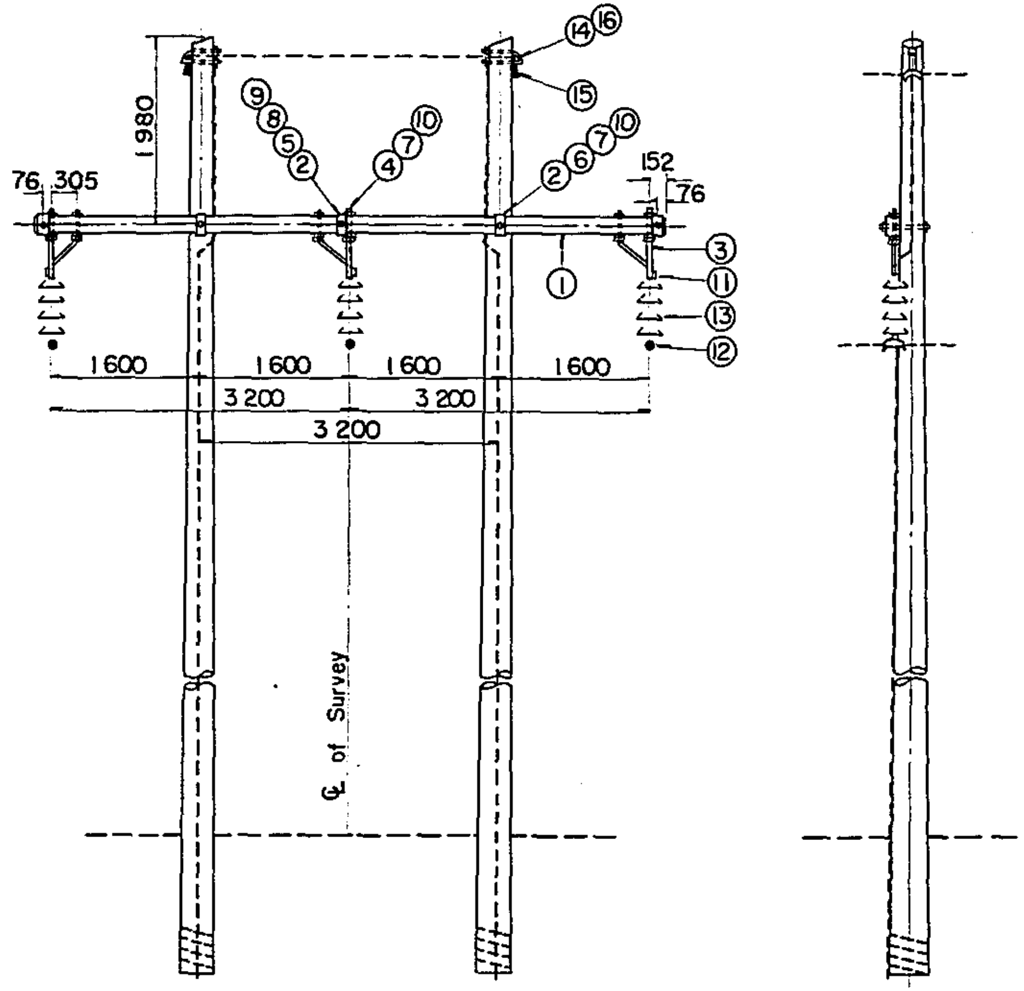
LIST OF MATERIAL

DRG REF.	REQUIRED TS-3G	REQUIRED TS-5G	DESCRIPTION
1		8	3/4" ShoulderEye Bolt. x 14"
2	6		5/8" Clevis Bolt. x 14" and 16"
3	3		3/4 Angle Bracket
4	6		21/4"x 21/4"x 3/16" Galv. Sq. Washer, 3/16" Hole
5	8		Locknuts for 5/8" Bolt
6	15	30	53/4" x 10" Suspension Insulator
7	3	6	Suspension Hook
8	3		Suspension Clamp & Connecting Piece
9		6	Dead End Clamp & Connecting Piece
10	1		Ground Wire Cable Support
11	1		Ground Wire Suspension Clamp
12		2	Ground Wire Dead End Clamp
13		1	6"-3 Bolt Clamp
14	4	8	Ground Wire Clamp
15		8	Locknuts for 3/4" Bolt
16	6	8	Washer, Square, Curved. 4"x4"x14"x13/16" Hole
17	3	8	Spring Washer
18	3		Armor Rod Single
19		3	Compression Connector

TRANSMISSION LINE VERTICAL STRUCTURES

69 KV. SINGLE POLE SUSPENSION WITH OVERHEAD GR'D

Fig. 7-9

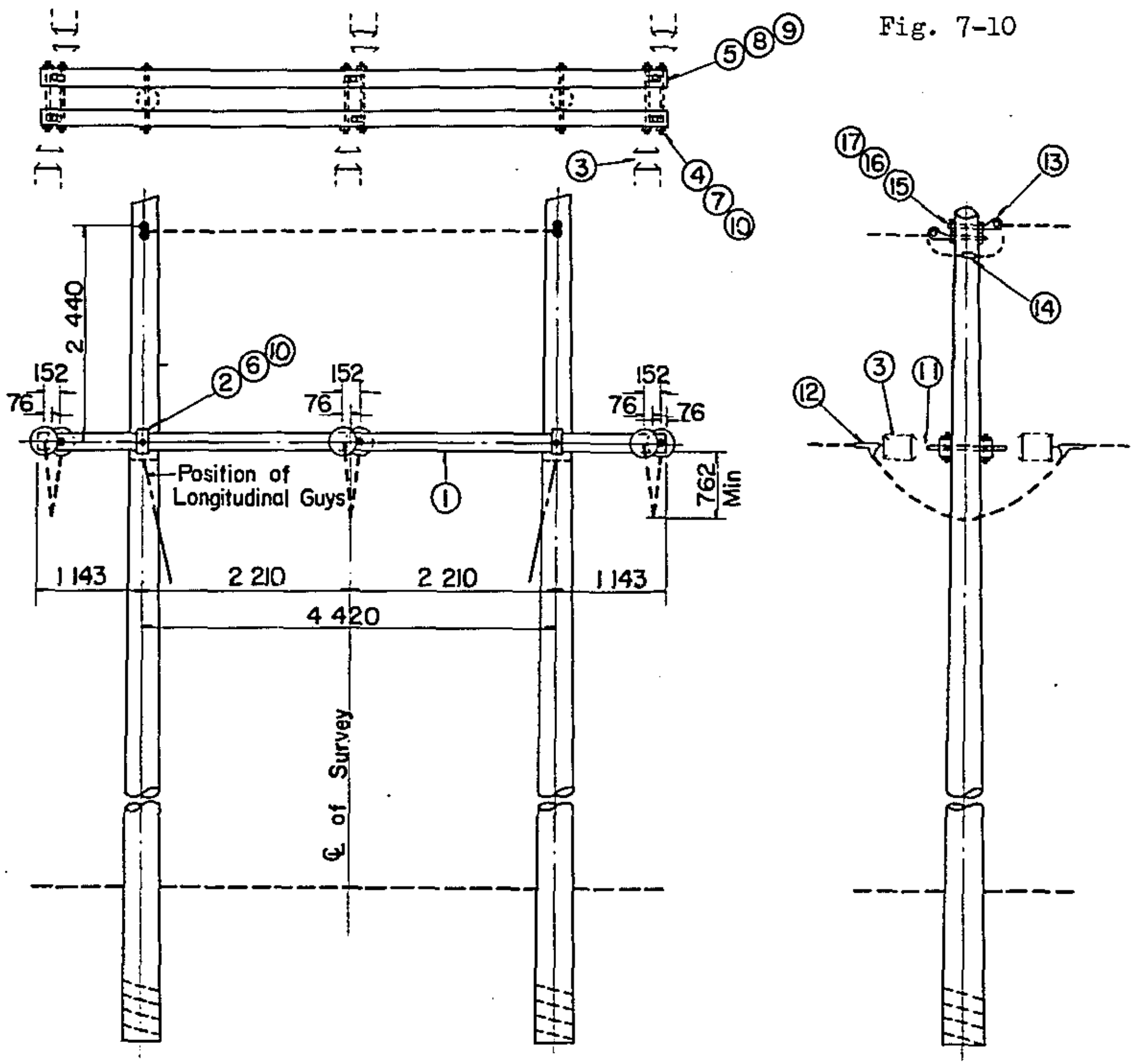


LIST OF MATERIAL

DRG. REF.	REQ'D	DESCRIPTION
1	1	55/8"x75/8"x22'-0" Wood Crossarm
2	8	Reinforcing Plate for 8" Crossarm
3	3	3/4" Angle Bracket
4	6	3/4"x10" Clevis Bolt
5	3	1/2"x 8" Machine Bolt
6	2	3/4"x18" Machine Bolt
7	14	4"x4"x3/16" Galv. Sq.Washer, 13/16" Hole
8	6	13/8" Galv. Round Washer 9/16" Hole
9	3	Locknuts for 1/2" Bolt
10	8	Locknuts for 3/4" Bolt
11	3	Suspension Hook
12	3	Suspension Clamp & Connecting Piece
13	12	53/4"x 10" Suspension Insulator
14	3	Armor Rod Single
15	2	Ground Wire Cable Support
16	2	Ground Wire Suspension Clamp
17	4	Locknuts for 5/8" Bolt

TRANSMISSION LINE TANGENT STRUCTURE
69 KV.H-FRAME SUSPENSION-TWO POLE-BRACKETS

Fig. 7-10

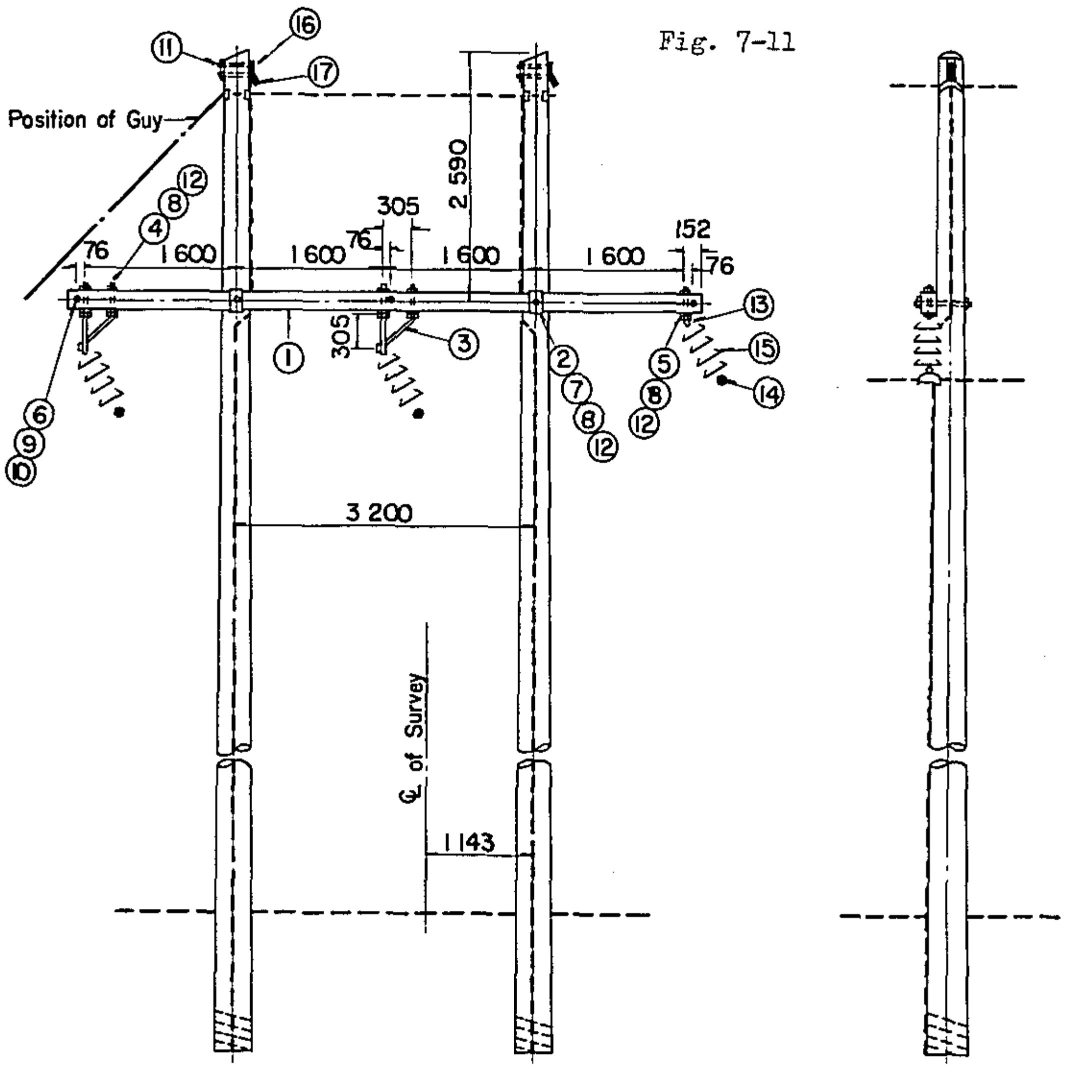


LIST OF MATERIAL

DRG REF	REQD	DESCRIPTION
1	2	55/8"x 75/8" Wood Crossarm x 22'-0"
2	4	Reinforcing Plate for 8" Crossarm
3	36	53/4"x 10" Suspension Insulator
4	6	3/4"x 26" Double Arm Eye Bolt
5	6	5/8"x 10" Machine Bolt
6	2	3/4"x 20" Machine Bolt
7	24	4"x 4"x 3/16" Galv. Sq. Washer, 13/16" Hole
8	12	21/4"x 21/4"x 3/16" Galv. Sq. Washer, 13/16" Hole
9	6	Locknuts for 5/8" Bolt
10	8	Locknuts for 3/4" Bolt
11	6	Suspension Hook
12	6	Dead End Clamp & Connecting Piece
13	4	Ground Wire Dead End Clamp
14	2	6"-3 Bolt Clamp
15	4	5/8"x 14" Eye Bolt
16	8	4"x 4"x 1/4" Galv. Sq. Washer, 13/16" Hole
17	4	Locknuts for 5/8" Bolt

TRANSMISSION LINE DEAD END STRUCTURE
69 KV. TWO POLE DOUBLE DEAD END

Fig. 7-11



LIST OF MATERIAL		
DRG REF	REQD	DESCRIPTION
1	1	55/8"x 75/8"x 22'-0" Wood Crossarm
2	2	Reinforcing Plate for 8" Crossarm
3	2	3/4" Angle Bracket
4	4	3/4"x 10" Clevis Bolt
5	1	3/4"x 10" Eye Bolt
6	3	1/2"x 8" Machine Bolt
7	2	3/4"x 18" Machine Bolt
8	12	4"x4"x3/16" Galv. Sq. Washer, 3/16" Hole
9	6	21/4"x 21/4"x3/16" Galv. Sq. Washer, 9/16" Hole
10	3	Locknuts for 1/2" Bolt
11	4	Locknuts for 5/8" Bolt
12	7	Locknuts for 3/4" Bolt
13	3	Suspension Hook
14	3	Suspension Clamp & Connecting Piece
15	15	53/4"x 10" Suspension Insulator
16	2	Ground Wire Cable Support
17	2	Ground Wire Suspension Clamp
18	3	Armor Rod Single

TRANSMISSION LINE MEDIUM ANGLE STRUCTURE
69 KV. H.FRAME SUSPENSION-TWO POLE W/BRACKETS

Fig. 7-12 69KV TOWER CONSTRUCTION FOR RIVER CROSSING

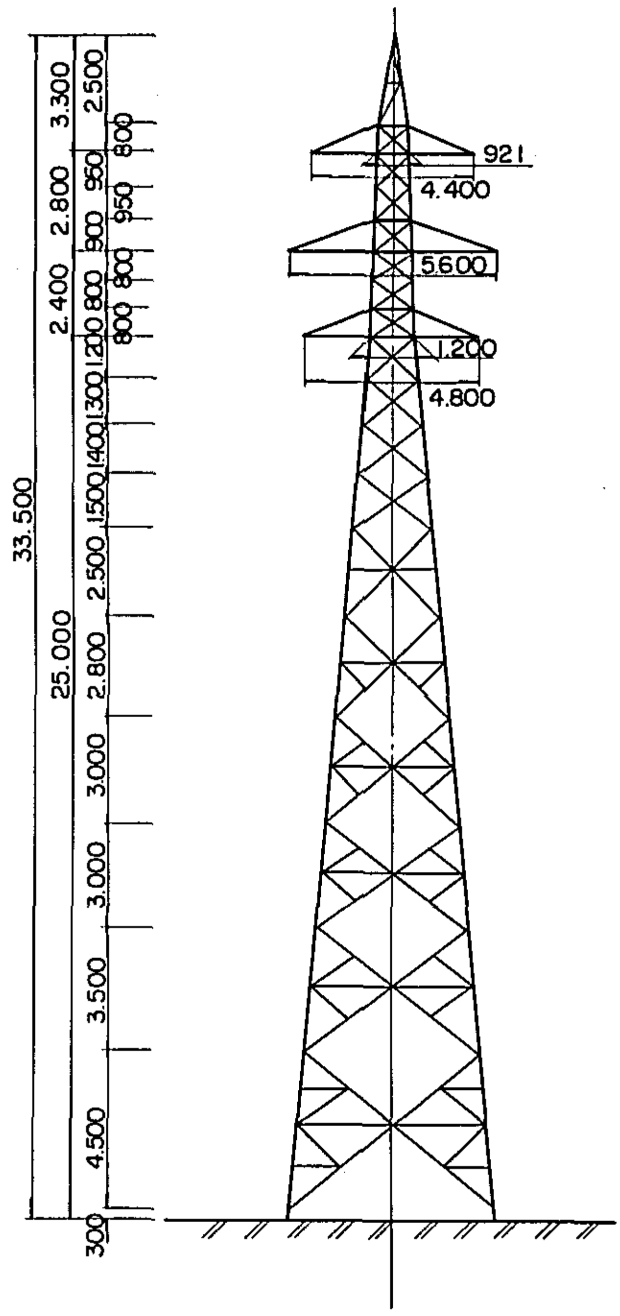
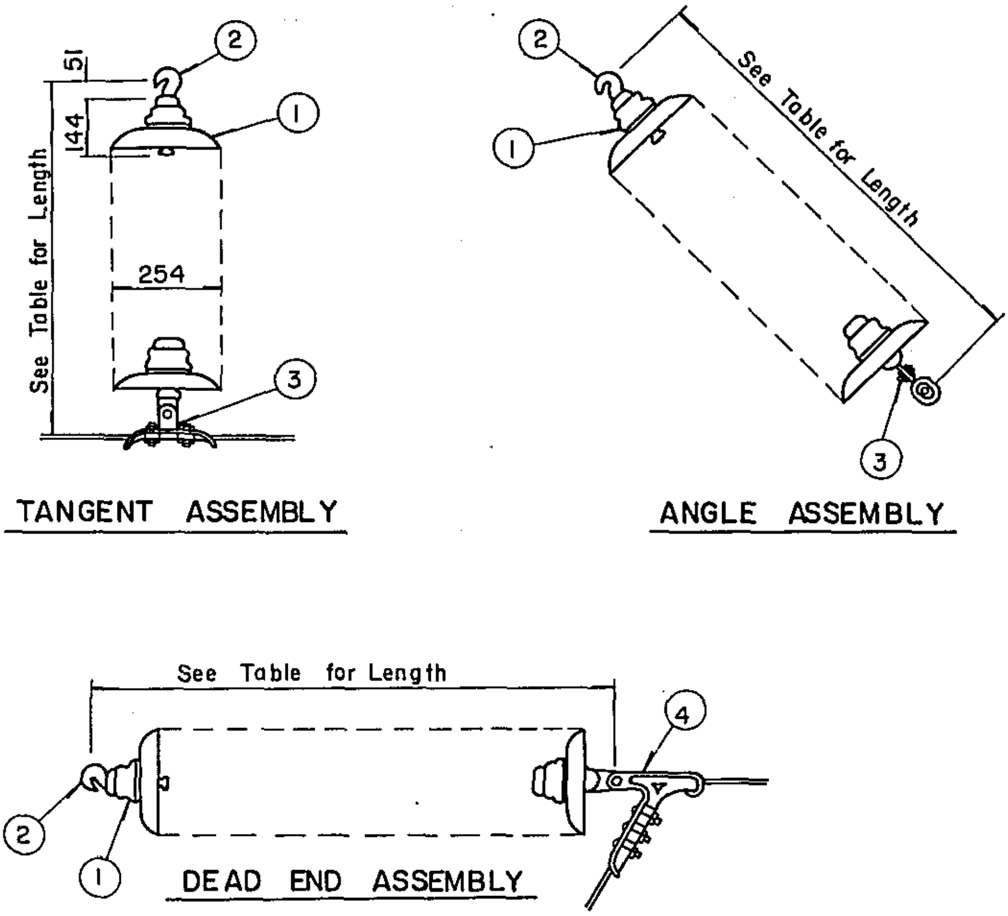


Fig. 7-13



Voltage Class	TANGENT		ANGLE		DEAD END	
	Units	Length	Units	Length	Units	Length
						1.096
69 KV	4	762	5	914	6	356

LIST OF MATERIAL

DRG. REF.	REQ'D	DESCRIPTION
1		5 3/4"x 10" Suspension Insulator
2	1	Suspension Hook
3	1	Suspension Clamp & Connecting Piece
4	1	Dead End Clamp & Connecting Piece

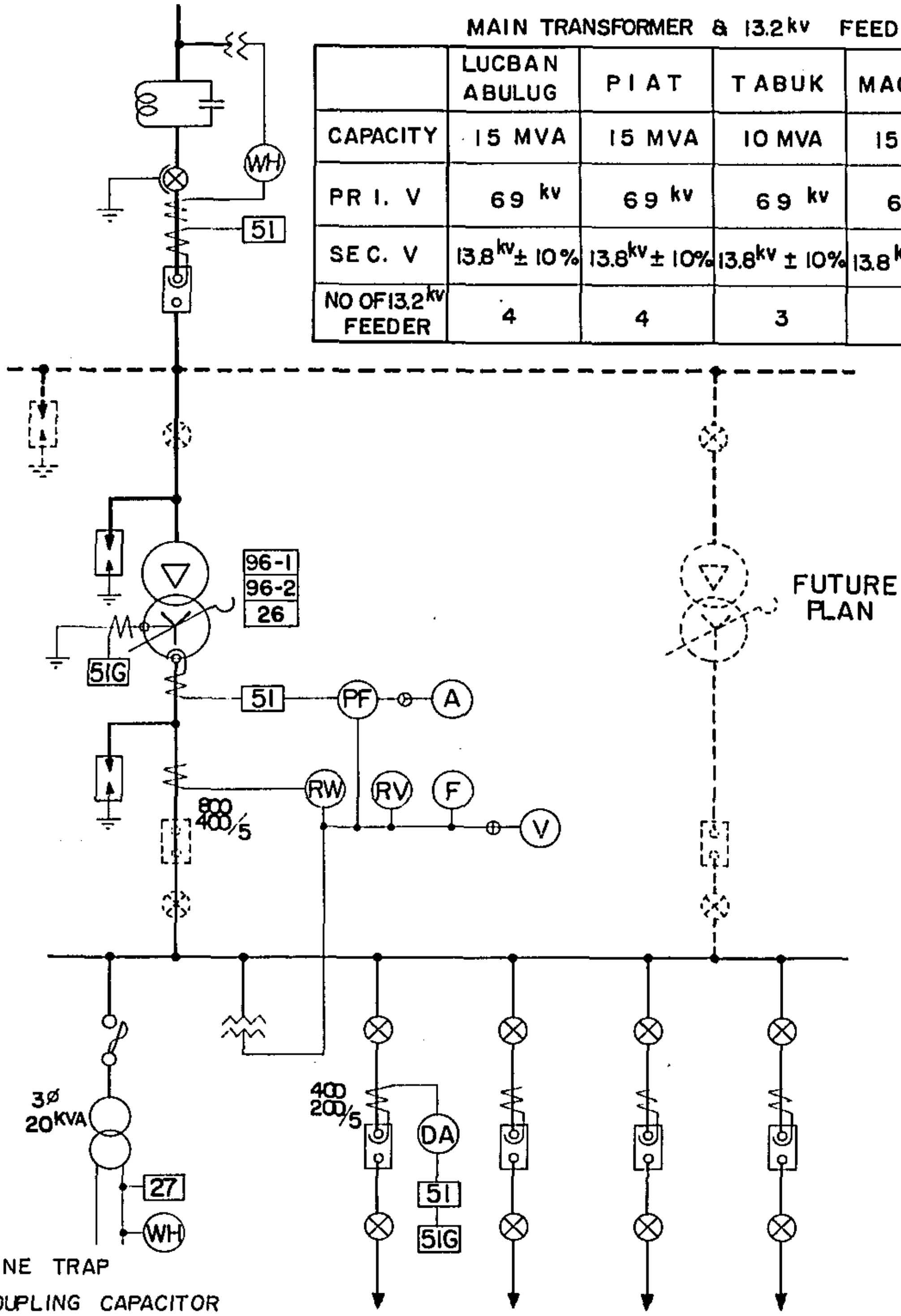
GUIDE TO

INSULATOR STRING ASSEMBLIES

Fig. 7-14 SINGLE LINE DIAGRAM OF 69/13.8^{kv} SUBSTATION

MAIN TRANSFORMER & 13.2^{kv} FEEDER

	LUCBAN ABULUG	PIAT	TABUK	MAGAPIT
CAPACITY	15 MVA	15 MVA	10 MVA	15 MVA
PRI. V	69 ^{kv}	69 ^{kv}	69 ^{kv}	69 ^{kv}
SEC. V	13.8^{kv} ± 10%	13.8^{kv} ± 10%	13.8^{kv} ± 10%	13.8^{kv} ± 10%
NO OF 13.2^{kv} FEEDER	4	4	3	4



LEGEND

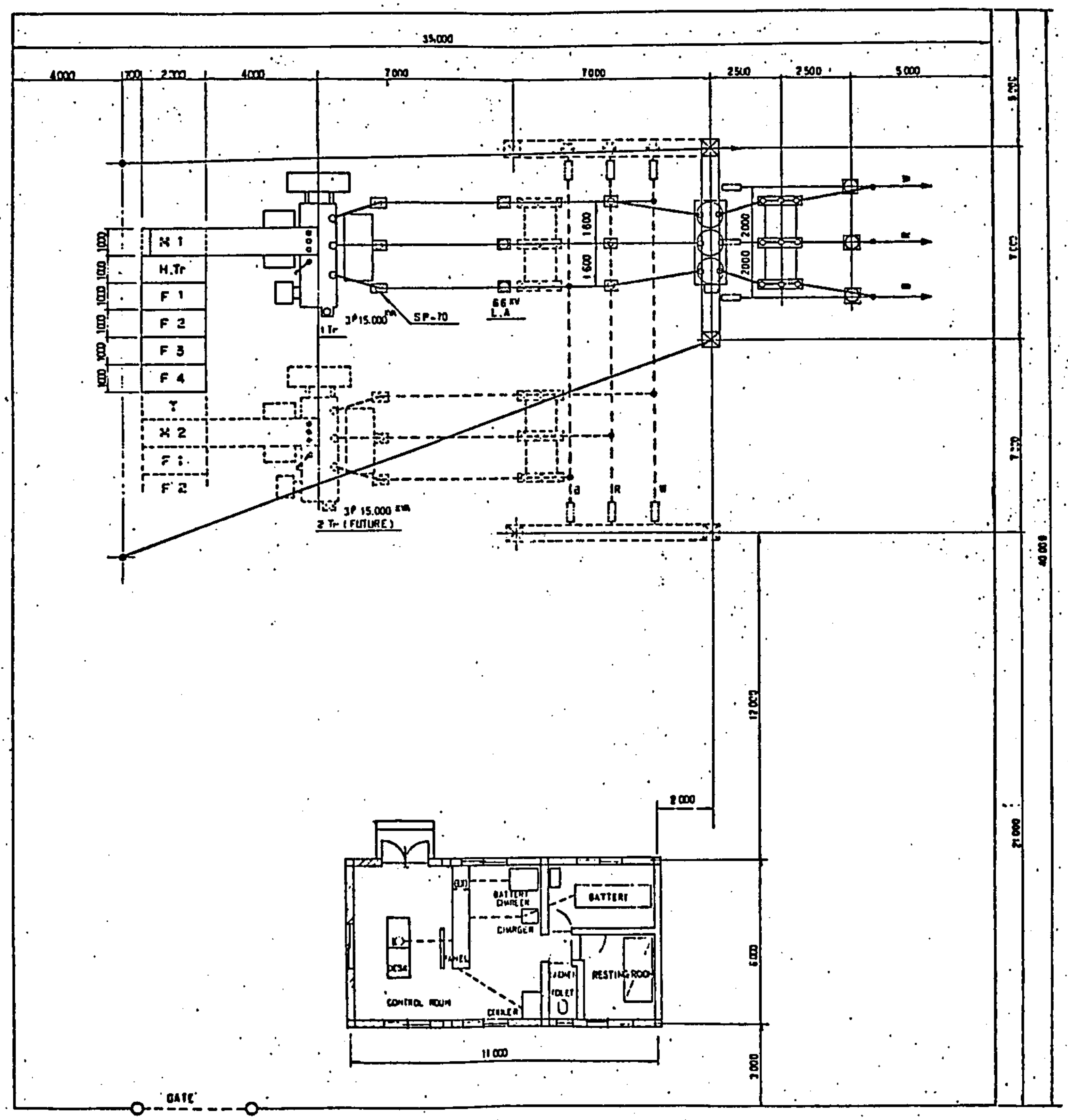
- : LINE TRAP
- : COUPLING CAPACITOR
- : CIRCUIT BREAKER
- : LIGHTNING ARRESTER
- ⊗ : DISCONNECTING SWITCH
- : CURRENT TRANSFORMER
- : TRANSFORMER
- : POTENCIAL TRANSFORMER

Table 7-8 Specifications of Power Line Carrier Telephone Circuit

Unit: db.

	Description	Section					
		Tuguegarao - Tabuk	Tuguegarao - Piat.	Tabuk -Piat	Tuguegarao - Lucban - Abulug	Tuguegarao Camalaniu-gan	Tuguegarao - Magapit
Transmission	Branching filter loss						
	Feeder loss	0.3	0.3	0.3	0.3	0.3	0.3
	Line coupling equipment loss	1.0	1.0	1.0	1.0	1.0	1.0
	BC insertion loss	1.5	1.5	1.5	1.5	1.5	1.5
	Others						
	(Total)	2.8	2.8	2.8	2.8	2.8	2.8
Line	Line loss	9.3	10.2	11.4	14.1	7.0	9.5
	Branch loss	6.0	6.0	6.0	6.0	3.0	6.0
	Bridge loss						
	(Total)	15.3	16.2	17.4	20.1	10.0	15.5
Receiving	BC insertion loss	1.5	1.5	1.5	1.5	1.5	1.5
	Line coupling equipment loss	1.0	1.0	1.0	1.0	1.0	1.0
	Feeder loss	0.3	0.3	0.3	0.3	0.3	0.3
	Branching filter loss						
	Others						
	(Total)	2.8	2.8	2.8	2.8	2.8	2.8
	Total transmission loss	20.9	21.8	23.0	25.7	15.6	21.1
	Equipment output	27.0	27.0	27.0	27.0	27.0	27.0
	Receiving input	6.1	5.2	4.0	1.3	11.4	5.9
	Line noise raining weather)	35	35	35	35	35	35
	S/N (rainy weather)	41.1	40.2	39.0	36.3	46.4	40.9
	" (fine weather)						
	Frequency	200 KHz	200 KHz	200 KHz	200 KHz	200 KHz	200 KHz
	Line length	58 Km	67 Km	79 Km	106 Km	70 Km	50 Km
	Transmission circuit System	Earth return	Earth return	Earth return	Earth return	Metallic	Earth return

Fig. 7-15 LAYOUT OF SUBSTATION



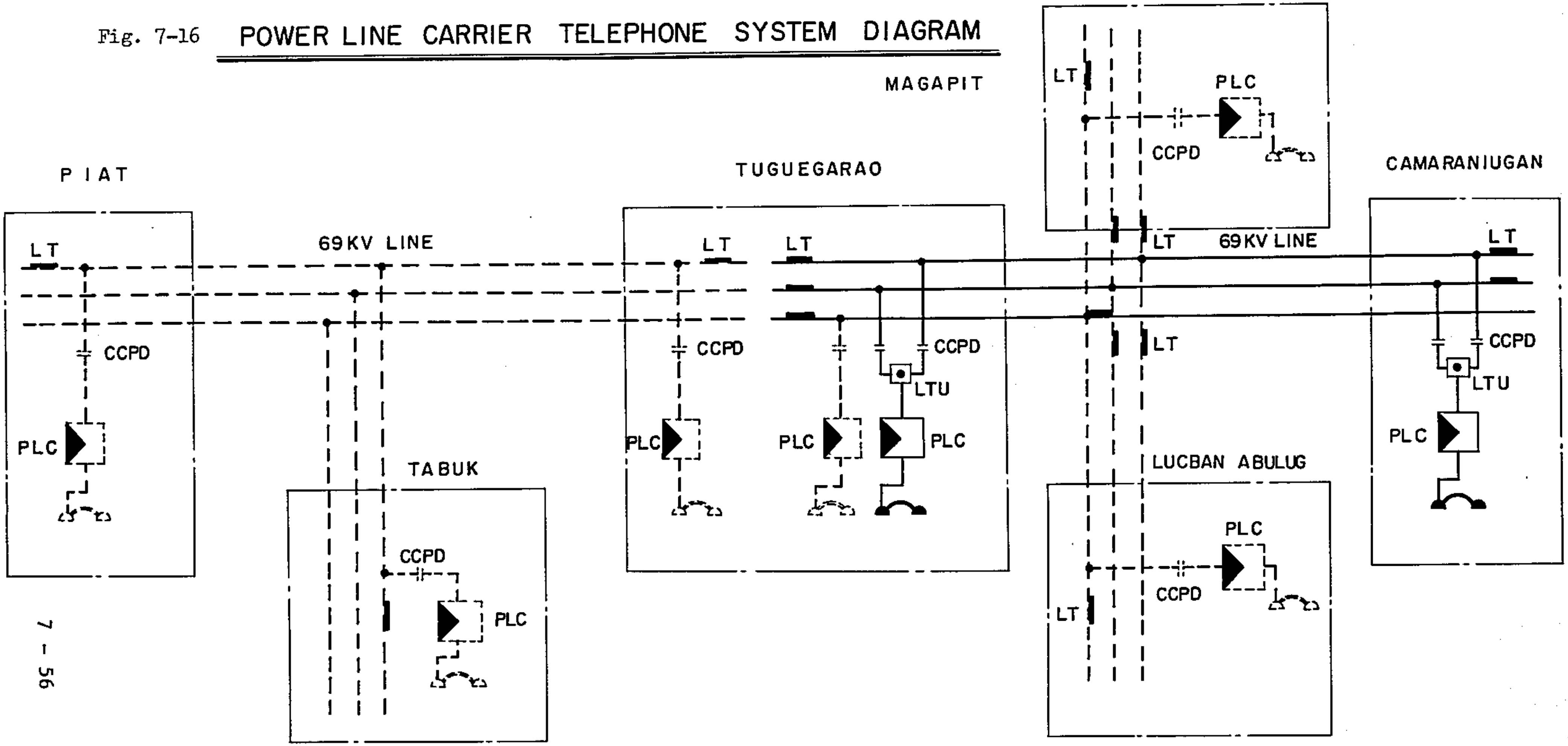
LAYOUT

OF

SUBSTATIDN

12

Fig. 7-16 POWER LINE CARRIER TELEPHONE SYSTEM DIAGRAM



LEGEND :

LT : Line Trap

CCPD : Coupling Capacitor Potencial Device

P L C : Power Line Carrier Equipment

L T U : Line Tunning Unit

---- : New Construction in This Project

Fig. 7-17 Distribution System - 7.62/13.2 kV, 3 Phase, 4 Wire, Common Neutral Multiple Grounding System.

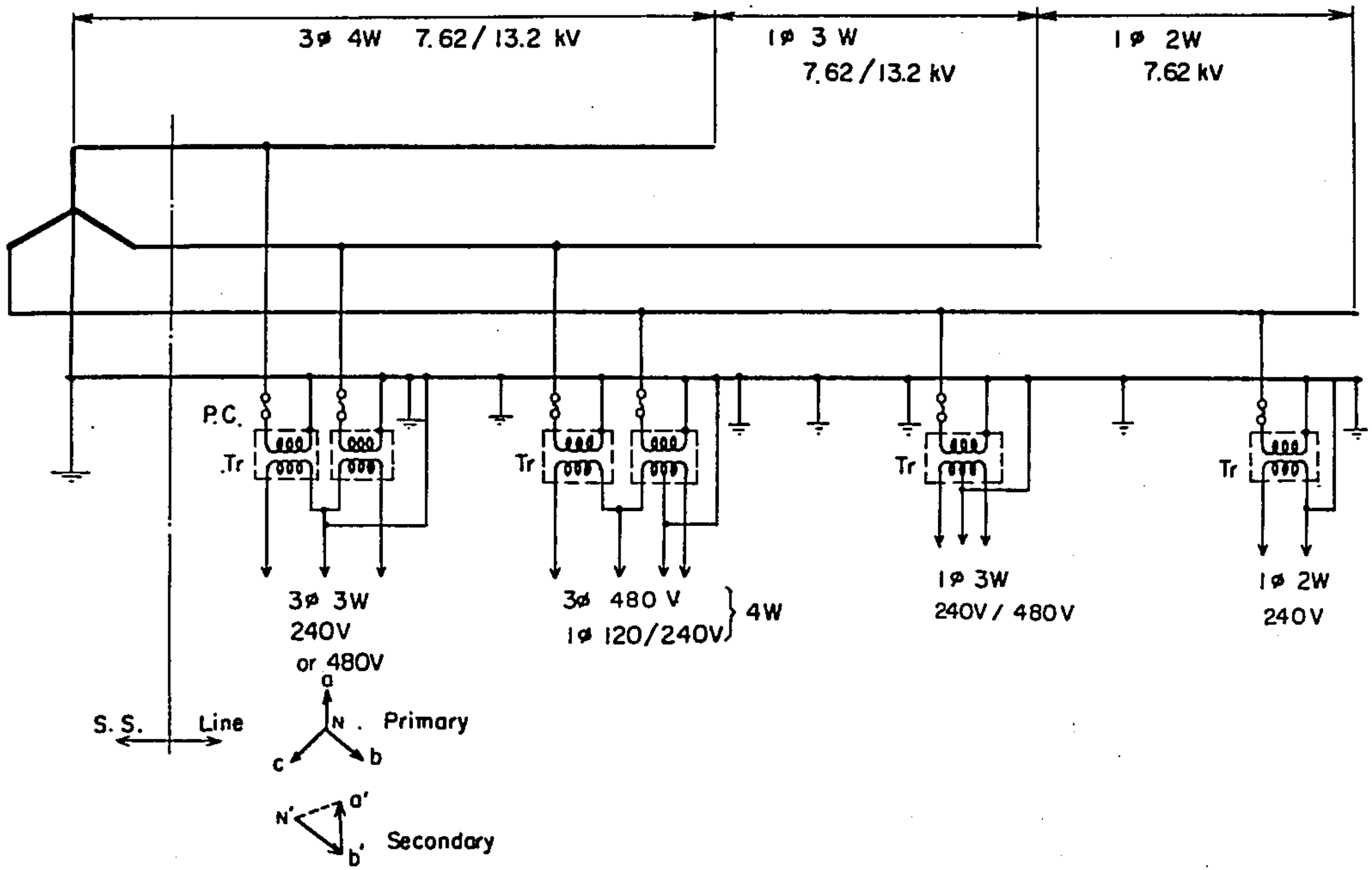
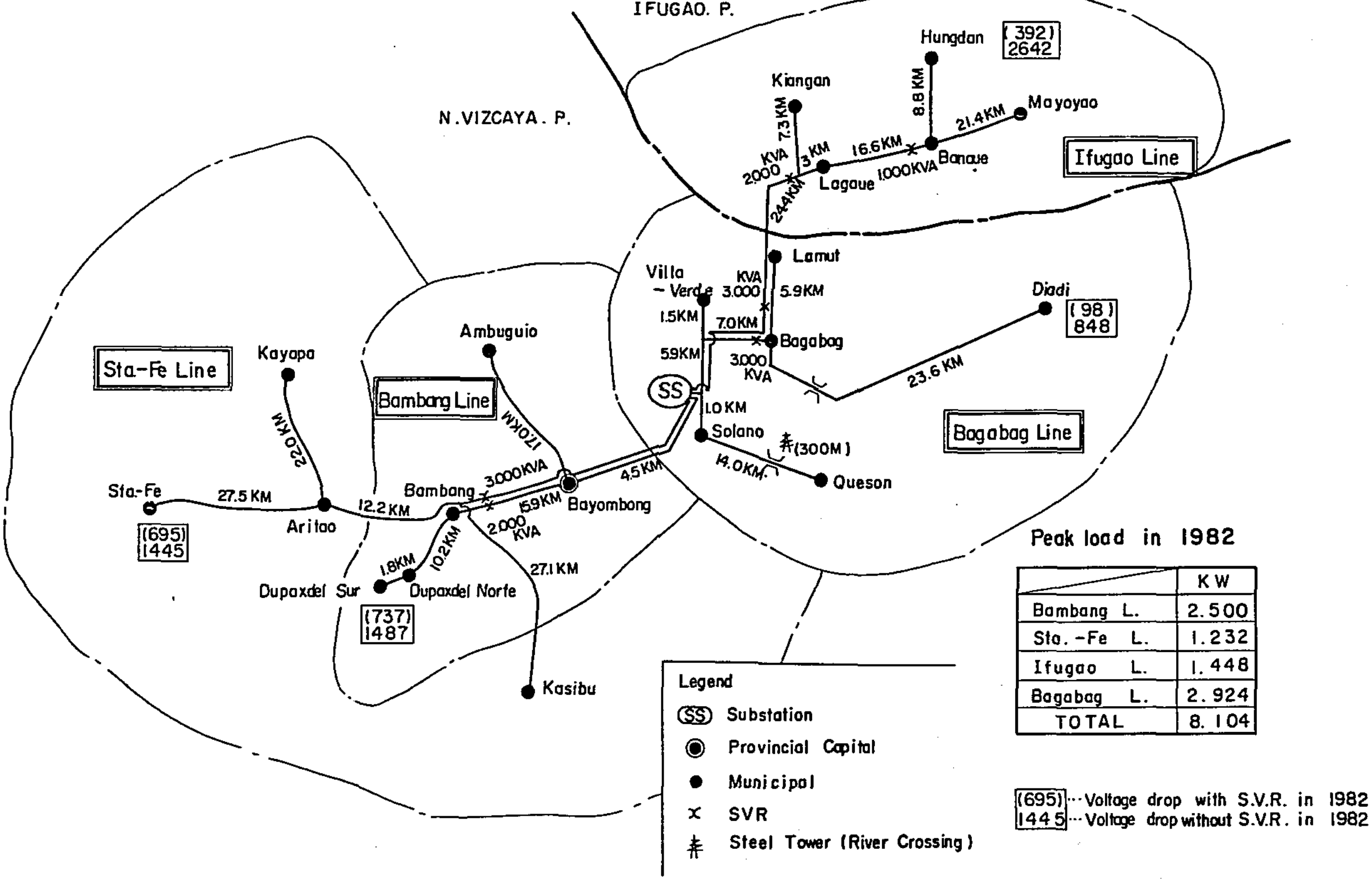


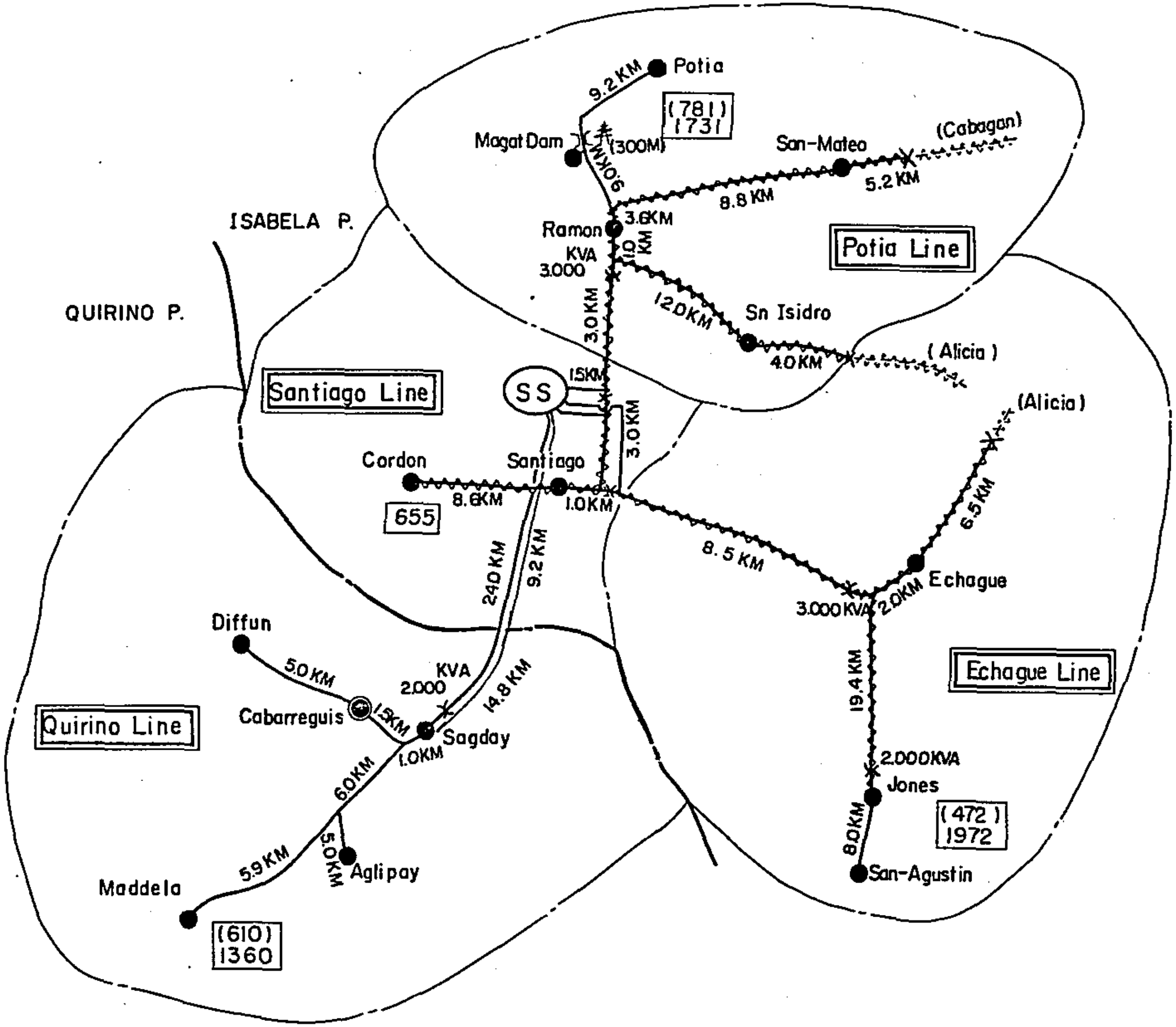
Fig. 7-18 SOLANO SS BACK-BONE LINE MAP



Peak load in 1982

	KW
Bambang L.	2.500
Sta.-Fe L.	1.232
Ifugao L.	1.448
Bagabag L.	2.924
TOTAL	8.104

Fig. 7-19 SANTIAGO SS BACK-BONE LINE MAP



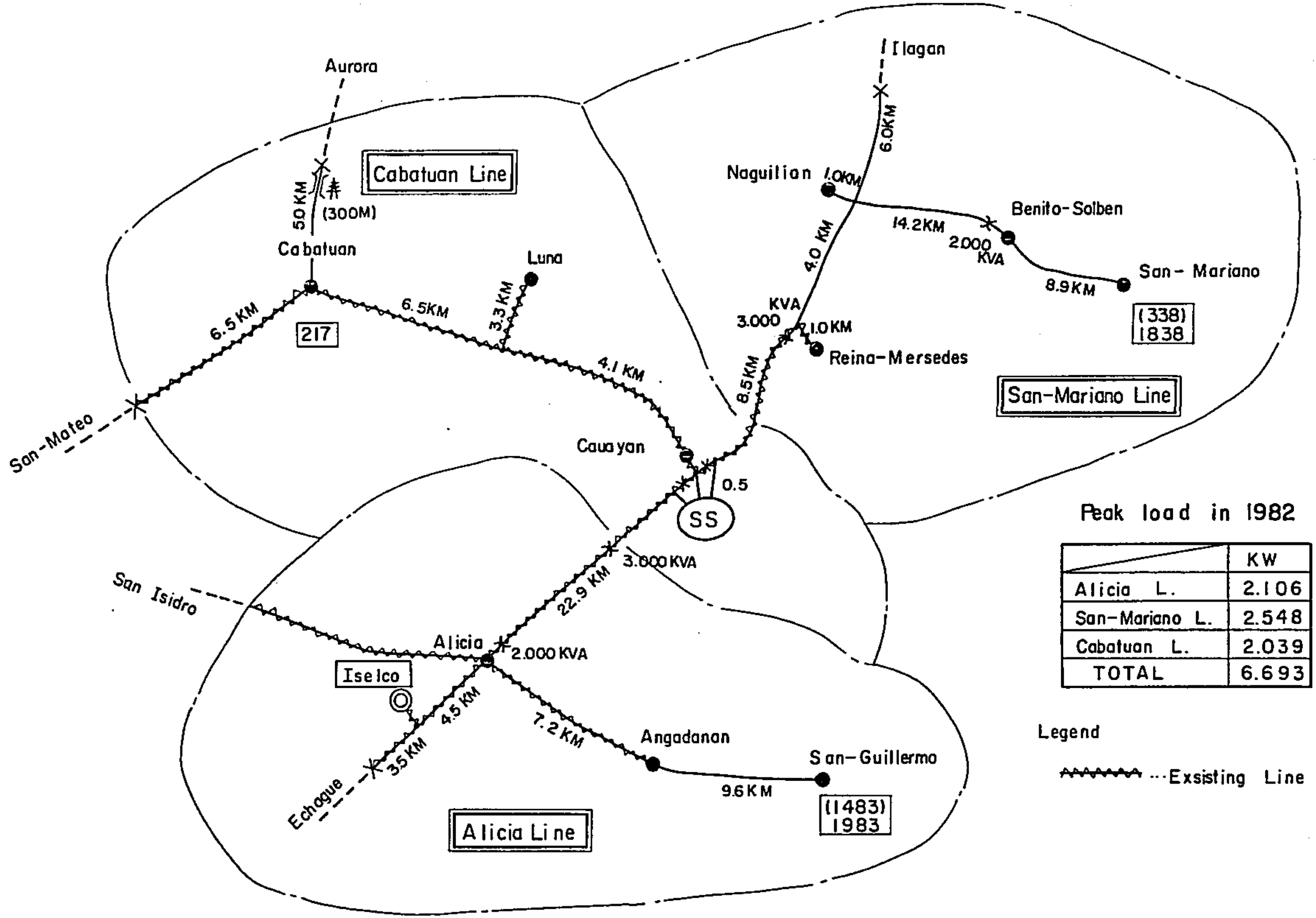
Peak load in 1982

	KW
Echague L.	2.995
Quirino L.	1.564
Santiago L.	2.579
Potia L.	4.095
TOTAL	11.233

Legend

·····Exsisting Line

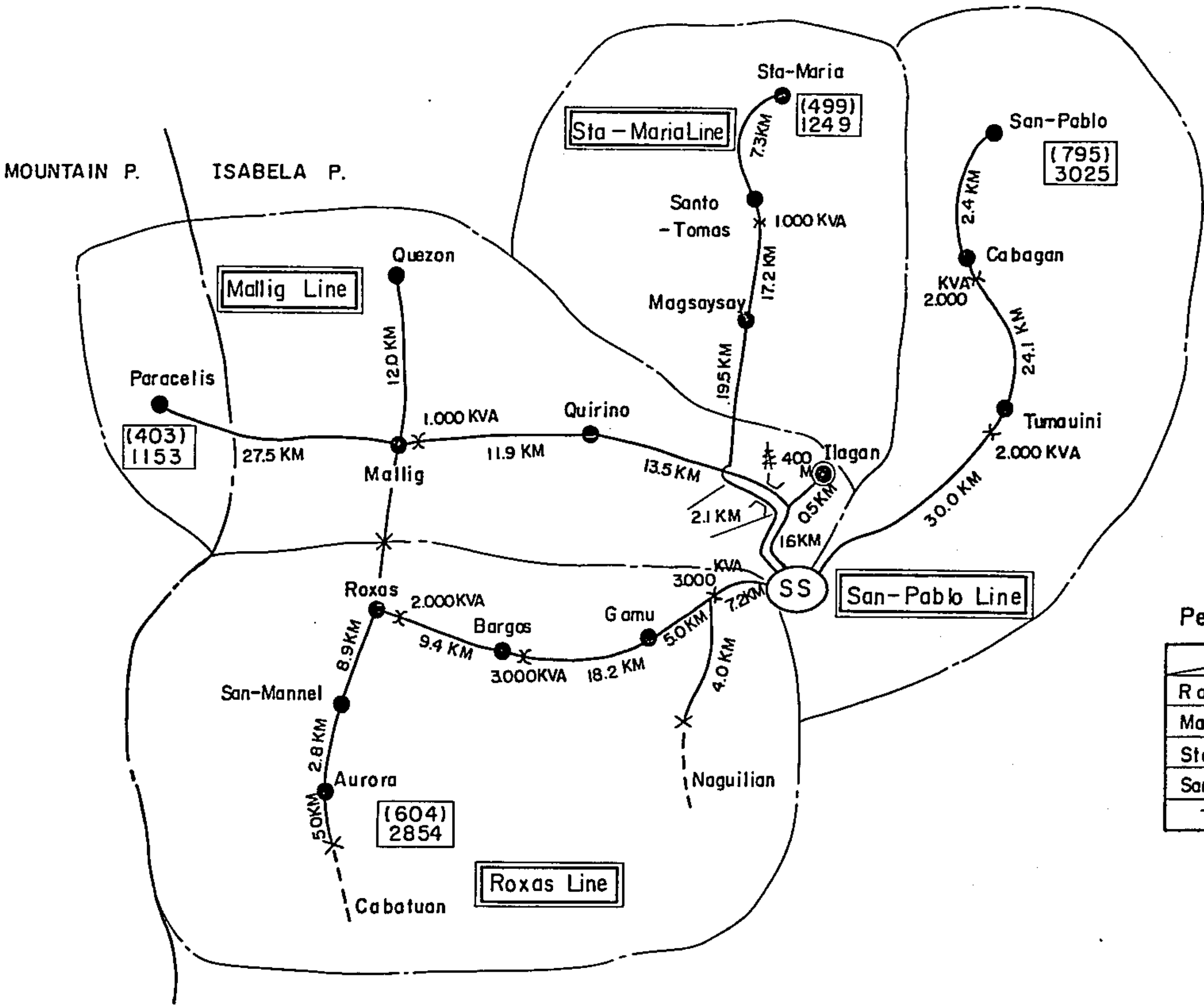
Fig. 7-20 CAUYAN SS BACK-BONE LINE MAP



Peak load in 1982

	KW
Alicia L.	2.106
San-Mariano L.	2.548
Cabatuan L.	2.039
TOTAL	6.693

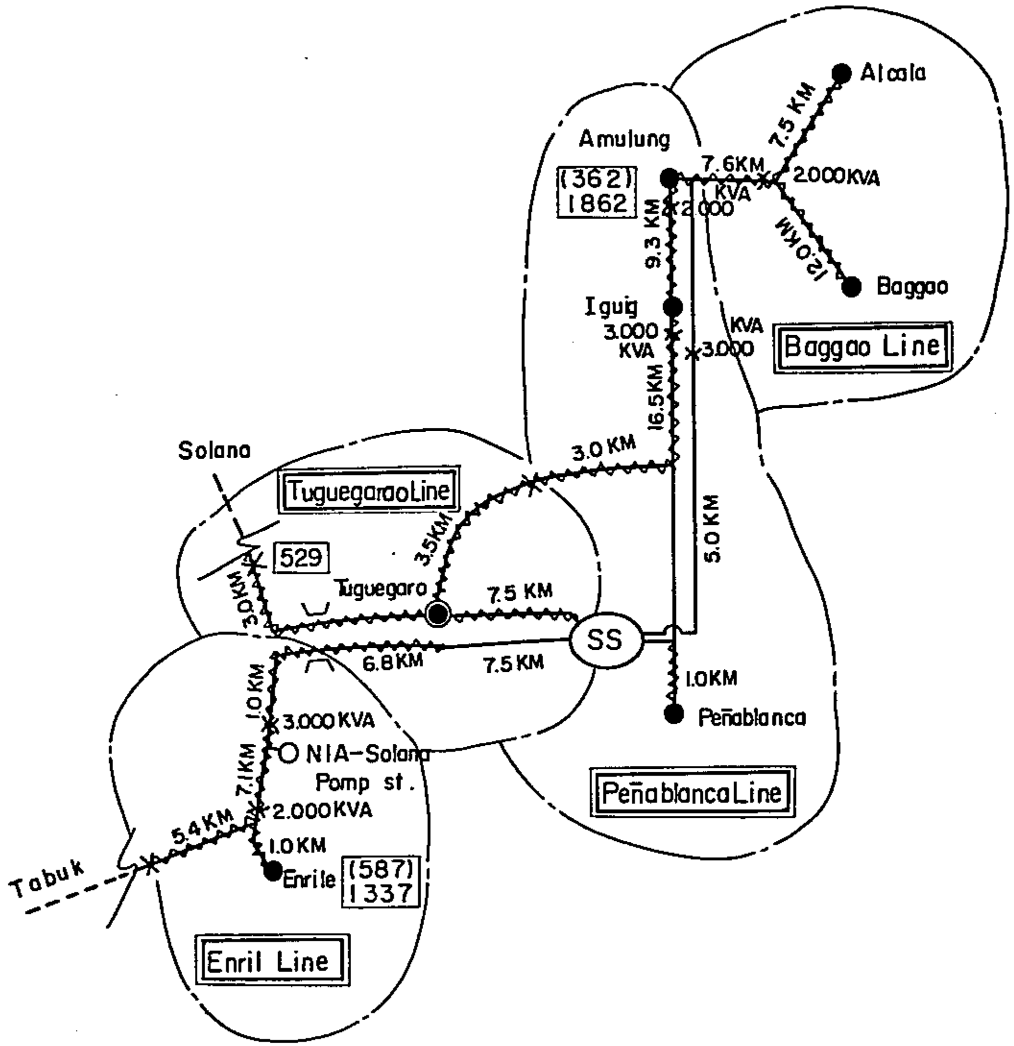
Fig. 7-21 ILAGAN SS BACK-BONE LINE MAP



Peak load in 1982

	KW
Roxas L.	3.006
Mallig L.	3.474
Sta-Maria L.	1.039
San-Pablo L.	2.392
TOTAL	9.911

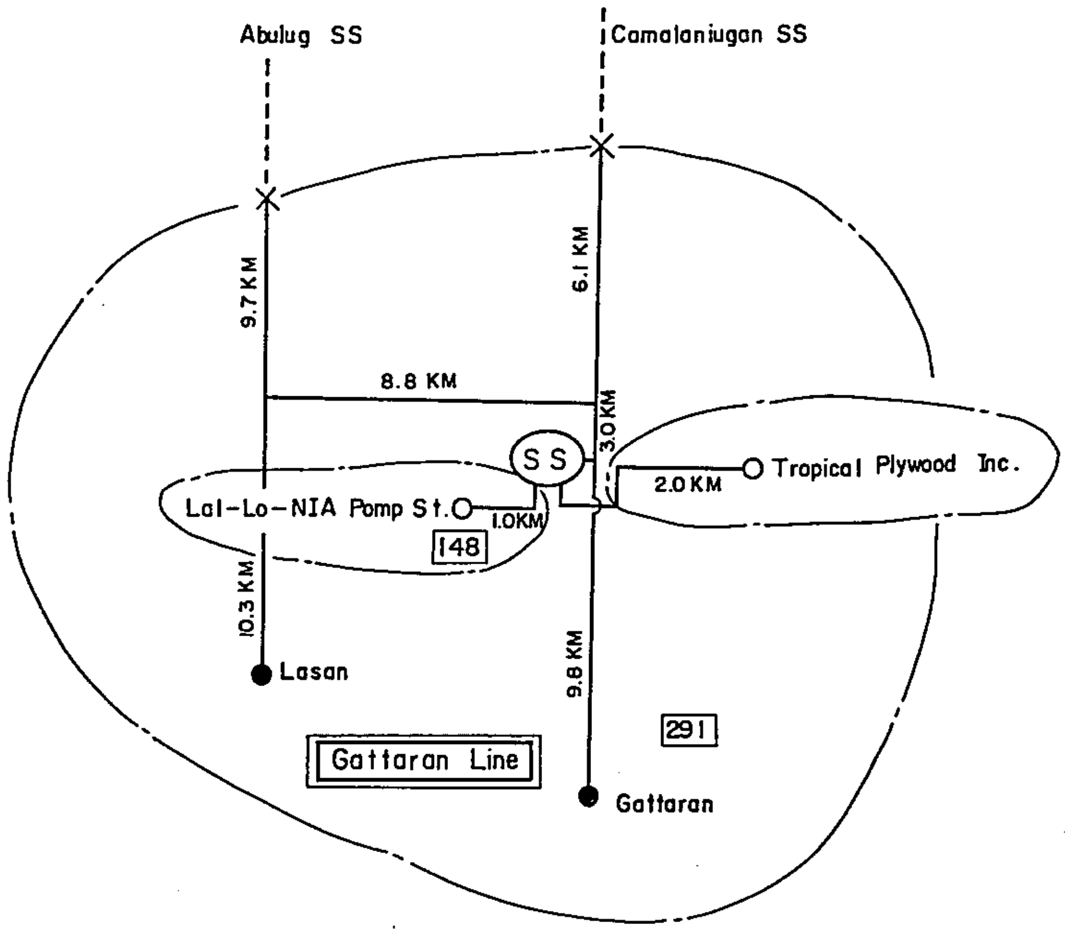
Fig. 7-22 TUGUEGARAO SS BACK-BONE LINE MAP



Peak load in 1982

	KW
Enrile L.	2.221
Tuguegarao L.	2.110
Penablanca L.	2.507
Baggao L.	1.284
TOTAL.	8.122

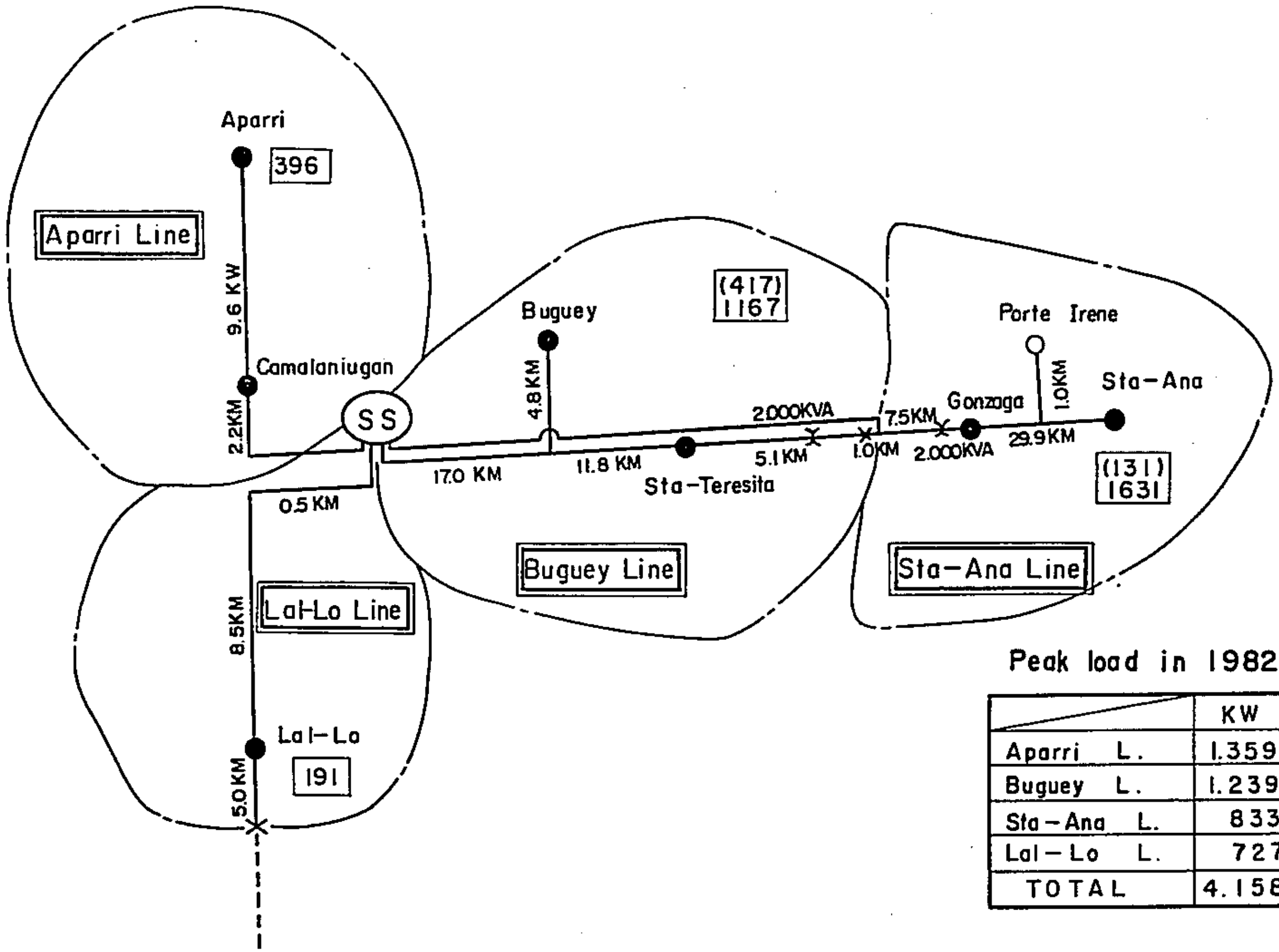
Fig. 7-23 Magapit S S BACK-BONE LINE MAP



Peak load in 1982

	KW
Gattaran L.	1.140
Lal-Lo-NIA L.	5.187
Tropical Wood L.	2.701
TOTAL	9.028

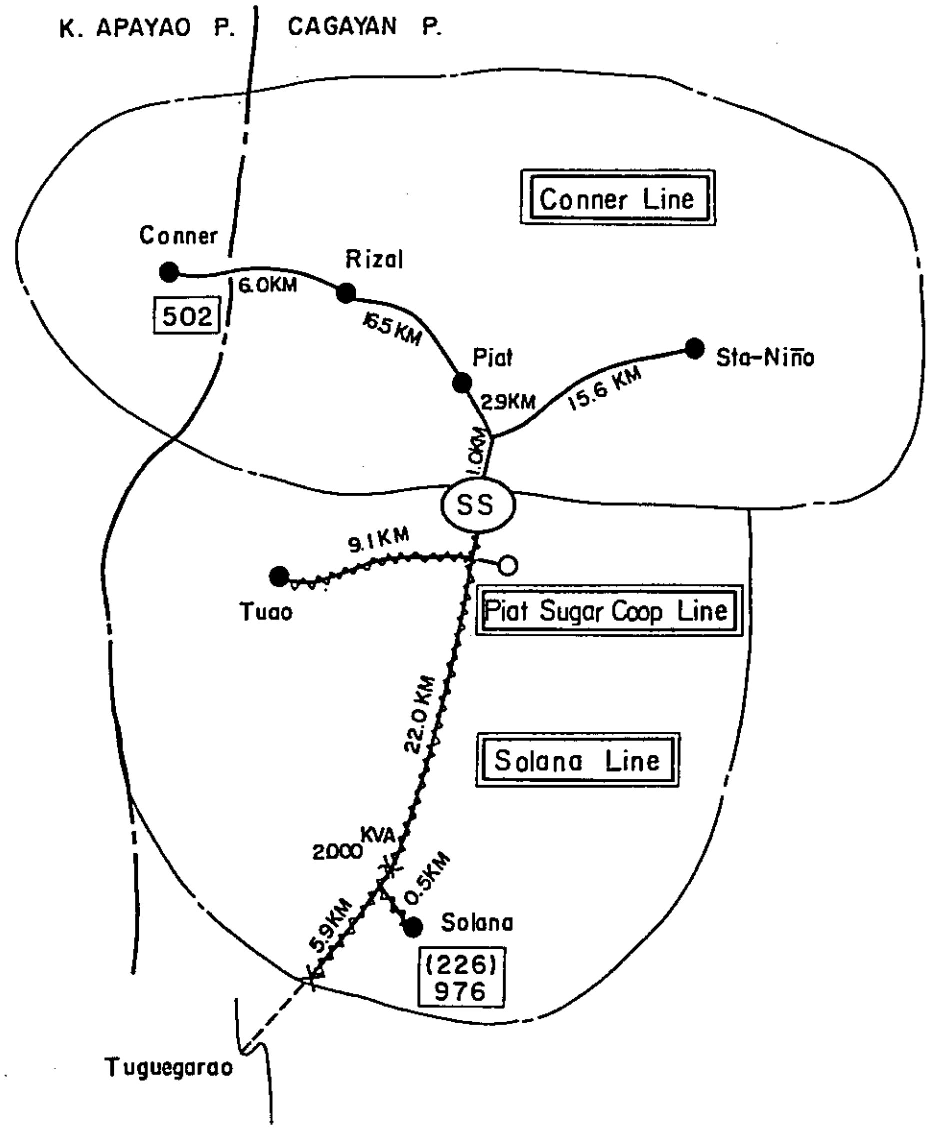
Fig. 7-24 CAMALANIUGAN SS BACK-BONE LINE MAP



Peak load in 1982

	KW
Aparri L.	1.359
Buguey L.	1.239
Sta-Ana L.	833
Lal-Lo L.	727
TOTAL	4.158

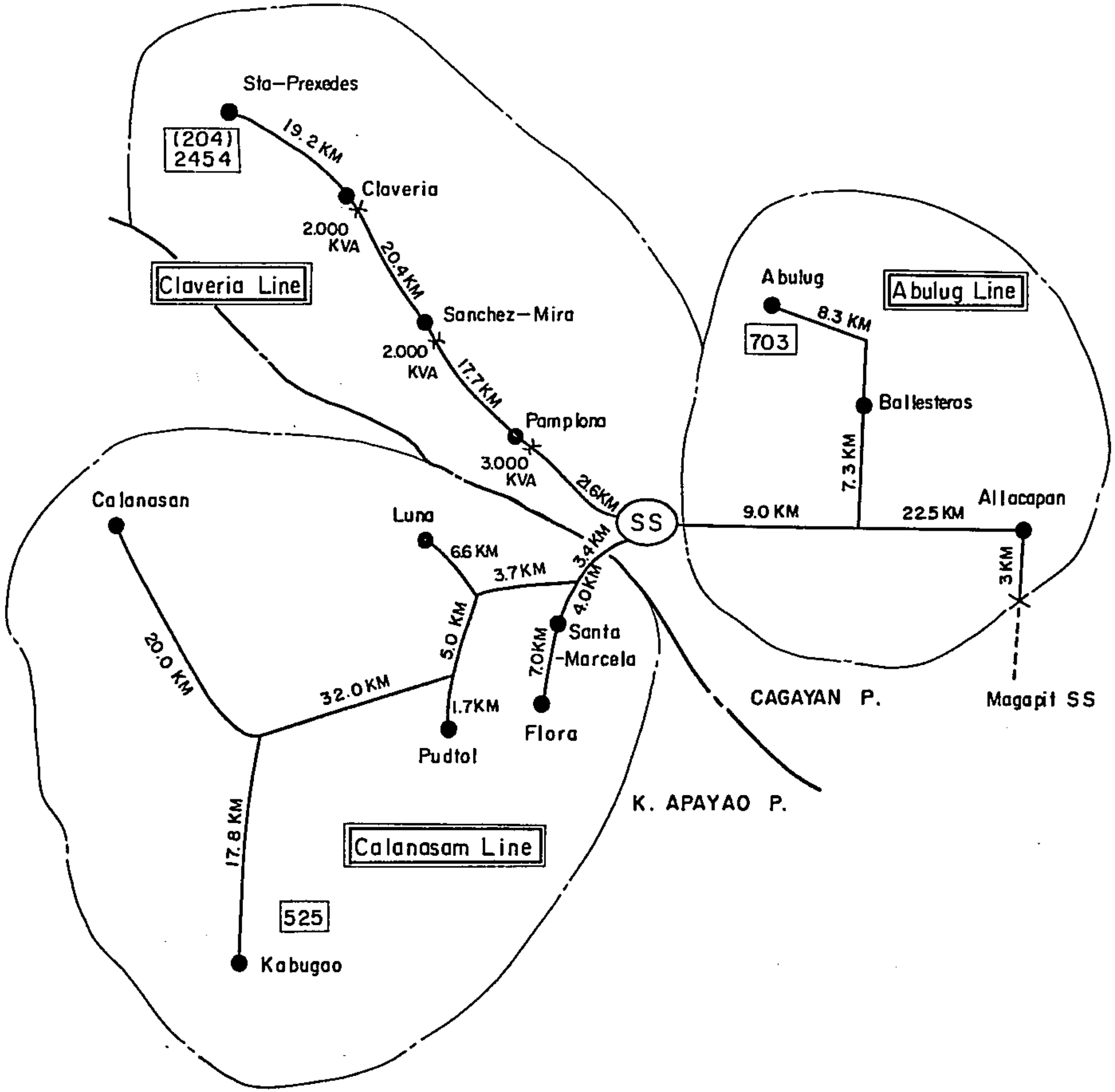
Fig. 7-25 PIAT SS BACK-BONE LINE MAP



Peak load in 1982

	KW
Solana L.	1. 956
Conner L.	1. 071
Piat Sugar Coop L.	1. 544
TOTAL	4.571

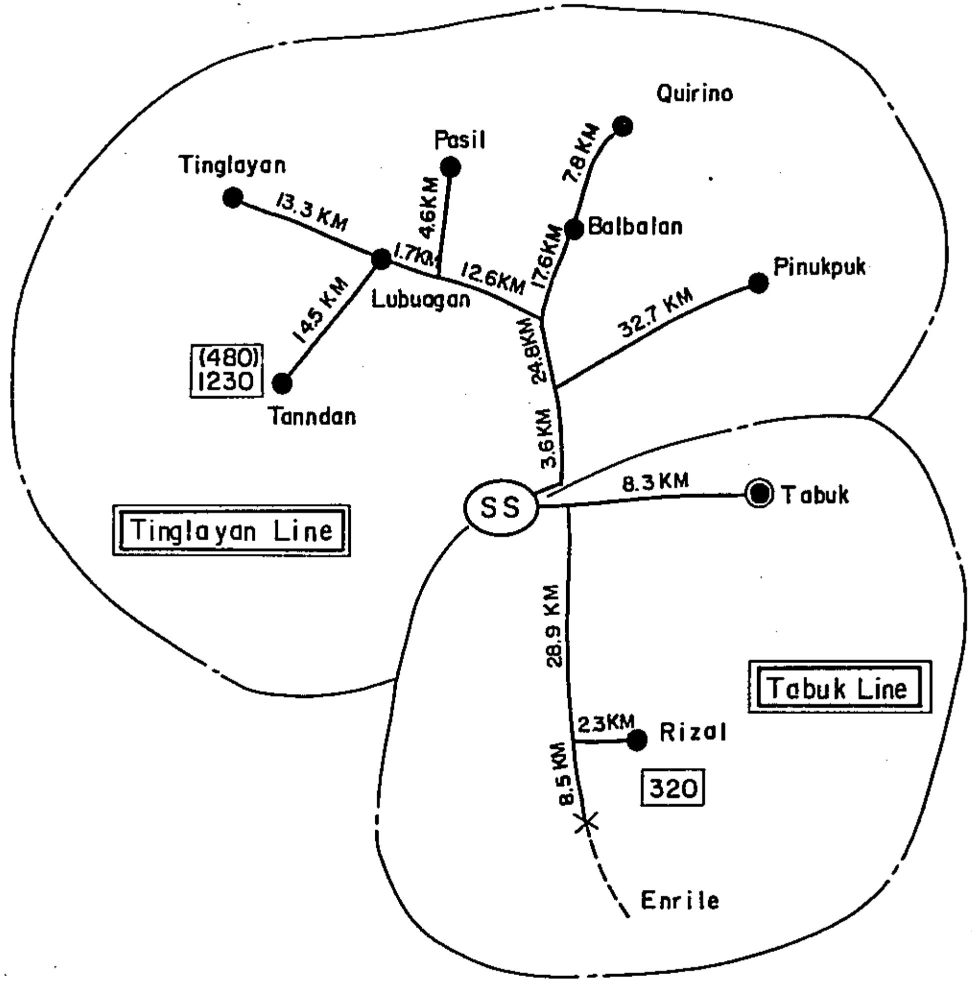
Fig. 7-26 LUCBAN-ABULUG SS BACK-BONE LINE MAP



Peak load in 1982

	KW
Abulug L.	1.324
Claveria L.	1.842
Calanasam L.	965
TOTAL	4.131

Fig. 7-27 TABUK SS BACK-BONE LINE MAP

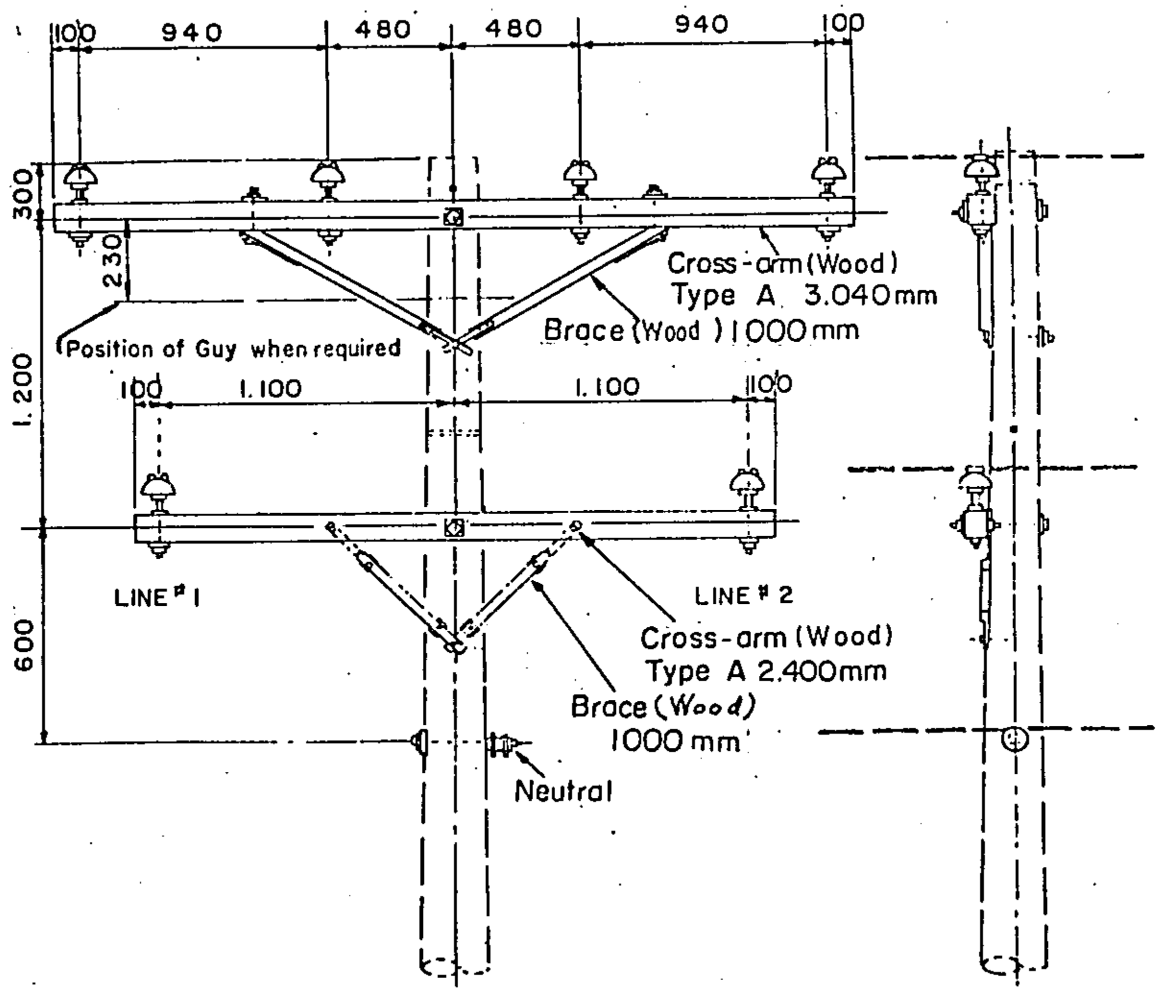


Peak load in 1982

	KW
Tabuk L	1.211
Tinglayan L.	1.323
TOTAL	2.534

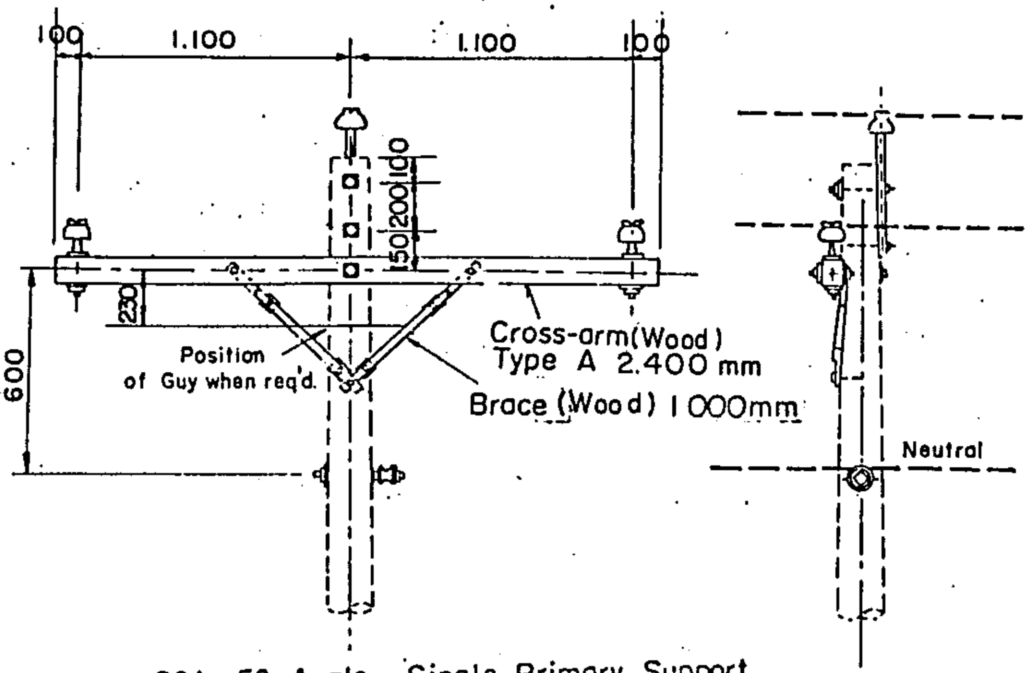
Fig. 7-28 **Details of Pole Dimension Diagram.**

(7.62 / 13.2 kV, 3 - phase)

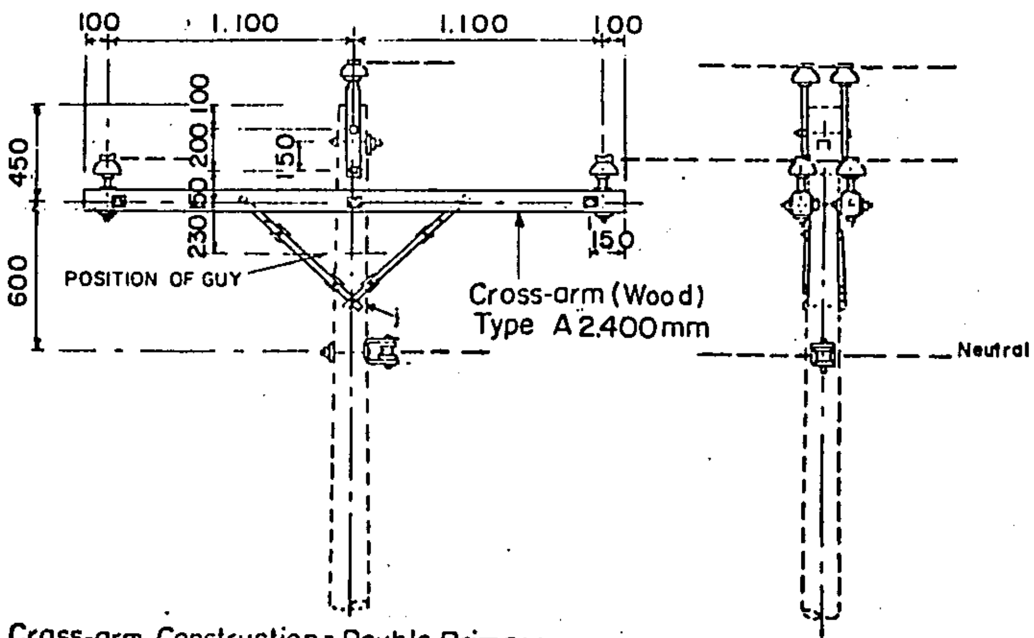


Cross-arm Construction - Double Circuit
Single Primary Support at 0° to 5° Angle.

Fig. 7-29 **Details of Pole Dimension Diagram.**
(7.62/13.2 kV, 3-phase)



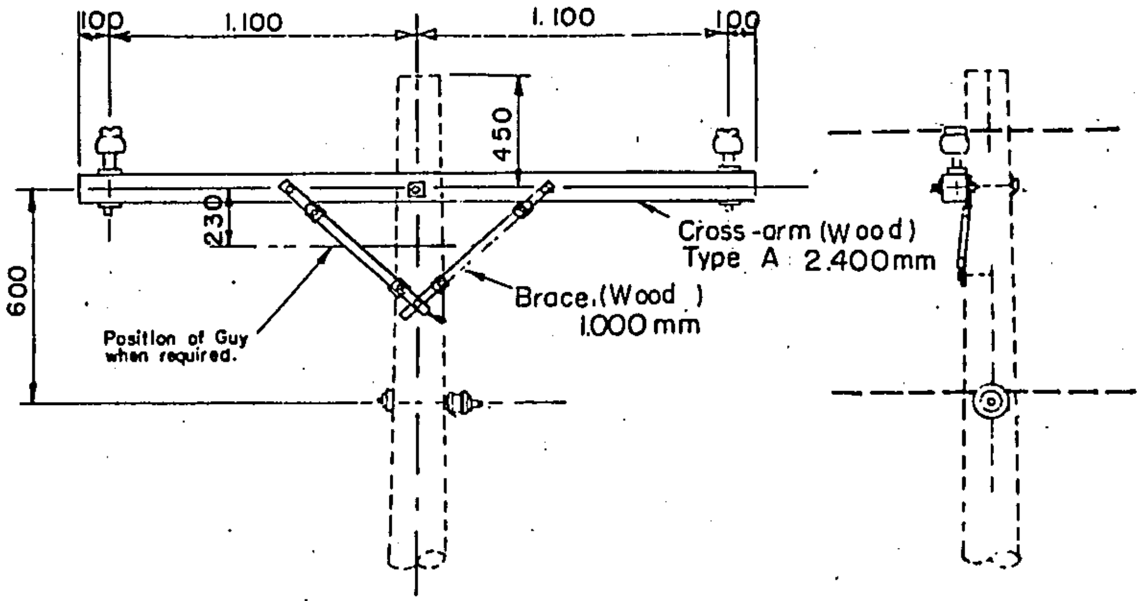
0° to 5° Angle, Single Primary Support



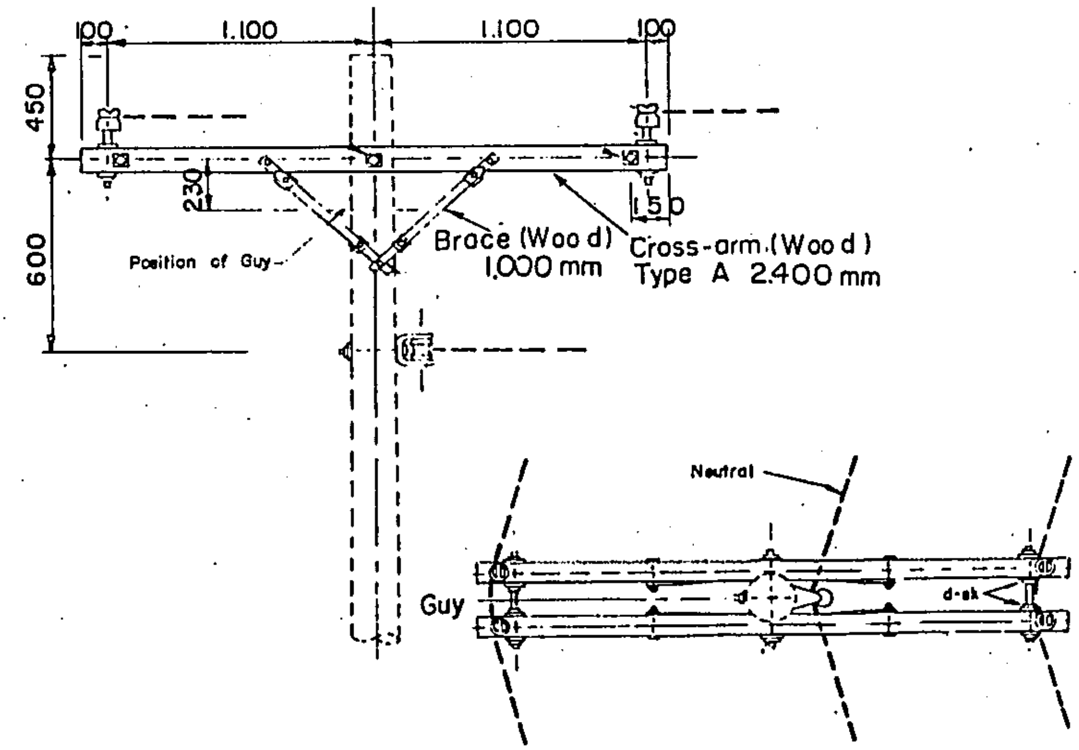
Cross-arm Construction - Double Primary Supports (5° to 30° Max. Angle)

Fig. 7-30 **Details of Pole Dimension Diagran.**

(7.62 / 13.2 kV, 3- phase.)



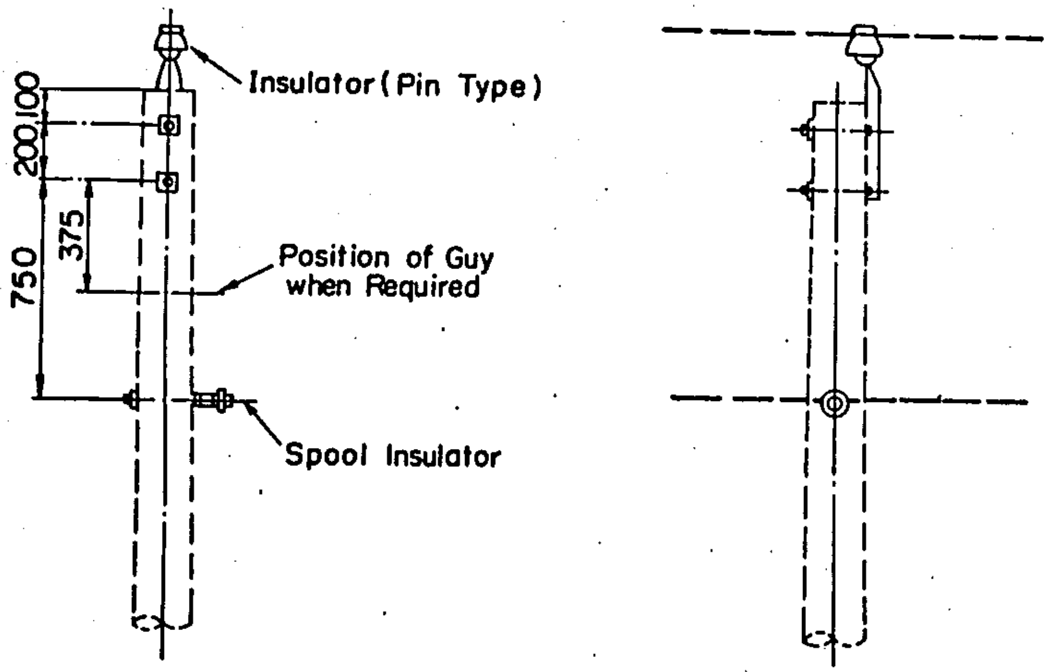
0° to 5° Angle, Single Primary Support.



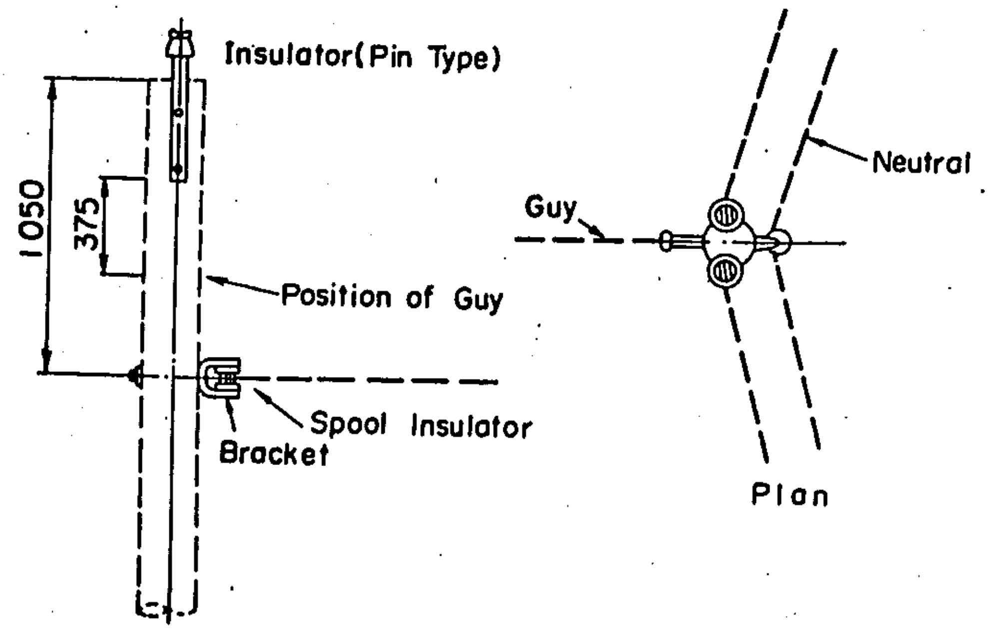
Cross-arm Construction - Double
Primary Supports
(5° to 30° Max. Angle)

Fig. 7-31 **Details of Pole Dimension Diagram.**

(7.62/13.2 kV, Single phase.)



0° to 5° Angle , Single Primary Support



5° to 30° Maximum Angle, Double Primary Supports

Fig. 7-32 **Details of Pole Dimension Diagram.**

(7.62 / 13.2 kV, Two Transformers on 3-phase.)

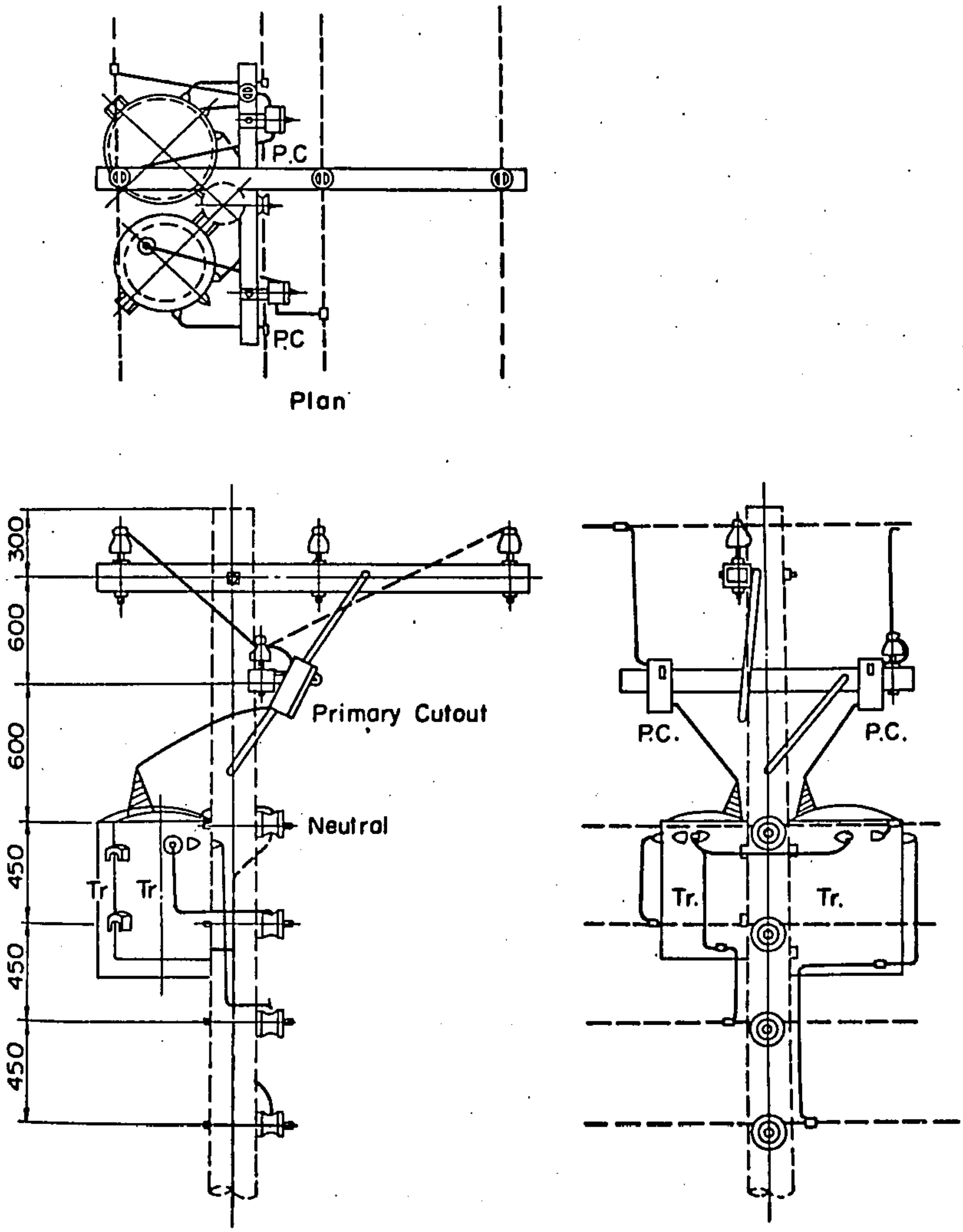


Fig. 7-33 **Details of Pole Dimension Diagram**

(7.62 / 13.2 kV, Single Phase Transformer)

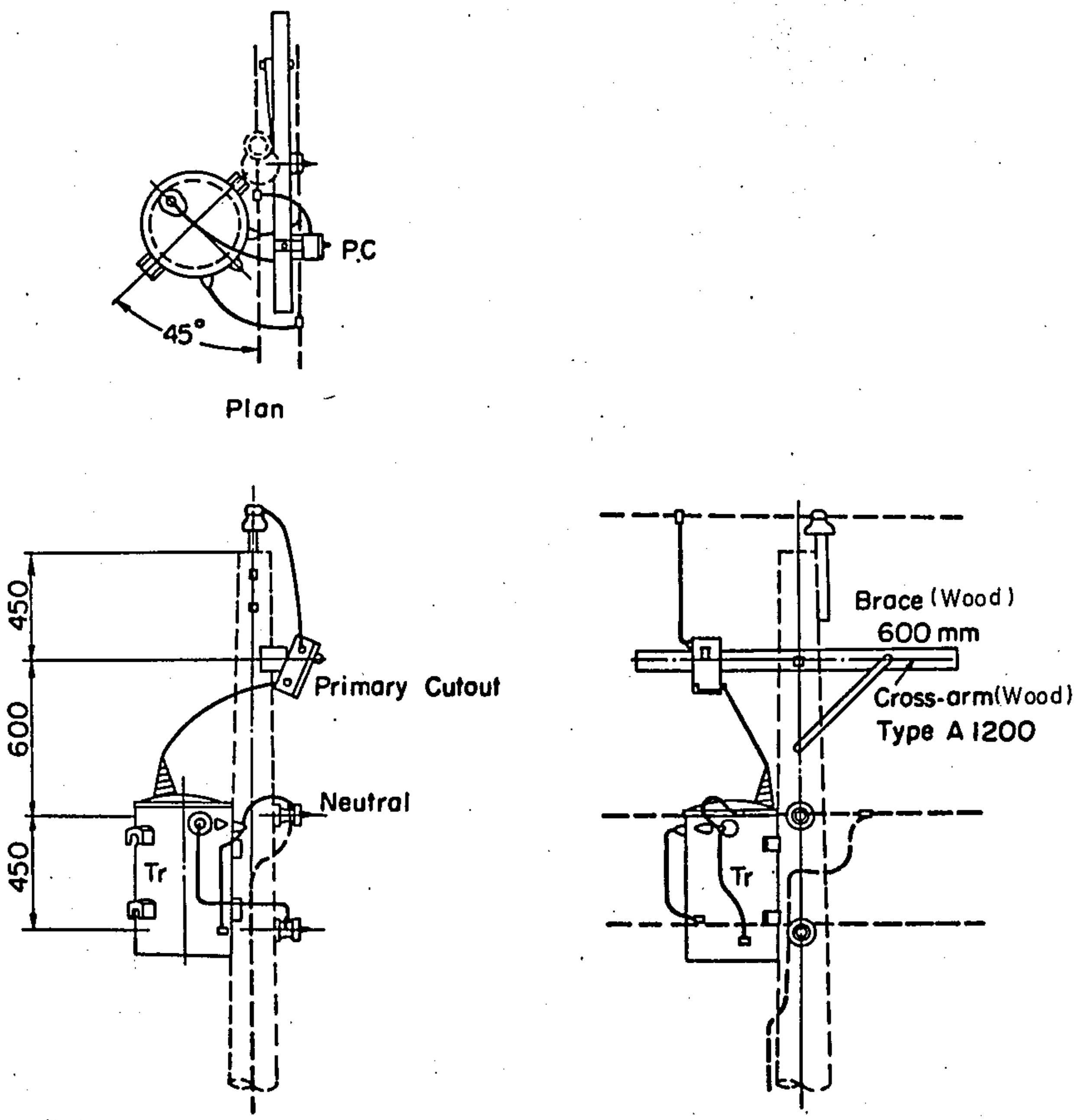
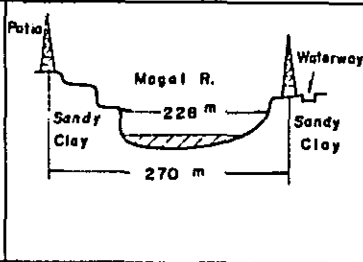
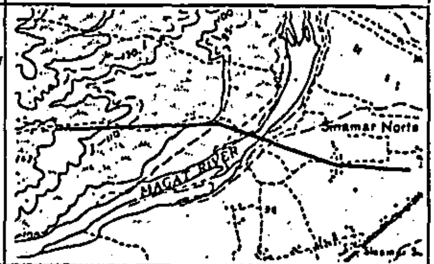
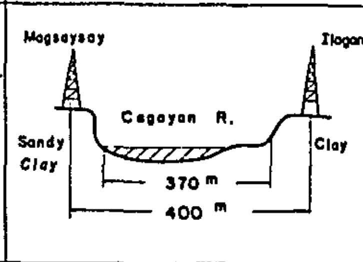
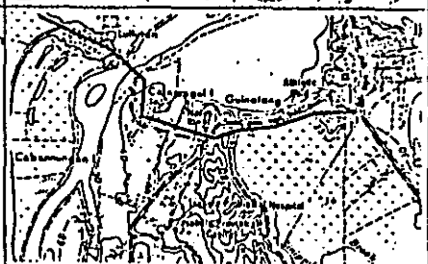
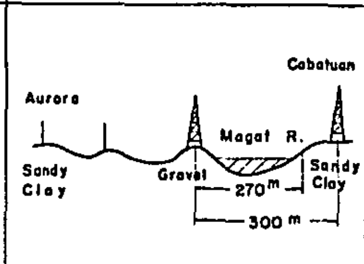
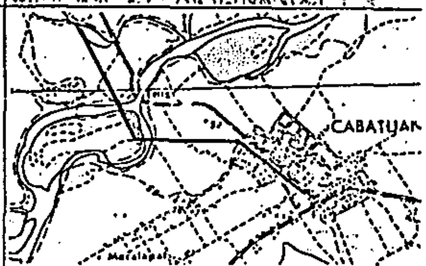
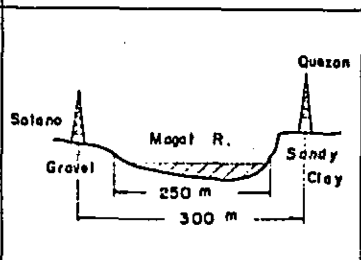
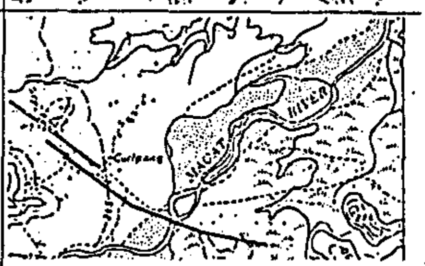
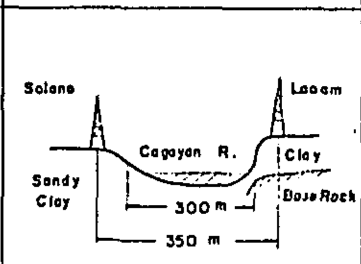
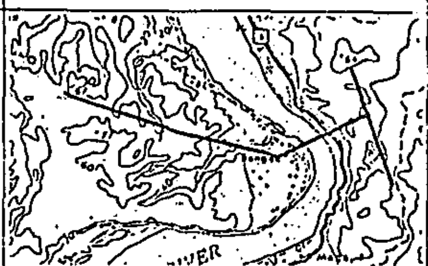
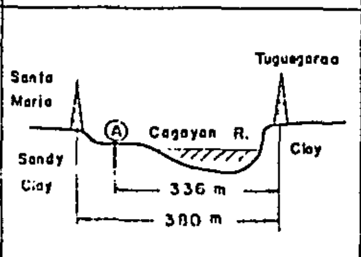
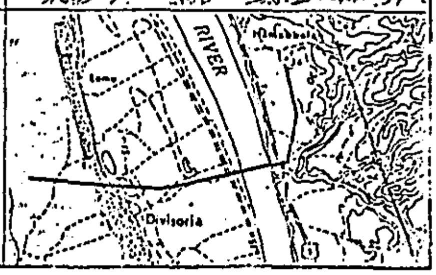


Fig 7-34

ROUGH SCKETCH OF RIVER CROSSING POINTS

	Crossing Point	River Width	Span Length	Section	Plan
Distribution Line	(1) Ramon-Potia	228 m	270 m		
Distribution Line	(2) Ilagan-Magsaysay	370 m	400 m		
Distribution Line	(3) Cabatuan-Aurora	270 m	300 m		
Distribution Line	(4) Solano-Quezon	250 m	300 m		
Transmission Line	(5) Magapit-Laoam	300 m	350 m		
Transmission Line	(6) Tuguegarao-Sta Maria Cone Pinetro Meter Data at Ⓐ Depth / C (kg/cm²) 95 cm / 5 kg/cm² 195 " / 5.5 " 276 " / 5.8 "	336 m	380 m		

Chapter 8 Construction Cost (for 1st Stage)

Chapter 8. Construction Cost (for 1st Stage)

8-1. Total Construction Cost

For computation of construction cost, the direct construction cost was calculated first for each item of transmission facilities, substations facilities, communication facilities (power line carrier communication system), distribution facilities and office buildings and equipment, and contingencies, administrative expenses and engineering fee were added. A breakdown of total construction cost is shown in Table 8-1. The direct construction cost represents the cost in 1980 based on 1977 costs with 5% annual increase incorporated.

Table 8-1 Total Construction Cost

Description	Foreign currency (F.C.) 10^3 yen	Domestic currency (D.C.) 10^3 ₱	Total 10^3 ₱
(1) Transmission facilities	760,000	7,020	27,600
(2) Substation facilities	723,000	2,870	22,450
(3) Communication facilities (Power line carrier comm. system)	108,000	270	3,190
(4) Distribution facilities	6,045,000	104,820	268,490
(5) Office building & equipment	525,000	20,000	34,210
A. Direct construction cost	8,161,000	134,980	355,940
B. Contingencies (A x 0.1)	*816,000	13,500	35,590
C. Subtotal (A + B)	8,977,000	148,480	391,530
D. Administrative expenses	-	9,450	9,450
D.C. A x 0.07			
E. Engineering fee	408,000	8,100	19,150
F.C. A x 0.05			
D.C. A x 0.06			
F. Total construction cost (C + D + E)	9,385,000	166,030	420,130
Equivalent Yen	9,385,000	6,132,000	15,517,000

Note: A conversion rate of 1 US$ = 277 yen = 7.5 ₱ was used for calculation.

* including contingency on Engineering fee.

8-2. Computation of Direct Construction Cost

8-2-1. Division between Foreign Currency and Domestic Currency Procurements

Foreign currency procurement and domestic currency procurement are divided as follows.

(1) Items to be covered by foreign currency

a. Steel materials

i) Steel brace for pole assembly, bolt and nut, guy wire, grounding materials and others.

ii) Steel tower materials (for river crossing), substation outdoor structures and others (reinforcing bars for foundation work excluded).

b. Conductors and overhead ground wires (hardware included but insulated wires for service drop wire excluded).

c. Insulators (hardware included).

d. Equipment

Transformer, circuit breaker, switch, communication equipment and others.

e. Tools and apparatus

Main items among measuring instruments, tools and vehicles.

(2) Items to be covered by domestic currency

a. Building

Administrative buildings (desks, chairs, and other office fixtures included), water supply and drainage system, fences and others (substation buildings included).

b. Materials

i) Pole and accessories

Wooden materials such as pole, crossarm, brace and guy anchor.

ii) Materials for foundation work

Cement, reinforcing bar, sand, gravel and others.

iii) Tools, apparatus and construction materials which can be obtained locally.

iv) Hardware

---

c. Drop wire	2-wire system	128,276 places	(4,490 km)
	3-wire system	2,314 places	(81 km)

8-2-2. Computation of Construction Cost by Type of Facilities

(1) Transmission facilities

Direct construction cost of transmission facilities by route is estimated as follows.

Table 8-2

Name of transmission line	Line length	Foreign currency	Domestic currency
		(10^3 ¥)	(10^3 ₱)
Lucban-Abulug	46	244,500	2,230
Piat	66	337,100	3,120
Tabuk	36	178,400	1,670
Total	148	760,000	7,020

(2) Substation facilities

Direct construction cost by substation is estimated as follows.

Table 8-3

Name of substation	Foreign currency	Domestic currency
	(10^3 ¥)	(10^3 ₱)
Magapit	183,700	644
Piat	177,100	644
Lucban-Abulug	177,100	644
Tabuk	155,100	633
Tuguegarao	30,000	305
Total	723,000	2,870

(3) Communication facilities

Table 8-4

Description	Foreign currency	Domestic currency
	(10^3 ¥)	(10^3 ₱)
Line coupling equipment	46,500	-
Carrier telephone equipment	47,500	-
D.C. power source	14,000	-
Construction cost	-	270
Total	108,000	270

(4) Distribution facilities

Construction costs of high voltage lines, high voltage equipment, pole transformers, low voltage lines, drop wires and WH meters are estimated as follows.

Table 8-5

Description		Unit	Quantity	Construction cost	
				F.C.	D.C.
				(10^3 ¥)	(10^3 P)
High voltage	3ϕ 120 ACSR (new)	km	566	703,538	9,049
	3ϕ 120 ACSR (Under-built)	km	133	136,591	484
	3ϕ 58 ACSR	"	505	390,365	7,840
	3ϕ 25 ACSR	"	71	39,547	997
	Vϕ 58 ACSR	"	793	440,908	11,452
	Vϕ 25 ACSR	"	907	375,498	12,232
	1ϕ 25 ACSR	"	514	136,724	6,352
	Steel tower	each	8	50,800	272
	Outgoing cable	circuit	34	62,429	249
(Sub total)			3,489	2,336,400	48,927
High voltage equipment	Capacitor (50 kVA)	each	39	20,124	14
	Recloser	"	69	67,206	162
	Air break switch	"	138	58,650	43
	Line fuse	"	138	6,486	3
	SVR 1000KVA	"	4	13,560	22
	SVR 2000KVA	"	20	83,000	109
	SVR 3000KVA	"	13	72,020	71
(Sub total)				321,046	424
Transformer		each	6,320	1,181,840	1,067
Low voltage line	(Under-built)	km	1,330	276,640	1,078
	(New)	"	2,494	788,104	32,547
(Sub total)		"	3,824	1,064,744	33,625
Drop wire:	2-wire system	place	128,276	-	18,050
	3-wire system	"	2,314	-	950
(Sub total)			130,590	-	19,000
WH meter	1ϕ L.V.	each	128,276	833,794	1,746
	3ϕ L.V.	"	2,303	46,060	24
	3ϕ H.V.	"	17	29,240	7
(Sub total)			130,596	909,094	1,777
Street light		each	3,764	231,876	-
Grand total				6,045,000	104,820

(5) COOP office facilities

Construction cost of COOP office buildings and cost of communication equipment, vehicles, instruments and tools are estimated as follows.

Table 8-6

Description	Foreign currency (10^3 ¥)	Domestic currency (10^3 ₱)
Office building	-	17,680
Communication equipment	204,100	-
Vehicles	226,400	-
Instruments and tools	33,000	1,120
Office machines and fixtures	61,500	1,200
Total	525,000	20,000

(6) Required investment by year

The required investment by fiscal year is shown in Table 8-7.

Table 8-7 Required Investments by Fiscal Year

Description	Grand total			1978			1979			1980			1981			1982		
	FC	DC	Total	FC	DC	Total	FC	DC	Total	FC	DC	Total	FC	DC	Total	FC	DC	Total
	(10^3 ¥)	(10^3 P)	(10^3 P)	(10^3 ¥)	(10^3 P)	(10^3 P)	(10^3 ¥)	(10^3 ¥)	(10^3 P)	(10^3 ¥)	(10^3 P)	(10^3P)	(10^3 ¥)	(10^3 P)	(10^3 P)	(10^3 ¥)	(10^3 P)	(10^3 P)
(1) Transmission facilities	760,000	7,020	27,600	-	1,500	1,500	360,000	2,520	12,270	400,000	3,000	13,830	-	-	-	-	-	-
(2) Substation facilities	723,000	2,870	22,450	-	300	300	290,000	580	8,430	433,000	1,990	13,720	-	-	-	-	-	-
(3) Communication facilities (P.L. carrier)	108,000	270	3,190	-	10	10	25,000	20	690	83,000	240	2,490	-	-	-	-	-	-
(4) Distribution facilities	6,045,000	104,820	268,490	1,000,000	17,100	44,180	2,418,000	22,900	88,370	2,627,000	22,600	95,720	-	22,000	22,000	-	20,220	20,220
(5) Office building & facilities	525,000	20,000	34,210	125,000	10,000	13,380	400,000	10,000	20,830	0	-	0	-	-	-	-	-	-
A. Subtotal of direct construction cost	8,161,000	134,980	355,940	1,125,000	28,910	59,370	3,493,000	36,020	130,590	3,543,000	27,830	123,760	-	22,000	22,000	-	20,220	20,220
B. Contingencies	816,000	13,500	35,590	-	-	-	-	-	-	218,000	2,870	8,770	219,000	3,870	9,800	379,000	6,760	17,020
C. Subtotal (A+B)	8,977,000	148,480	391,530	1,125,000	28,910	59,370	3,493,000	36,020	130,590	3,761,000	30,700	132,530	219,000	25,870	31,800	379,000	26,980	37,240
D. Administrative expenses	-	9,450	9,450	-	2,490	2,490	-	2,030	2,030	-	2,030	2,036	-	1,600	1,600	-	1,300	1,300
E. Engineering fee	408,000	8,100	19,150	131,000	2,130	5,680	87,000	1,700	4,060	87,000	1,690	4,050	53,000	1,330	2,760	50,000	1,250	2,600
F. Total construction cost (C+D+E)	9,385,000	166,030	420,130	1,256,000	33,530	67,540	3,580,000	39,750	136,680	3,848,000	34,420	138,610	272,000	28,800	36,160	429,000	29,530	41,140

Chapter 9 Construction Schedule (for 1st Stage)

Chapter 9 Construction Schedule (for 1st Stage)

9-1 Overall Construction Schedule

As already mentioned, the Electrification Program of the Philippine Government aims at 100% electrification in Region II in the following manner.

Electrification of 33.6% of the Region by 1982,

Electrification of 50.0% of the Region by 1984,

Electrification of 100% of the Region by 1990.

Of the above three stages, the 1st stage (1982 being the target year) is considered most important as it forms a basis of the electrification project. It is for this reason that the early start of this stage is recommended.

For the 1st stage of the project, the following overall construction schedule may be considered.

o Project IP (including engineering) ∿ L/A	December 1977
o Contract for engineering service ∿ field survey ∿ detailed design (major equipment) ∿ preparation of tender documents	August 1978
o Approval of tender documents by OECF	October 1978
o Ordering of part of equipment covered by domestic currency ∿ start of construction	February 1979 (Actual start of construction)
o Closing of tender ∿ evaluation of tender ∿ award of contract	March 1979
o Contract	April 1979

o Start of designing of equipment and facilities by manufacturers	April 1979
o Approval of contract by OECF	May 1979
o Start of manufacturing of equipment	June 1979
o Start of preparatory works for construction at site by contractor	July 1979 (Start of foreign currency portion)
o Receipt of L/C by contractor	August 1979
o Receipt of E/L by contractor and start of shipment (delivery)	September 1979
o Completion and take over of the work	November 1982

9-2 *Setup for Construction Work*

Construction work under the project will be carried out by the following 9 COOP with NEA acting as the central organ.

NEA
- CAGELCO I (existing) - Electrification of 16 municipals
- CAGELCO II (to be established in 1977) - Electrification of 13 municipals
- KAL. APCO I (to be established in 1977) - Electrification of 9 municipals
- KAL. APCO II (to be established in 1977) - Electrification of 6 municipals
- ISELCO I (existing) - Electrification of 19 municipals
- ISELCO II (to be established in 1977) - Electrification of 16 municipals
- IFUGAOCO (to be established in 1977) - Electrification of 5 municipals
- NUVELCO (to be established in 1977) - Electrification of 15 municipals
- QUIRINOCO (to be established in 1977) - Electrification of 5 municipals

As a rule, each COOP will be responsible mainly for the following in the implementation of the project.

(1) Design of equipment and facilities.

(2) Summarization of equipment and materials required.

(3) Preparation of tender documents.

(4) Tendering.

(5) Supervision of construction.

(6) Witness inspection and acceptance test.

On the other hand, NEA will be responsible mainly for the following.

(a) Final check of the design submitted by each COOP.

(b) Final check of the quantity of equipment and materials requested by each COOP, preparation of tender specifications, procurement - storage - delivery of materials to each COOP.

(c) Final check of tender documents prepared by each COOP.

(d) Review of the amount of investment required by each COOP and release of loans to the COOP concerned.

(e) Control and supervision of construction work carried out by each COOP.

(f) Witnessing of completion test and acceptance test of main items to be performed by COOP.

Besides, there is an engineering firm called A & E (Architect & Engineer) assigned to each COOP to extend assistance in engineering and construction supervision.

The flow of work between COOP, NEA, A&E and other related organs is shown in Fig. 9-1.

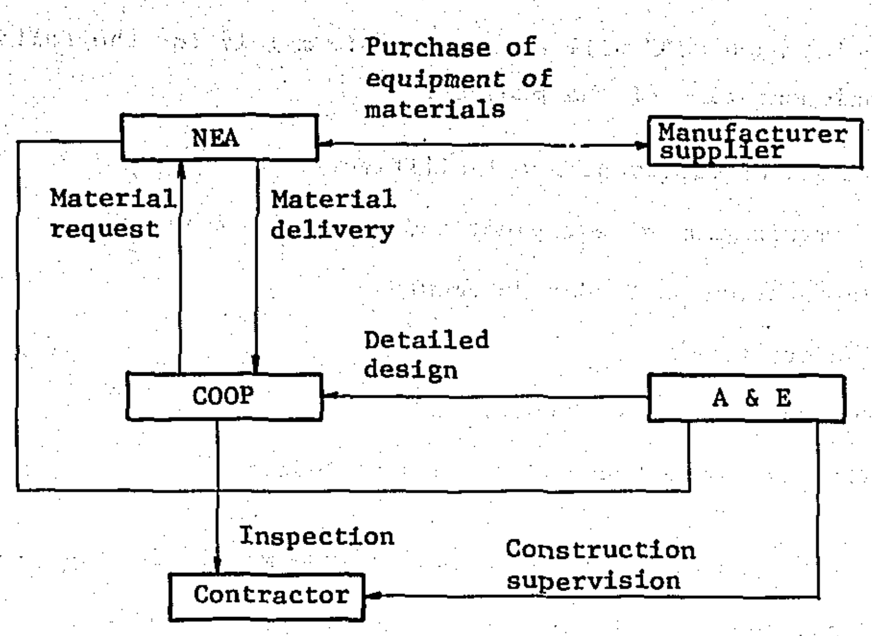


Fig. 9-1 Flow of Work

Judging from the accomplishment of ISELCO I and CAGELCO I, the ability of these COOP's has increased to such an extent that they are now capable of carrying out detailed designs themselves, with A & E only reviewing the design, and that they are able to supervise construction works to a considerable extent. The ability of contractors also seems to have increased to some extent.

For implementation of the electrification project through expansion of the main power system in Region II, the aforementioned setup of NEA and COOP must be maintained as a basis with consideration given to the following.

1) Supplement any considerations to the present work system

   i) Electrification in the region has so far been carried out as independent systems in each district. For this project, however, the design of distribution system must be such that it will provide a complete and efficient distribution network which will be beneficial to the public at large.

ii) At present, only two COOP's are in operation and the remaining 7 COOP's must be established hereafter. For this reason, there may be cases in which inadequacy of personnel, organization and operation is felt for the smooth and efficient execution of overall construction schedule of the project.

iii) For the establishment of an integrated distribution system in Region II by COOP's, it is essential that all COOP's work closely with each other and coordinate their construction work through adjustment of construction schedule and joint use of equipment and materials, specifications and labors.

iv) COOP has no experience in construction of 69kV transmission lines and substations.

2) Recommended setup for implementation of the project

For the smooth and efficient implementation of the project which is highly beneficial to the public, it is important to supplement the existing setup with consideration given to the points mentioned in the preceding paragraph 1). For this purpose, the setup shown in Table 9-1, Assignment of Construction Responsibility, will be quite effective for implementation of the project within the limit of overall construction schedule.

Table 9-1 Assignment of Construction Responsibilities (Draft)

(1) Distribution System　　　○ : Executing body

	Official procedures for loans and approval	Survey and engineering	Procurement of main equipment			Construction work	Construction supervision		Test and takeover		
			Equipment and material specification	Tendering: Overseas	Tendering: Domestic	Contract (Local)	Equipment	Construction work	Test of individual equipment	System test	Acceptance test
NEA (Executing body)	○	Final check & Approval	Final check & Approval	○ Supply only	○	Final check & Approval	○ Supply only	Inspection	Witness	Witness	○
Consultant	↑ Assist in all official procedures	Check & riview Design of special structures Assist & guidance ↓	Check and review ↓	↑ Draft tender documents Assist. in tendering		Check & review Arrangement Assist. & guidance ↓	↑ Assist. in approval of design, drawings, deliyery schedule and necessary items	Assist. in arrangement of const. schedule, supervision and other necessary items ↓	Witness ↓	Preparation of test program Assist. in tests ↓	Assist. ↓
COOP Assist. in A & E		○	○			○		○	○	○	○

Note; For smooth execution of 2nd stage and following construction works, it is advisable to train engineers of COOP's, especially the newly established COOP's, during the 1st stage construction period.
Training of engineers will be needed especially for,
- o Distribution voltage operation
- o Overall operation of the distribution system.

9-3. Execution of Work

9-3-1. Transmission System

(a) Immediately after route planning of 69kV transmission lines and site investigation for construction of substations, the necessary land space must be secured by NEA and the related COOP through purchasing or lease, with the necessary compensations paid to local residents.

(b) Custody of equipment and materials

In the case of turnkey base contract, the equipment and materials imported by the contractor will be unloaded at Manila Port and transported via national road (Japan - Philippine Friendship Highway) to the storage yard or warehouse designated by NEA, where the materials are stored under the custody of the contractor and delivered to the site whenever necessary. The equipment and materials will be inspected upon arrival by inspectors of NEA-COOP and the Consultants firm. Custody of equipment and materials procured locally by the contractor on the turnkey base will also be the responsibility of the contractor.

Custody of equipment and materials procured by NEA will be the responsibility of NEA, who will delivere the material to the contractor at the designated location.

(c) Transportation

Road is complete and adequate for transportation between Manila and the project site. Heavy equipment such as transformers and other equipment and materials including wooden poles, steel structural members, conductors and insulators can be transported safely to the site via several bridges over the Cagayan River and provincial roads leading to each Municipal.

(d) Construction work

(i) Construction of transmission lines at a rate of about 15 km per month is considered possible for each route. Therefore, completion of 3 routes in one year can be expected.

(ii) Construction of steel towers is necessary at two crossing points of the Cagayan River. A total of four months will be required for each crossing point for foundation work, erection of tower and installation of conductors.

(iii) No problems are expected to be encountered for construction of four substations as the site of each substation will be selected in the flat land. A total of 10 months will be sufficient for construction of one substation including civil work, erection of outdoor structures, construction of control room and installation of transformers.

Distribution Facilities

(a) Material control

All the equipment and materials for distribution facilities will be procured in the lump by NEA. The equipment and materials imported from other countries will be unloaded at Manila Port and transported via national road (Japan-Philippine Friendship Highway) to the storage yard or warehouse designated by NEA, where they are stored or delivered to the site under the custody of NEA. The materials will then be issued directly to COOP, which, in turn, stores the materials in its own storage facilities and delivers the required quantity to the contractor. The contractor is responsible for custody of the materials until they are used for construction work.

In the case of lump sum contract for supply and erection of special structures such as steel towers, the custody of all materials will be the responsibility of the contractor.

(b) *Transportation*

In the case of distribution system, lines must be extended to Barrios of each Municipal. No special problems are expected to be encountered for transportation to Barrios located along the provincial roads. In part of Kalinga-Apayao, Ifugao and N. Vizcaya, however, some Barrios are located far from the main road and it will be necessary to use animals such as buffaloes to transport wooden poles, conductors and insulators to the construction site.

For transportation across the river at several locations, mainly ferry boats will be used. In some districts, main equipment must be transported during the dry season.

(c) Construction work

As a rule, construction works will be carried out by each COOP. For a route of ordinary topography, erection of poles and installation of conductors for 13.2KV trunk distribution lines can be carried out at a rate of 15 ∿ 20 km per month.

Since the maximum length of 13.2 KV trunk distribution lines to be constructed by one COOP is 550 km, a total of 27 months will be required for completion of the work by each COOP. The 240 V low voltage lines may be installed step by step according to the progress of electrification by the time the 1st stage of the project is completed.

9-4. Construction Schedule (1st stage)

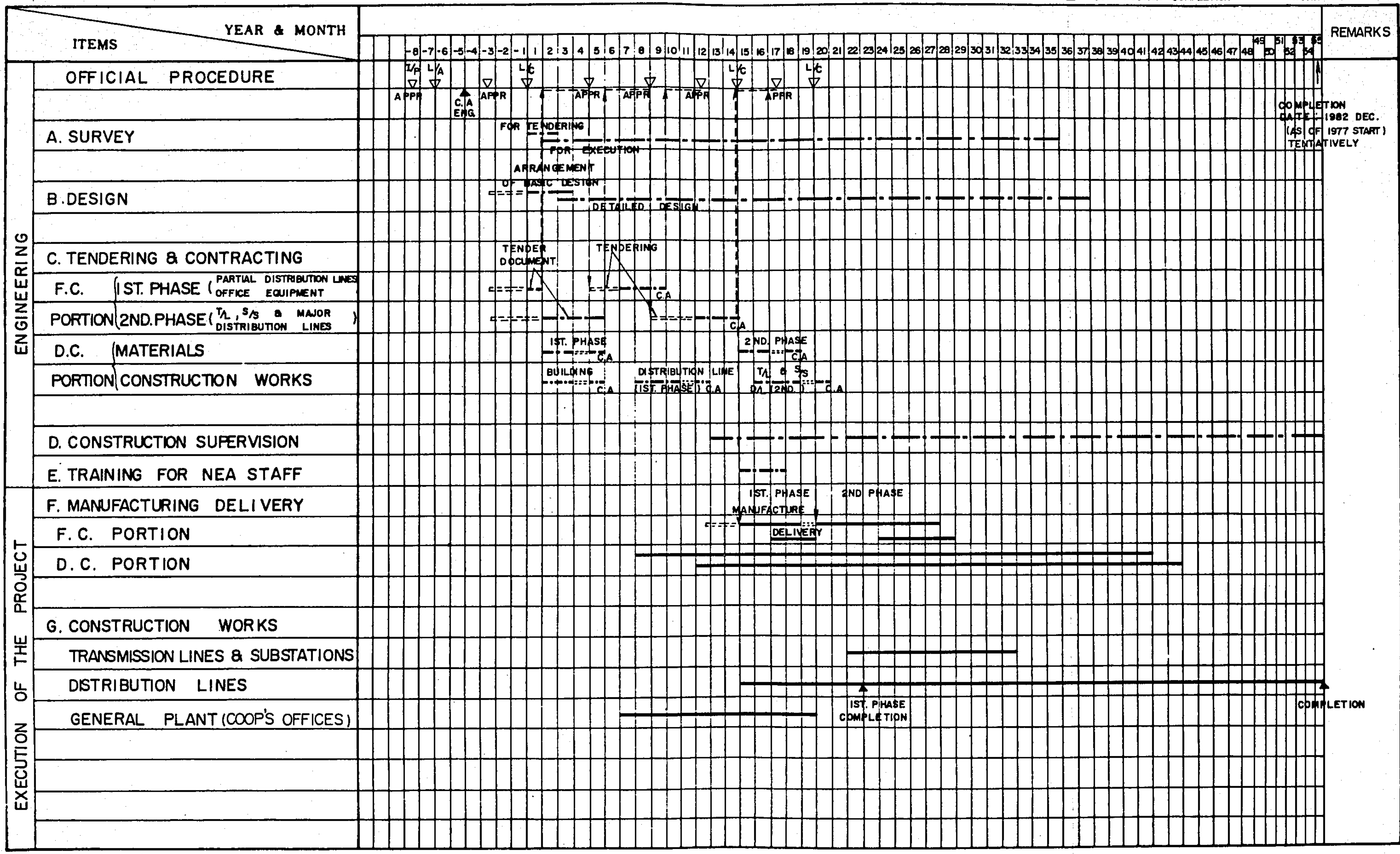
The construction of 230 KV and 69 KV transmission and substation facilities in Cagayan Valley by NPC is now under way way for the target of commissioning in April 1979.

In this connection, construction of main distribution lines before the completion of the above-mentioned transmission and substation facilities is most desirable, but it cannot be expected because of the time required for construction work. However, electrification of even a portion of the project area upon completion of the transmission and substation facilities is still desirable. The construction schedule shown in Table 9-2 is intended for this purpose. To realize this construction schedule, however, cooperation of the related agencies in handling official procedures for the Yen Loan and speedy actions of the parties concerned in the preparation of designs and specifications for tendering and contract will be necessary as a precondition.

TABLE 9-2 CONSTRUCTION SCHEDULE (IST. STAGE) (TENTATIVE)

DATE AUGUST 1977

LEGEND
- ---- OFFICIAL PROCEDURE
- ▽ OFFICIAL LETTER
- ▲ CONSTRUCTION COMPLETION
- ==== PRELIMINARY WORK
- -·-·- ENGINEERING
- —— WORK



Chapter [illegible] – Outline of 2nd Stage and 3rd Stage Development Results

Chapter 10. Outline of 2nd Stage and 3rd Stage Development Programs

Though it may be appropriate to take up the development programs for the period after 1983 at the time when all Towns and Municipals have been electrified in 1980, the outline of the required future construction work, envisaged by the Survey Mission on the basis of demand forecast, will be given below.

10-1. 2nd Stage Construction Program (1982 - 1984)

10-1-1. Transmission and Substation Facilities

(1) Construction of Ifugao S/S

Ifugao S/S (69/13.8 KV, 10 MVA) will be constructed and one circuit (40 km) of 69 KV transmission line will be provided between Solano and Ifugan to meet the increase of load in Ifugao Province.

(2) Construction of Roxas S/S

Roxas S/S (69/13.8 KV, 15 MVA) will be constructed near Roxas and one circuit (30 km) of 69 KV transmission line will be provided between Ilagan and Roxas to meet the increase of load in the western district of Ilagan Province.

(3) Construction of Echage S/S

Echage S/S (69/13.8 KV. 15 MVA) will be constructed near Echage to cope with the overload of transformers at Santiago S/S and to meet the increase of load in the Echage area. A transmission line (1 km) will be branched off from the Santiago - Cauayan transmission line.

(4) Addition of 230/69 KV transformer at Tuguegarao S/S

One additional 230/69 KV, 50 MVA transformer will be installed at Tuguegarao S/S as the overload of existing 230/69 KV transformers is expected in 1984.

10-1-2. Distribution Facilities

Construction of high voltage branch distribution lines to cover the remaining 50% of Barrios which are excluded from the 1st stage of the Project and construction of distribution lines to expand the range of electrification will be carried out as follows.

High voltage line:	Vø 58 mm^2 ACSR (new)	1,024.7 km
	Vø 25 mm^2 ACSR (new)	1,077.5 km
	1ø 25 mm^2 ACSR (new)	257.8 km
High voltage equipment:	Capacitor (50 kVA)	29 each
	Recloser	0 each
	Air break switch	94 each
	Line fuse	94 each
	SVR (1000-4000 KVA)	34 each
Transformer:		3,569 each
Low voltage line:	Under-built	663.5 km
	New installation	1,100.9 km
Drop wire:	2-wire system	83,138 places
	3-wire system	1,242 places
WH meter:	Single-phase	83,138 each
	3-phase	1,242 each
Street light:		2,184 each

The rate of electrification upon completion of the 2nd stage construction program will be 50%.

10-2. 3rd Stage Construction Program (1985 - 1990)

10-2-1. Transmission and Substation Facilities

(1) *Construction of Bambang S/S*

Bambang S/S (69/13.8 KV, 10 MVA) will be constructed near Bambang and one circuit (20 km) of 69 KV transmission line will be provided between Solano and Bambang to meet the increase of load in the southern district of N. Vizcaya Province.

(2) Construction of Quirino S/S

Quirino S/S (69/13.8 KV, 10 MVA) will be constructed near Cabarroguis and one circuit (25 km) of 69 KV transmission line will be provided between Santiago and Quirino to meet the increase of load in Quirino Province.

(3) Construction of Cabagan S/S

Cabagan S/S (69/13.8 KV, 15 MVA) will be constructed near Cabagan and one circuit (25 km) of 69 KV transmission line will be provided between Tuguegarao and Cabagan to meet the increase of load in the northera district of Isabela Province.

(4) Construction of Alcala S/S

Alcala S/S (69/13.8 KV, 15 MVA) will be constructed near Alcala and one circuit (2 km) of 69 KV transmission line will be branched off from the Tuguegarao-Camalaniugan transmission line to meet the increase of load in the central area of Cagayan Province.

(5) Construction of Claveria S/S

Claveria S/S (69/13.8 KV, 10 MVA) will be constructed near Claveria and one circuit (50 km) of 69 KV transmission line will be extended from Lucban-Abulug S/S to meet the increase of load in the northwestern district of Cagayan Province.

(6) Installation of additional transformers

The following transformers will be installed additionally to cope with the overload of existing transformers at each substation.

Solano S/S	69/13.8 KV, 15 MVA
Santiago S/S	69/13.8 KV, 15 MVA
Cauayan S/S	69/13.8 KV, 15 MVA
Ilagan S/S	69/13.8 KV, 15 MVA
Tuguegarao S/S	69/13.8 KV, 15 MVA

(7) Expansion of transmission line

a. One circuit (55 km) of 69 KV transmission line will be provided between Tuguegarao and Magapit to cope with the overload of 69 KV Tuguegarao - Camalaningan transmission line and to ensure stable power supply in the area.

b. One circuit (70 km) of 69 KV transmission line will be provided between Santiago and Ilagan to cope with the overload of 69 KV Santiago - Ilagan transmission line and to ensure stable power supply in the area.

(8) Installation of an additional 230/69 main transformer at Santiago S/S

One unit of 230/69 KV, 50 MVA transformer will be installed additionally to cope with the overload of existing 230/69 KV main transformers at Santiago S/S.

10-2-2. Distribution Facilities

Though all of the Barrios will be connected into the distribution system by the 2nd stage of the Project, construction of high voltage branch distribution lines and installation of transformers and low voltage lines will be carried out during this stage to realize power supply to the rural area left behind in the electrification of the previous stages.

High voltage line:	Vϕ 25mm^2 ACSR (new)	2,000 km
	1ϕ " " "	1,000 km
High voltage equipment:	Capacitor (50 kVA)	30 each
	Recloser	0 each
	Air break switch	0 each
	Line fuse	100 each
	SVR (1000 - 4000 kVA)	25 each
Transformer		6,000 each
Low voltage line:	Under-built	1,200 km
	New installation	1,800 km
Drop wire	2-wire system	210,000 places
	3-wire system	1,000 places
WH meter	Single-phase	210,000 each
	Three-phase	1,000 each
Street light		2,000 each

The rate of electrification upon completion of the 3rd stage of the Project will be 85%.

10-3 Estimated Construction Costs of 2nd and 3rd Stages

The estimated construction costs for the above-mentioned 2nd and 3rd Stages of the Project are as follows.

10-3-1. 2nd Stage Construction Program

Table 10-1

Description	F.C.(10^3 ¥)	D.C. (10^3 P)	Total (10^3 P)
Transmission and substation facilities	1,483,000	7,290	
Distribution facilities	3,618,000	73,130	
Total	5,101,000	80,420	218,530
Equivalent Yen	5,101,000	2,970,000	8,071,000

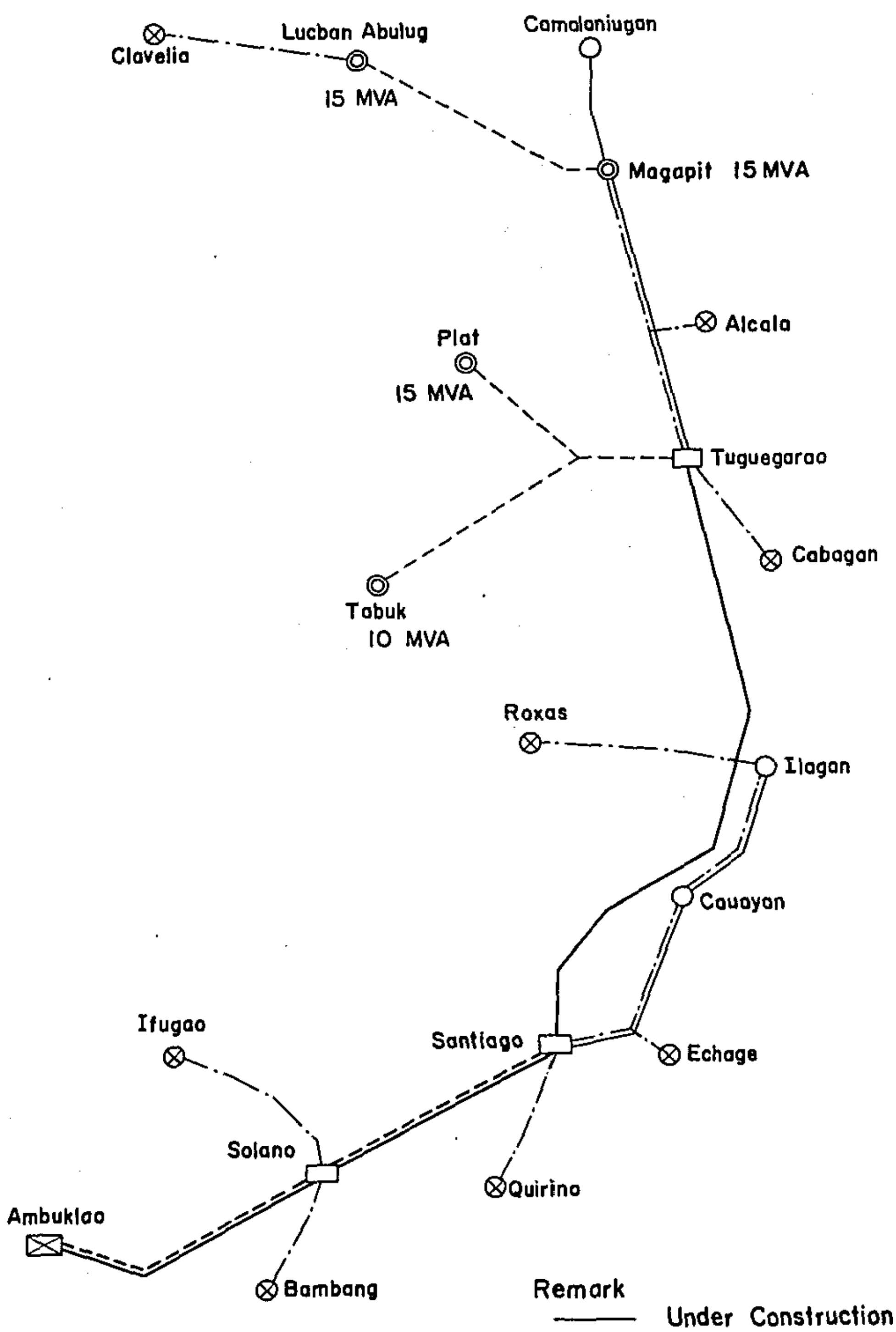
10-3-2. 3rd Stage Construction Program

Table 10-2

Description	F.C.(10^3 ¥)	D.C. (10^3 P)	Total (10^3 P)
Transmission and substation facilities	4,180,000	20,110	
Distribution facilities	5,360,000	114,000	
Total	9,540,000	134,110	392,420
Equivalent Yen	9,540,000	4,953,000	14,493,000

Fig. 10-1 shows the transmission lines and substations planned to be constructed in the 1st stage through the 3rd stage of the Project, and Fig. 10-2 shows the trend of the peak system load and the transformer capacities.

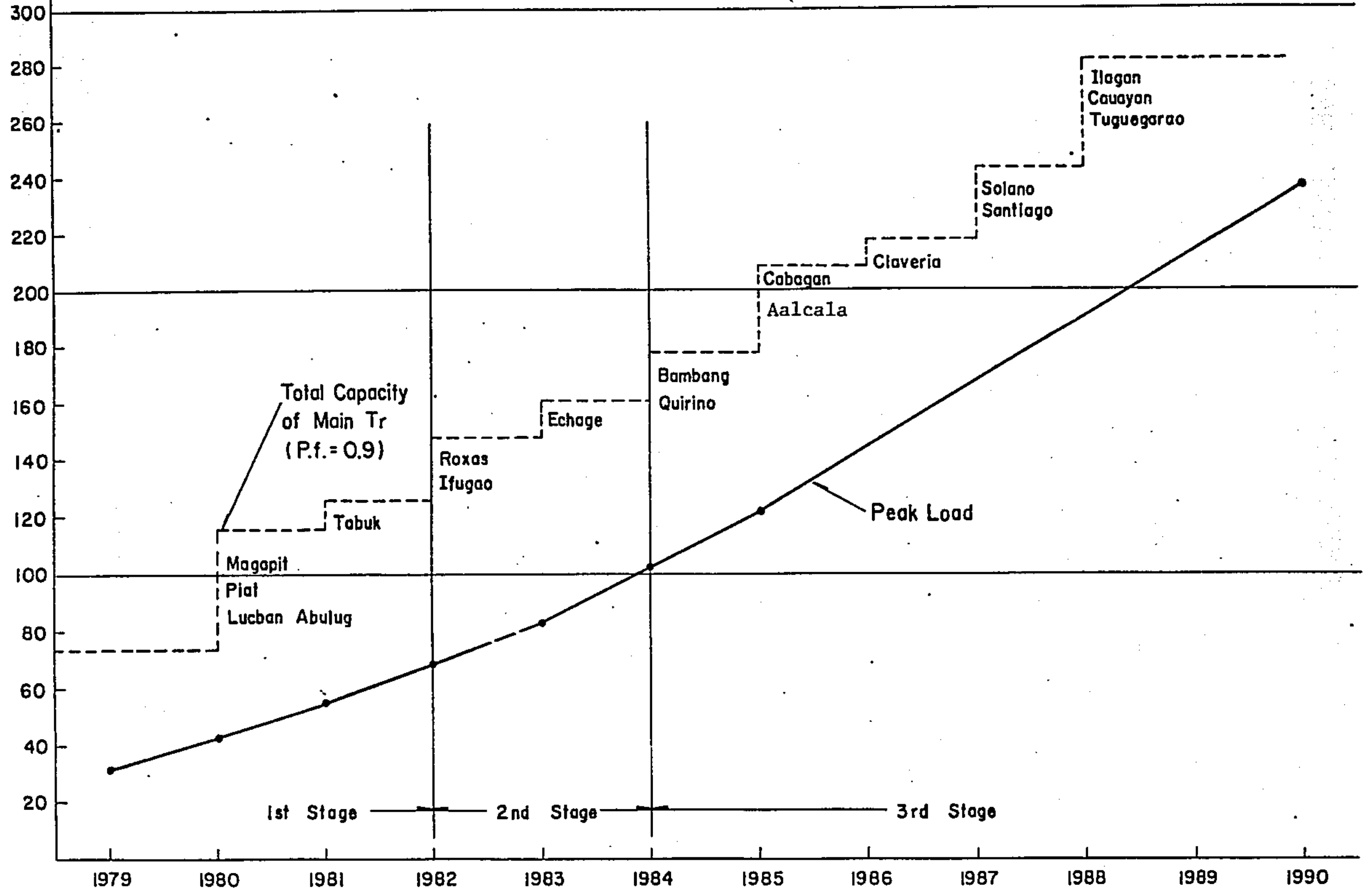
Fig. 10-1 230KV & 69KV POWER SYSTEM MAP



Remark

- ——— Under Construction by NPC
- - - - - New Construction in This Project
- —·— New Construction in 2nd or 3rd Stage
- □ ○ Under Construction by NPC
- ◎ New Construction in This Project
- ⊗ 〃 〃 in 2nd or 3rd Stage

Fig.10-2 ESTIMATED PEAK LOAD in MW



Chapter 11 NPC 230KV System Expansion Program

Chapter 11 NPC 230 KV System Expansion Program

11-1. Power Demand and Supply in Luzon

With the increase of power demand in the urban area in and around Manila and the progress of rural electrification carried out by COOP's, the power demand (KW) in Luzon Island will grow at an annual rate of 10% during the 1977 - 1982 period (reaching 2.8 million KW in 1982) and at an annual rate of 6% during the 1983 - 1987 period (reaching 3.7 million KW in 1987).

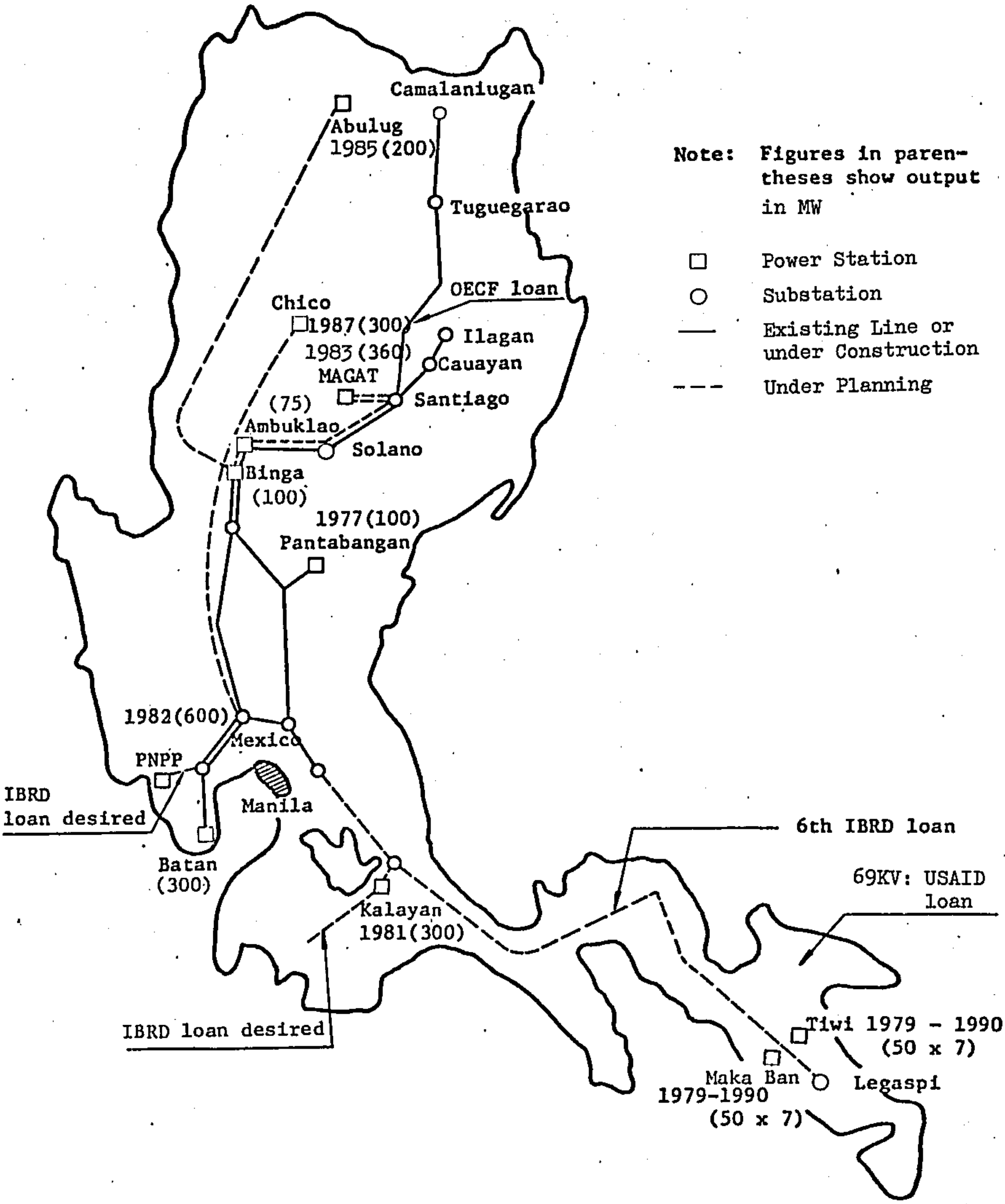
To meet this growth of demand, the existing facilities having a total capacity of 2.17 million KW (firm peak capacity of 1.75 million KW) will have to be expanded in the future. For development of power resourses in the future, a long-range program, calling for the development of hydro power, geothermal power (in the southern district of Luzon) and nuclear power as main power sources, has been formulated by the Government on the condition that fuel consumption of thermal power plants will not increase further except for the thermal power plants now under construction. The long-range power development program shown in Table 11-1 aims at increasing the reserve capacity for the period after 1982 from the present 10% to 20%.

It was originally planned to construct Chico No.4 Hydro Power Plant (300,000 KW) simultaneously with the construction of the nuclear power plant PNPP-I (600,000 KW) in the Batan Peninsular in 1982. However, the early development of Chico No.4 Hydro Power Plant has become impossible because of the difficulty in securing the necessary land space. For this reason, the timing of construction of Magat Power Plant has been moved up for commissioning in 1983 from originally scheduled 1985 in view of the advantage of this site for early construction in respect of availability of the necessary land space and other favorable conditions.

Table 11-1 Demand and Supply Balance (MW) and Power Resources Development Program

Fiscal Year		1977	1978	1979	1980	1981	1982	1983	1984
Maximum demand (10 MW)		1,720	1,890	2,110	2,330	2,560	2,800	2,940	3,110
Maximum generating capacity (10 MW)		2,190	2,250	2,660	2,720	3,030	3,540	4,000	3,880
Reserve ratio		21%	16%	20%	14%	15%	20%	26%	20%
Power Resources Development Program	Hydro power	Panta Bangan (100 MW)				Kalayaan 1 and 2 (300 MW)		Magat 1-4 (360 MW)	
	Thermal power	Batan 2 (150 MW)		Malaya 2 (300 MW)					Rock well abandoned Δ(125 MW)
	Nuclear power						PNPP 1 (600 MW)		
	Geothermal power		Tiwi 1 (55 MW)	Tiwi 2 (55 MW) Maka Ban 1, 2 (110 MW)			Tiwi 3, 4 (110 MW) Maka Ban 3 (55 MW)	Maka Ban 4 (55 MW)	

Fig. 11-1 NPC's Main Power Systems and Power Resources Development Sites in Luzon



11-2 NCP Power Development Projects in Luzon and Foreign Aids

The transmission and substation projects and power plant projects for NPC power system in Luzon have so far been implemented with the foreign aids as shown below.

1) 5th IBRD Loan

Electrification projects in Ilcos, Zambales, Central Luzon, Laguna-Batangas and Southern Luzon - Completed in 1976.

2) 6th IBRD Loan

Expansion of transmission line and substations of the existing power system and construction of North-South Luzon Interconnection System and Tiwi Geothermal related transmission lines - To be completed in 1979.

3) USAID Loan

Expansion of transmission system in Southern Luzon - To be completed in 1978.

4) OECF Loan

Construction of transmission and substation system in Cagayan Valley - To be completed in 1979.

5) Construction of Maka Ban Geothermal transmission lines - To be completed in 1978.

6) Construction of trunk line system for nuclear power plant.

7) Construction of other systems related to the development of hydraulic power and expansion of 69KV transmission system.

Of the above, the projects under items 6) and 7), which are scheduled to be commenced after 1978, are being negotiated by NPC as the object of IBRD Loan. However, the works of expansion of Ambuklao-Santiago Line and incoming line equipment at Ambuklao Power Plant, Solano S/S and Santiago S/S following the development of Magat Power Plant have to be completed within the period of Cagayan Valley Transmission System Project by OECF Loan. For this reason, a request has been made to the Japanese Government for financial aids for these works.

11-3. Need for Two Circuits of 230 KV Transmission Line between Ambuklao and Santiago in Relation to the Construction of Magat Power Plant

The Magat Power Plant utilizes the Magat multi-purpose dam for power generation. The power plant is designed as a three-hour peak-load station with an annual generation of about 1,000 million KWH. It is essential that the power plant is completed by 1983 to keep the demand and supply balance (KW) in Luzon as shown in Table 11-1. Without this power plant in 1983, the reserve ratio in Luzon in 1983 will become 19%, and a serious power shortage with the resultant load restriction would result in case of failure of the nuclear power plant.

Upon completion, the Magat Power Plant can always be operated during the peak-load, and can be operated for 24 hours during the wet season.

Fig. 11-3 shows a power flow diagram at peak time during the dry season when Magat Power Plant is operated at the capacity. The power flow between Santiago and Ambuklao amounts to 280,000 KW according to the diagram. (Capacity of one circuit of 230 KV transmission line is approximately 300,000 KW.) This means that the power flow will exceed the safe limit of one circuit of 230 KV transmission line at time of light load in the Cagayan Valley except in the wet season and at peak time. Moreover, a fault of transmission lines during the operation of the Magat Power Plant will impede the safe operation for reasons of stability of hydro generators if only one circuit of transmission line is provided.

It is necessary, therefore, to expand the one circuit 230 KV transmission line between Ambuklao and Santiago to two-circuit system by 1983 when the Magat Power Plant is scheduled to be commissioned.

11-4. System Formation and Stability

In connection with the need for expansion of 230 KV transmission lines to the two-circuit system as mentioned previously, it is important to clarify the following points in planning the expansion of the system.

a. The Magat P/S is expected to have a max. output of 540 MW. Is it possible to transmit 540 MW from the standpoint of system stability?

b. Which will be used for branch at the Solano S/S, T branch or π branch?

In order to answer the above questions, a transient stability calculation was made and the following result was obtained.

(1) Summary of result of transient stability calculation

a. Condition for calculation

System — As shown in Fig. 11-2 Power Flow Diagram and Fig. 11-3 Impedance Map

Fault — Three-phase ground fault near Santiago

b. Summary of results

Table 11-2 Results by Low-speed Reclosing

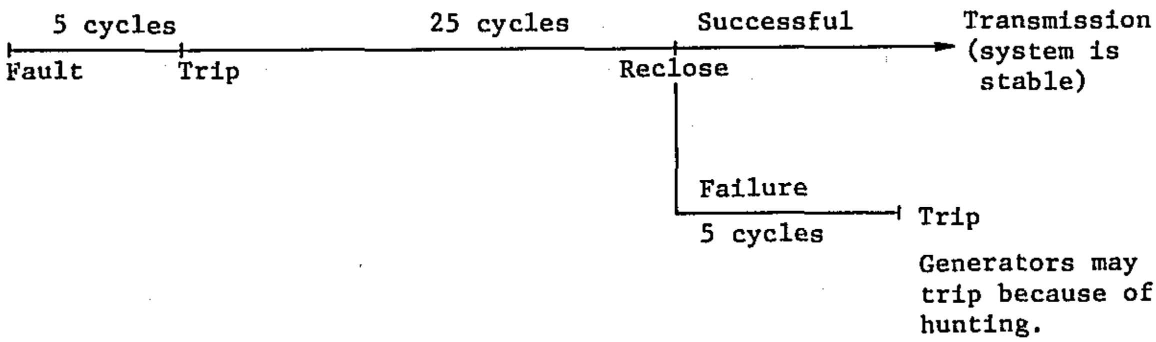
O : Stable
x : Unstable

System composition	Solano T branch		Solano π branch	
Output of Magat p.p.	360 MW	540 MW	360 MW	540 MW
Clear time (Cycle)	5	5	5	5
Reclosing successful	O	x	O	x
Reclosing failure	O	x	O	x
No reclosing	O	x	O	x

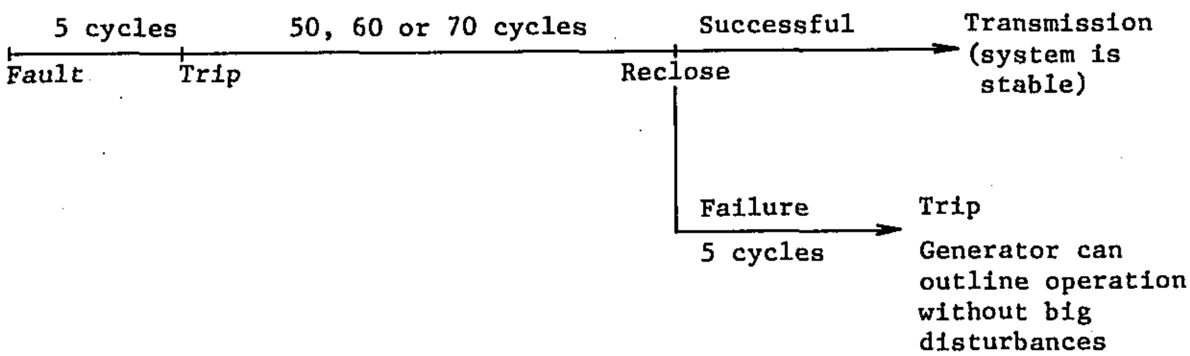
tability calculations were made for the cases of high-speed reclosing and low-speed reclosing.

Stability calculation for high-speed reclosing (no voltage time 25 cycles) indicates that the system might becomes unstable in case of reclosing failure at 360 MW output of Magat Power Plant. However, in case of low-speed reclosing (3 cases of 50, 60 and 70 cycles of no voltage time), the system remains stable in all of the cases.

High-speed reclosing



Low-speed reclosing



Figs. 11-4 and 11-5 show typical results of calculations.

a) Fig. 11-4 shows the conditions of the generators at Ambuklao (75 MW), Magat (360 MW), Binga (100 MW) and Pantabogan (100 MW) Power Plants in case of 3-phase grounding fault near Santiago S/S at the system condition of 540 MW of Magat output and π-brand at Solano S/S. As seen in this figure, Magat generator (indicated by M in the figure) and Ambuklao generator (indicated by A) near the fault point undergo serious swinging and finally step out. (The generators trip because of the system disturbances.)
Thus, in case of 540 MW output of Magat Power Plant, stable supply of power cannot be expected, and π-branching at Solano S/S would contribute little to the system stability.

b) Fig. 11-5 show the conditions of the generators at the foregoing 4 power plants after the final tripping of the lines after the low-speed reclosing process of tripping in 5 cycles, reclosing after 60 cycles of no voltage time and re-tripping in 5 cycles because of continuing fault, in case of 3-phase grounding fault near Santiago S/S at the system condition of 360 MW of Magat output and T-branch at Solano S/S.

The figure shows that Magat generator (M) and Ambuklao generator (A) as well as the other generators can continue stable operation through the system disturbances. This indicates that stable power supply would be maintained in case of 360 MW output of Magat Power Plant with T-branch at Solano S/S if low-speed reclosing is adopted.

(2) Conclusion

The following conclusion may be reached as a result of the foregoing calculations.

a. Stability of transmission can be maintained for 360 MW output at the 1st stage of Magat Power Plant through the expansion of transmission lines between Ambuklao and Santiago to two circuits, while stability of transmission cannot be expected for 540 MW output after the 2nd stage because of a greater possibility of step-out phenomenon resulting from a system fault. For this reason, the transmission system after the 2nd stage of Magat Power Plant should be studied together with the transmission system for Abulug Power Plant and Chico Power Plant to be constructed in this area in the future.

b. T-branch will be used for Solano S/S for the time being. π-branch requires a tremendous amount of money for construction and contributes very little to the stability of transmission. Since the Solano S/S has a small load and has no important customers, there is no need for π-branch for the time being, and operation with one-circuit receiving system by T-branch is considered sufficient.

   It would be appropriate to consider π-branching for Solano S/S together with the development of 2nd stage of Magat Power Plant and Abulug and Chico Power Plants, after thorough system stability study.

Fig. 11-2 POWER FLOW DIAGRAM in 1983 at PEAK TIME

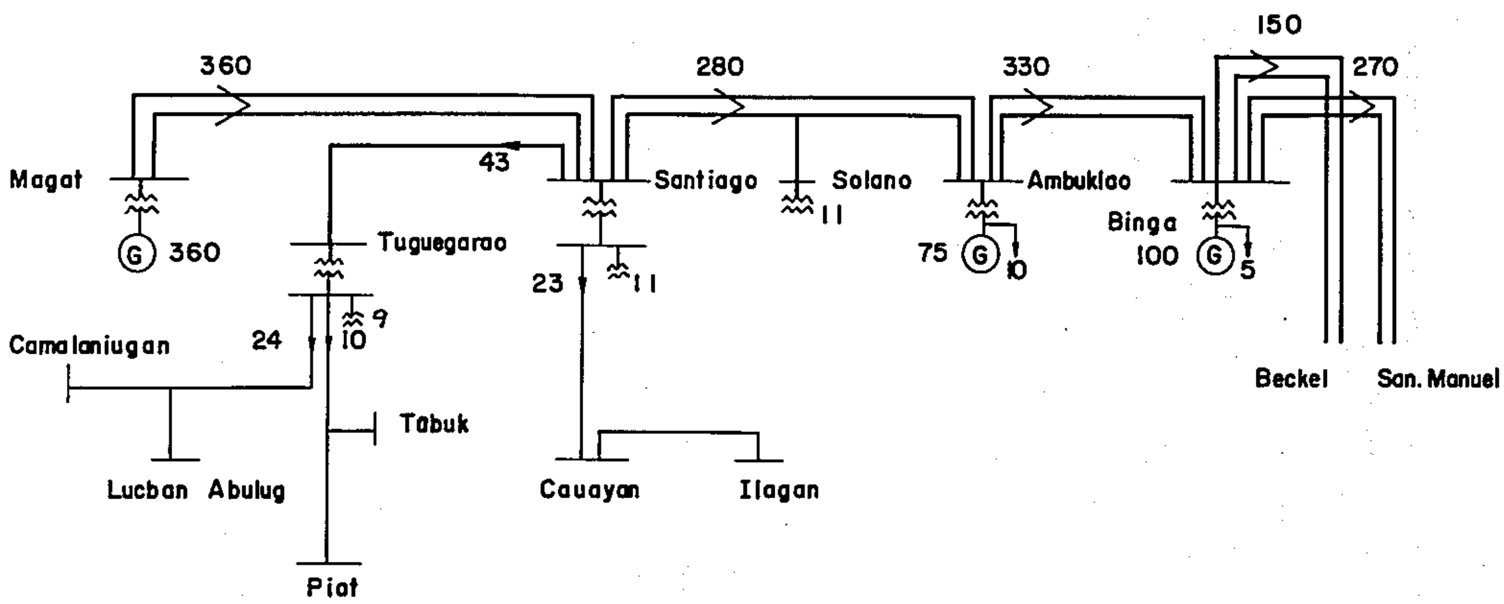


Fig. 11-3 Northern Luzon Power System in 1987
Impedance Map, 100MVA, 345kV, 230kV Base.

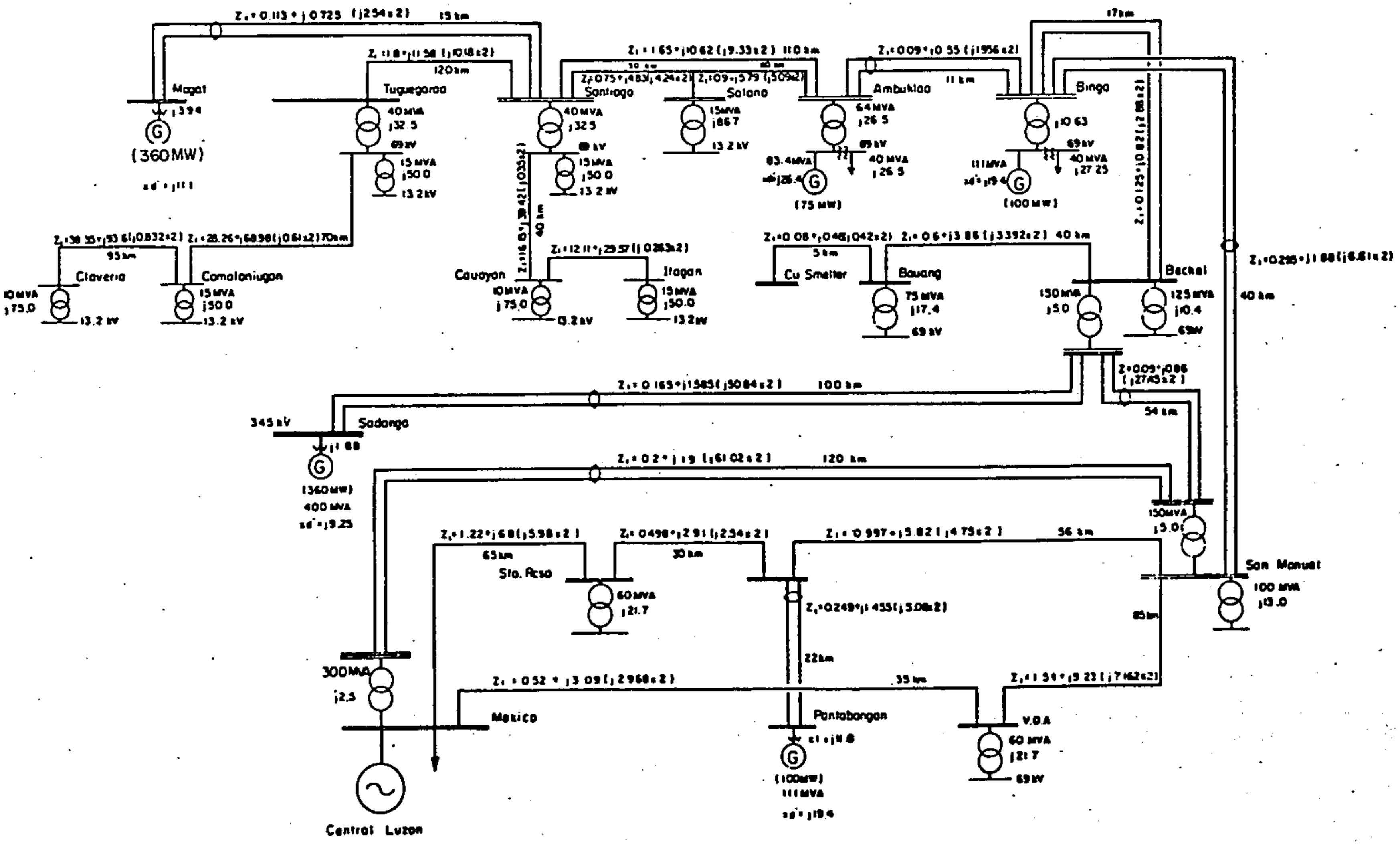
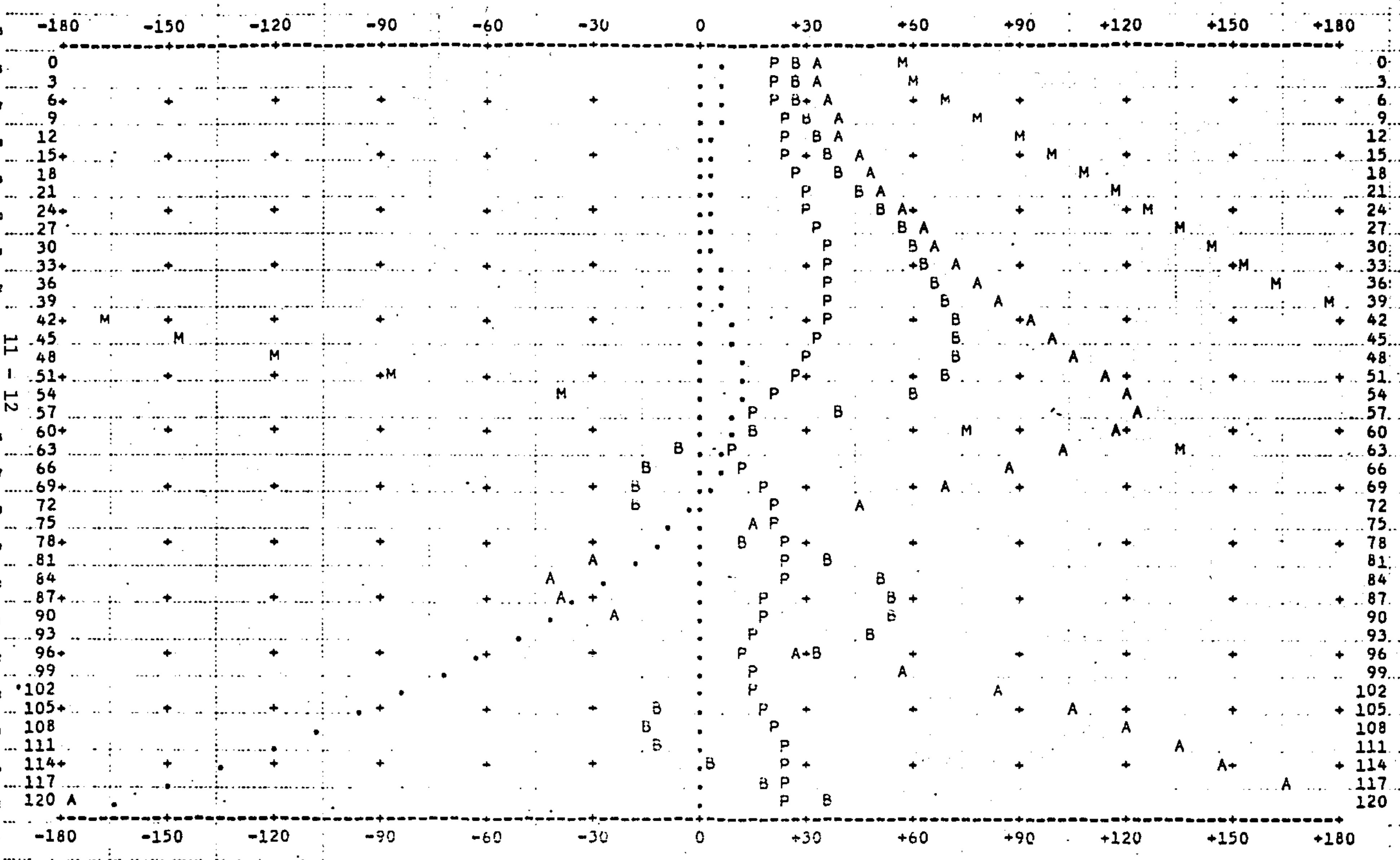


Fig. 11-4 TRANSIENT STABILITY CALCULATION DATA

MAGAT OUTPUT : 540 MW SOLANO : π BRANCH

FAULT POINT : SANTIAGO 3LG CLEAR TIME : 5 CYCLES



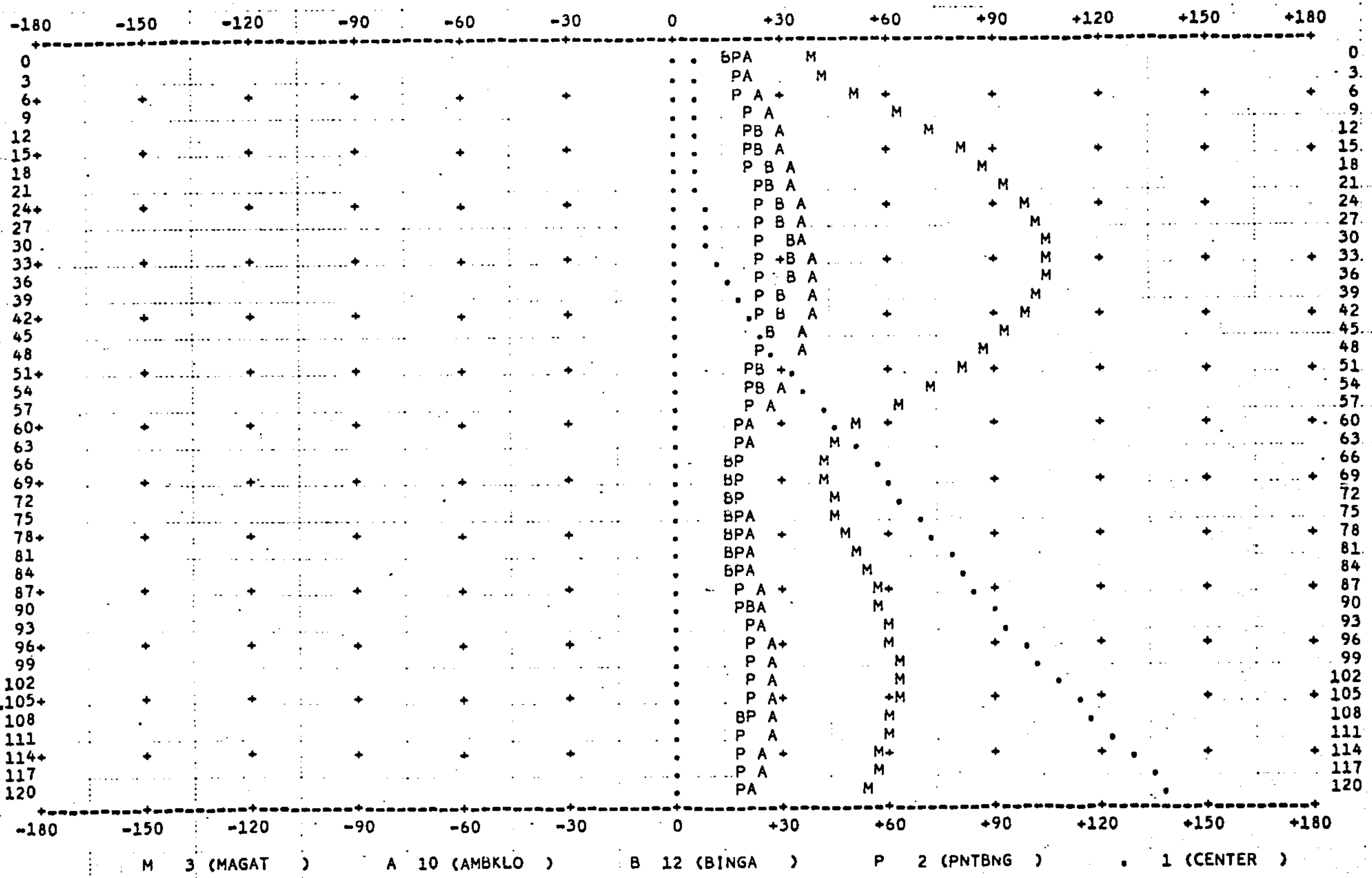
M 3 (MAGAT) A 10 (AMBKLO) B 12 (BINGA) P 2 (PNTBNG) . 1 (CENTER)

Fig. 11-5 TRANSIENT STABILITY CALCULATION DATA

MAGAT OUTPUT : 360 MW SOLANO : T BRANCH

FAULT POINT : SANTIAGO 3 LG CLEAR TIME : 5 CYCLES

RECLOSE TIME : 60 CYCLES RECLOSE : FAILED (O-C-O)



11-5 Outline of Construction Work for Expansion to Two Circuits of Transmission Line

(1) Transmission line

One circuit of 230 KV transmission line will be installed additionally in the Ambuklao - Solano - Santiago section.

Line length:	Ambuklao - Solano; 63 km Solano - Santiago; 44 km	} 107 km
Voltage:	230 KV	
No. of circuits:	1	
Support:	Steel tower (designed for 2 circuits)	
Conductor:	405 mm^2 (795 KCM) ACSR	
Insulator:	250 mm^2 ball and socket type suspension insulator, 14-insulator string (dead-end insulator: 15-insulator string)	

(2) Substation

Additional incoming line equipment will be provided at substation in connection with the installation of one additional circuit of transmission line. Specifications and quantity of main equipment to be installed are as follows.

Fig 11-6 230 KV TRANSMISSION ROUTE MAP

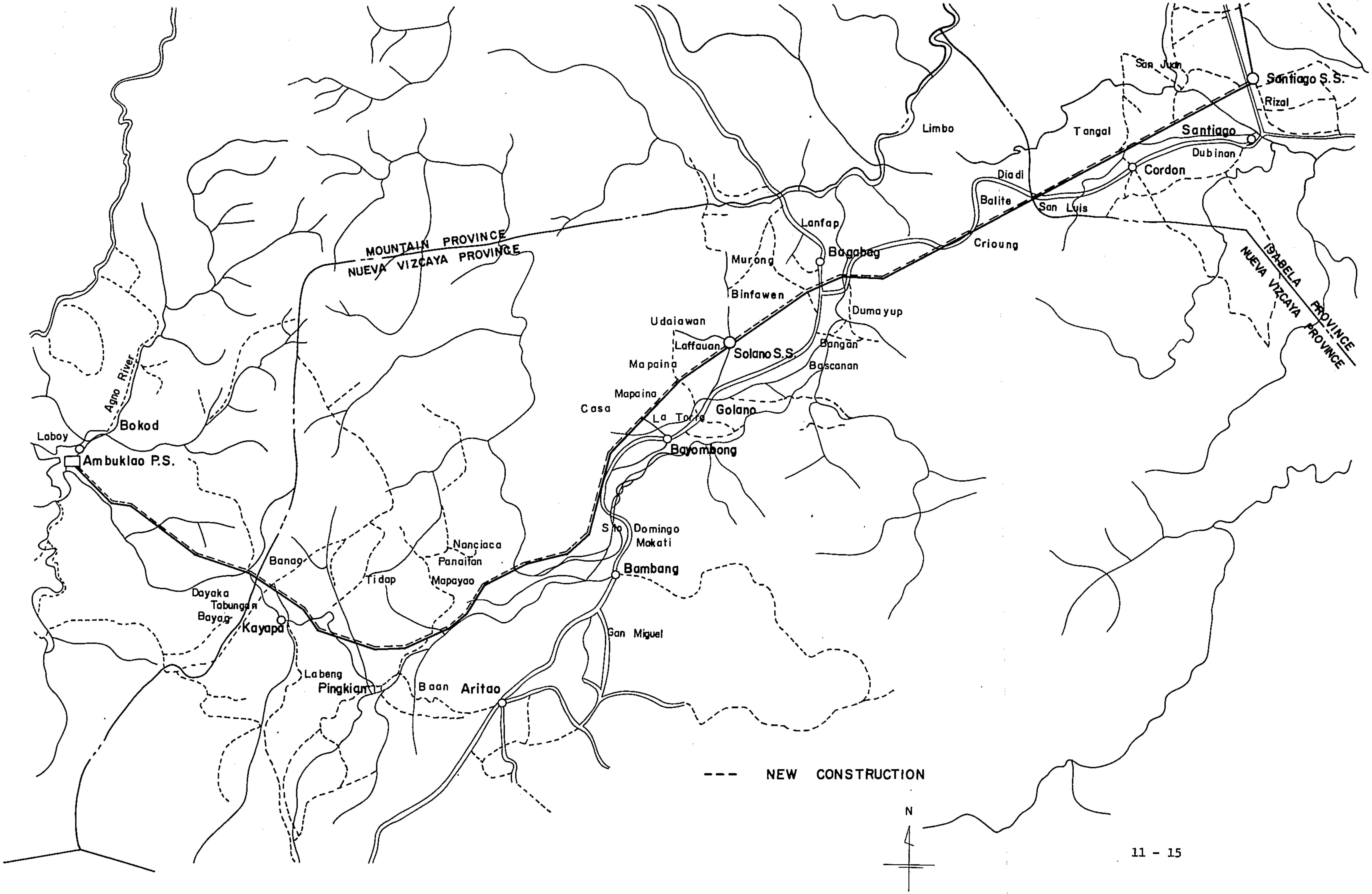


Table 11-3

Description	Specification	Unit	Quantity			
			Ambuklao	Solano	Santiago	Total
Circuit breaker	230KV, 1200A, 25KA 3ϕ	ea	2	1	3	6
Disconnecting switch	230KV, 1200A	"	6	3	8	17
Current transformer	230KV, 1200/5A, 4-core	"	6	3	9	18
PD	$\frac{230}{\sqrt{3}} / \frac{110}{\sqrt{3}}$ 275VA 2-core	"	3	3	5	11
Arrester	192KV	"	3	3	3	9
Line trap	800A	"	2	2	2	6
PLC relay	Directional comparison power line carrier relaying system by the distance relay	set	1	1	1	-
PLC device		"	1	2	1	4
Control panel		"	1	1	1	-
Relay panel			1	1	1	-
Conductor and insulator			1	1	1	-

(3) Supplemental data on construction programs

a. Specifications of equipment described so far are the same as those of the equipment now under construction by NPC.

b. System protection

For system protection, the directional comparison power line carrier relaying system by the distance relay (the same specifications as those of the system now being installed by NPC) will be used.

For 3-phase reclosing, adoption of low-speed reclosing system is recommended.

Though the Solano S/S will be operated with two circuit T-branch for the time being, it is desirable to receive power with one circuit at ordinary times because of the type of its protection system.

11-6. Construction Cost

(1) *Estimated Total Construction Cost*

The estimated total construction cost required for installation of one additional 230 KV transmission line is as shown below.

Table 11-4

(1979 cost)

Description	Foreign currency 10^3 yen	Domestic currency 10^3 P	Total 10^3 P
Transmission facilities	482,000	5,950	19,000
Substation facilities	772,000	3,880	24,780
Subtotal	1,254,000	9,830	43,780
Contingencies F.C. 5% D.C. 10%	63,000	980	2,690
Subtotal	1,317,000	10,810	46,470
Engineering fee 5%	63,000	510	2,220
Total	1,380,000	11,320	48,690
Equivalent Yen	1,380,000	418,000	1,798,000

Notes:
1. Figures shown in the table represent construction cost when implemented as an additional work to the Cagayan Valley Project implemented by NPC.
2. Direct construction cost is estimated at 1979 cost based on 1977 cost with annual escalation of 5%.
3. A conversion rate of 1 US$ = 277 yen = 7.5 P is used for calculation.
4. Interest during construction is not included.

(2) Required investment by year

Description	Total amount	1978	1979	1980
Foreign currency (10^3 ¥)	1,380,000	20,000	750,000	610,000
Domestic currenty (10^3 ₱)		300	6,500	4,520

11-7 Construction Schedule

The Cagayan Valley Electrification Project by NPC, is scheduled for completion in April 1979, and NPC strongly desires to implement this transmission line expansion project simultaneously with the above mentioned Cagayan Valley Project. However, implementation of this project at the same time is considered difficult. For this reason, the construction schedule which envisages the completion of the project in May 1980, one year after the completion of the Cagayan Valley Electrification Project, has been prepared as shown in the attachment.

Fig. 11-7 SINGLE LINE DIAGRAM (ORIGINAL PLAN BY NPC)

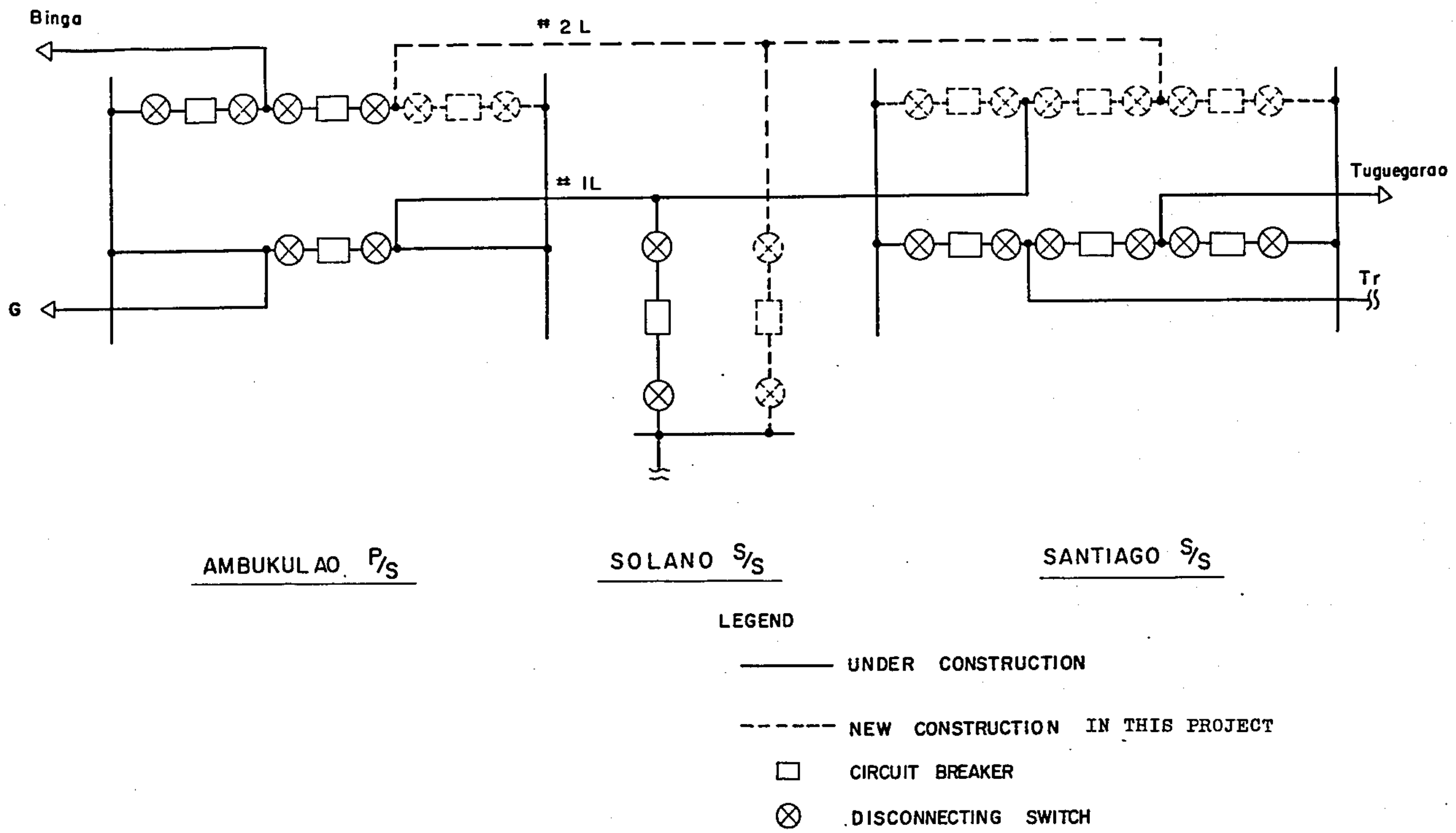


Fig 11-8

SINGLE LINE DIAGRAM

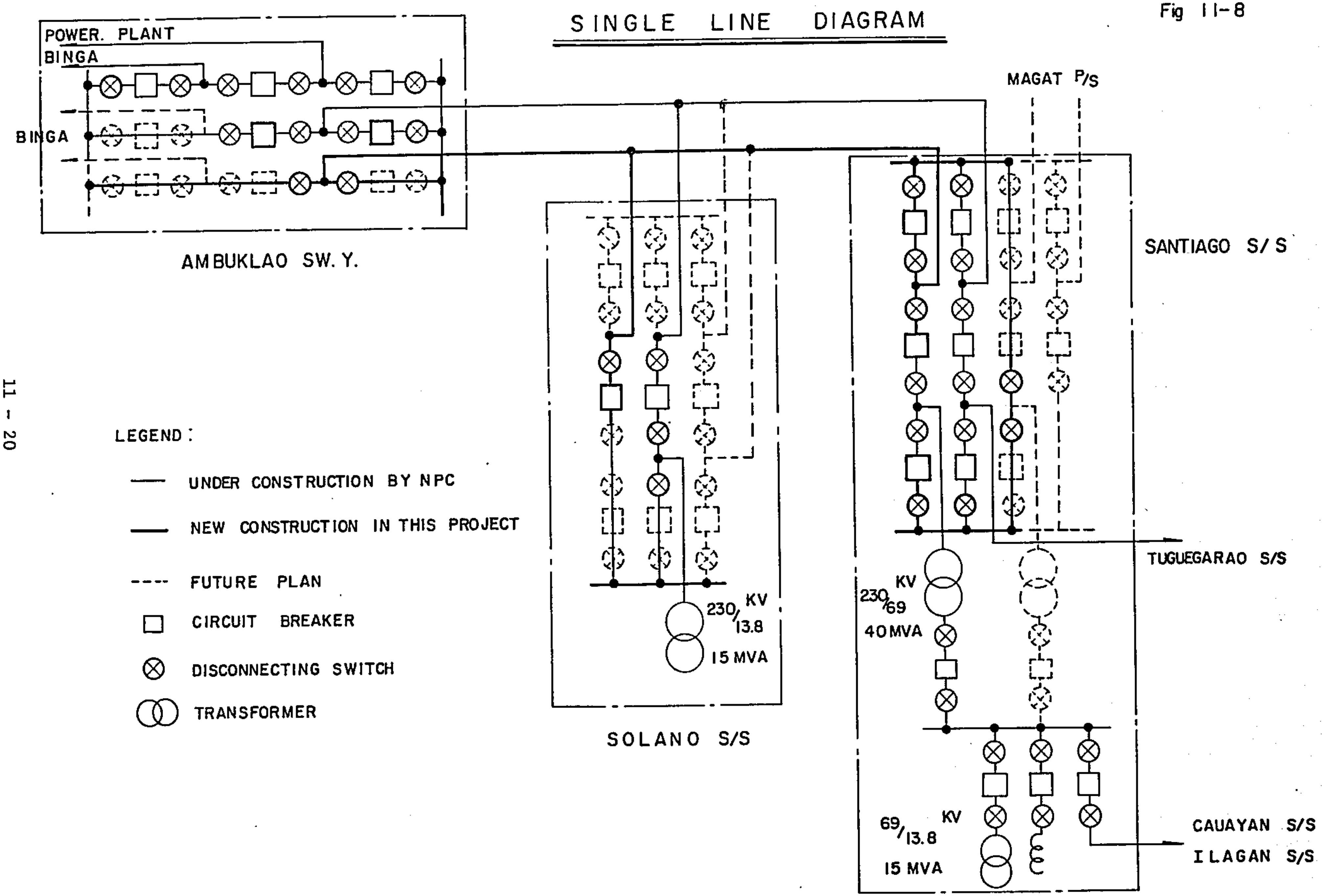
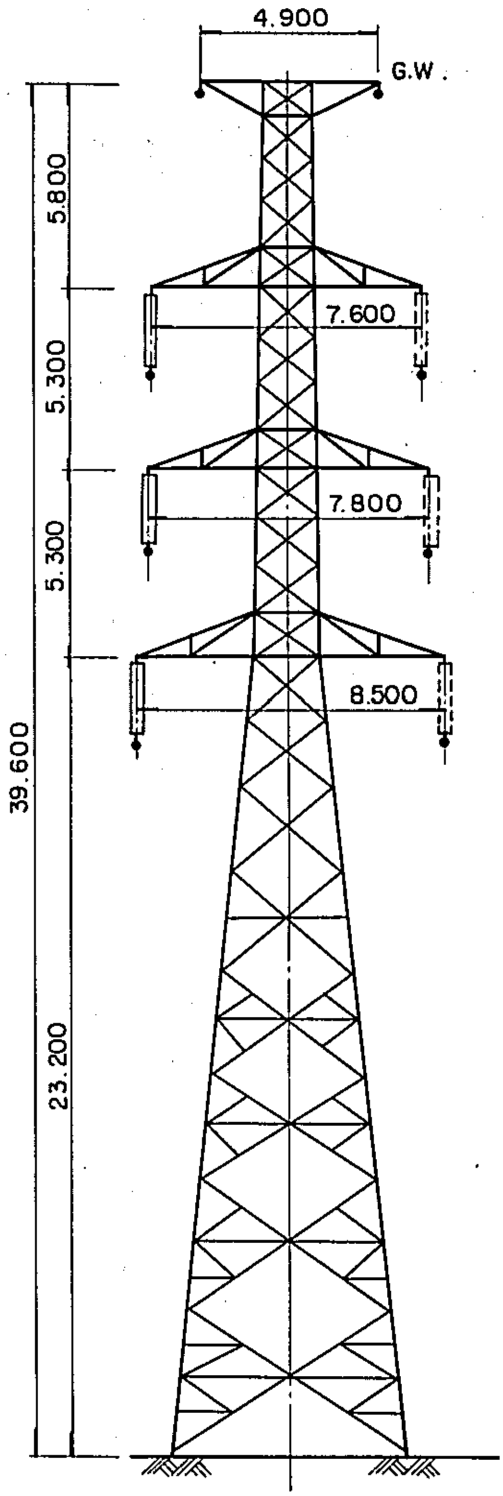
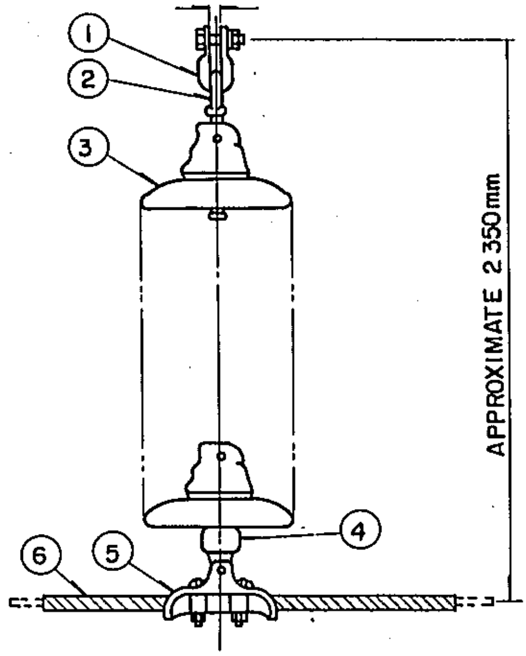


Fig. 11-9 **230 KV 2cct STANDARD SUSPENSION TOWER**



Normal Span 400(m)

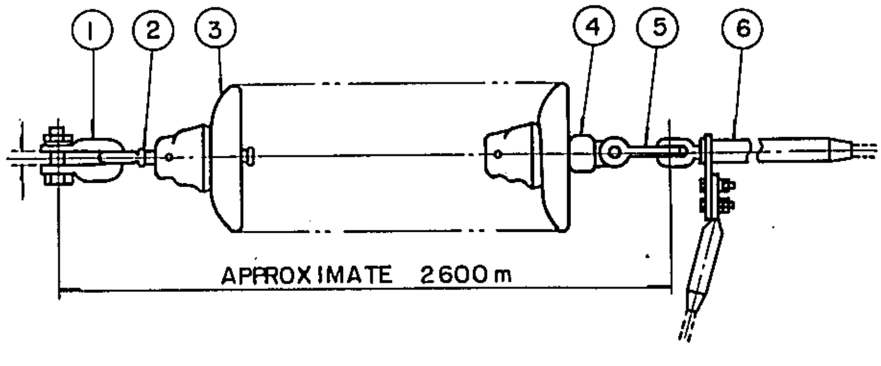
Fig. 11-10 SUSPENSION INSULATOR STRING TYPE "S"



ITEM	DESCRIPTION	QTY
①	Anchor Shackle Bolt Type	1
②	Ball Eye	1
③	Insulator ANSI 52-3	14
④	Socket Eye	1
⑤	Suspension Clamp	1
⑥	Preformed Armor Rod	1 Set

MIN. BREAKING STRENGTH : 7.000 kg

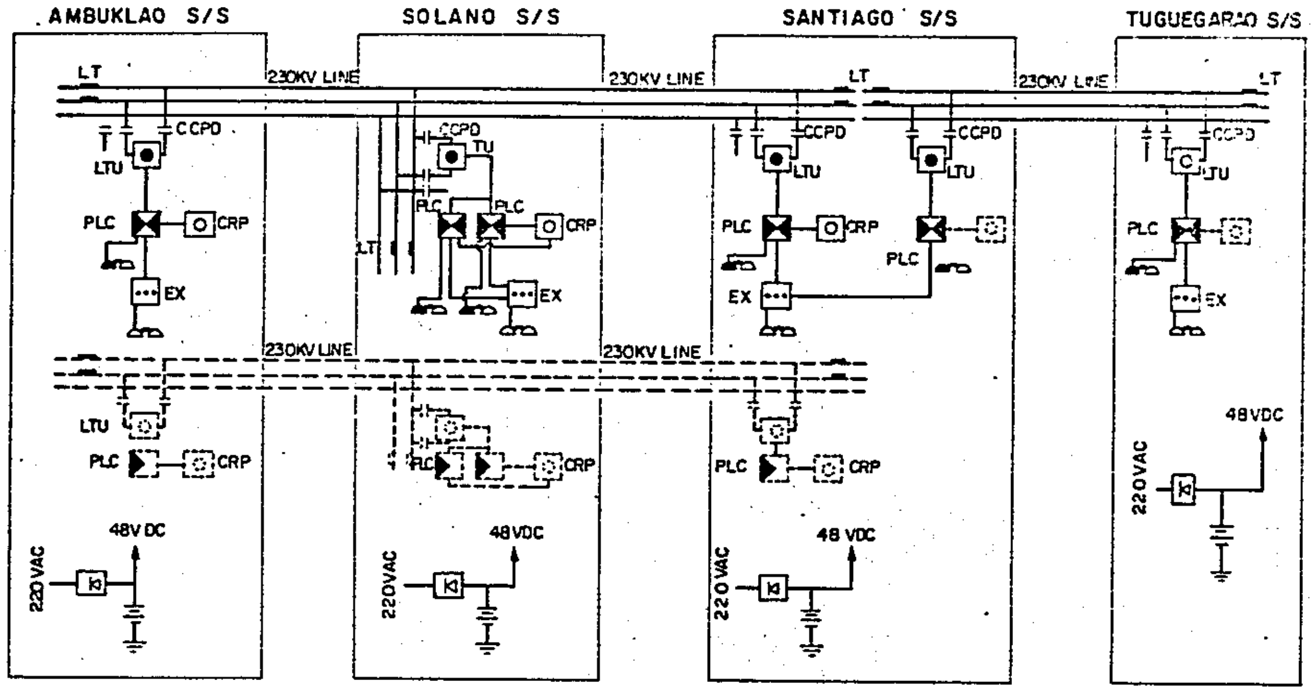
DEAD END INSULATOR STRING TYPE "D"



ITEM	DESCRIPTION	QTY
①	Anchor Shackle Bolt Type	1
②	Ball Eye	1
③	Insulator ANSI 52-5	15
④	Socket Eye	1
⑤	Anchor Shackle	1
⑥	Compression Dead End Clamp	1

MIN. BREAKING STRENGTH : 12.000 kg
(WITHOUT COMPRESSION DED END CLAMP)

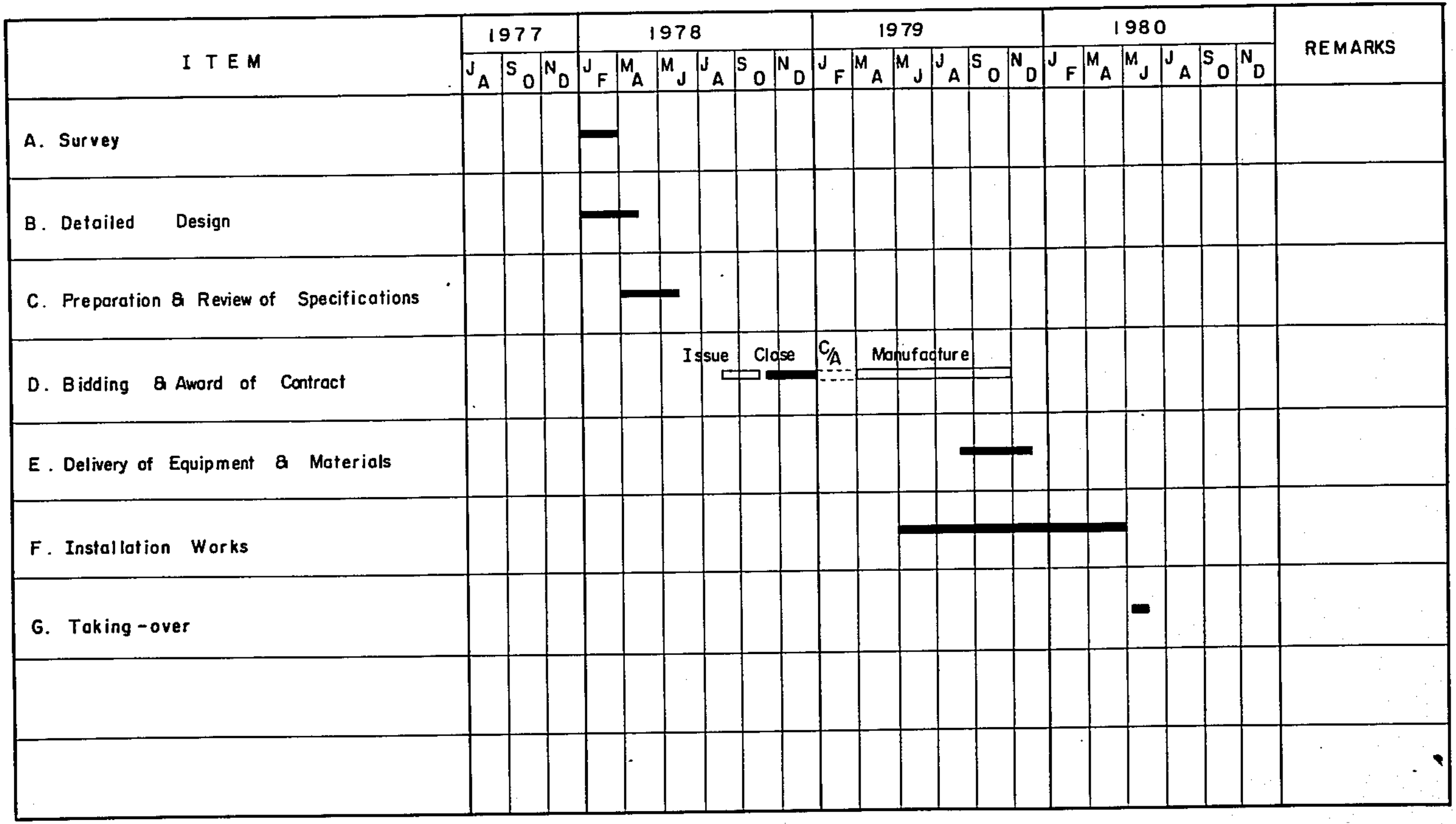
Fig. 11-11 POWER LINE CARRIER SYSTEM FOR 230KV SYSTEM



LEGEND:

- LT — LINE TRAP
- CCPD — COUPLING CAPACITOR POTENTIAL DEVICE
- LTU — LINE TUNING UNIT
- PLC — 2-CHANNEL TYPE PLC EQUIPMENT
- PLC — 1-CHANNEL TYPE PLC EQUIPMENT
- CRP — CARRIER RELAYING PROTECTION
- EX — AUTOMATIC EXCHANGE
- — TELEPHONE SET
- — TONE RINGER PARTY LINE TEL. SET
- — RECTEFIER & BATTERY
- — NEW CONSTRUCTION

Fig. 11-12 CONSTRUCTION SCHEDULE (Tentative)



Chapter 12 Economic Feasibility

Chapter 12

Chapter 12 Economic Feasibility

12-1. Operating Expenses of COOP's in Region II

12-1-1. Estimation of Operating Expenses of COOP's

The approximate service areas and outline of distribution facilities of the COOP's in Region II in 1982 are tabulated in Table 12-1.

According to this table, the scale of the COOP's in 1982 are classified into 3 classes, A, B and C, as follows.

Class A: With wide service area and large distribution facilities; ISELCO I and II.

Class B: With wide service area and long H.V. and L.V. distribution lines but with less than 800 units of transformers; N. VIZCAYA, CAGELCO I and II.

Class C: With relatively small distribution facilities; IFUGAO, QUIRINO, KAL-APA I and II.

The distribution facilities and number of employees of the existing COOP's as of the end of 1976 are shown at the bottom of Table 12-1, and judging from the operation of these existing COOP's, the COOP's of Class C will be sufficiently operated by the number of employees of ISELCO at present and COOP's of Class B with 1.5 times the number and COOP's of Class A with 2 times the number. Consequently, the operating expenses in 1984 can be estimated at 12 times those of ISELCO at present.

The Operating Expense Budget for half-year period from January through June 1977 of ISELCO is shown in Table 12-2.

Table 12-1 DISTRIBUTION FACILITIES BY COOP'S

COOP	Service area 10^3 km^2	Facilities in 1982				Employees	
		H.V. Dist. line km	L.V. Dist. line km	Trans-former unit	KWH meters units	Total or Class	Distri-bution
N. VIZCAYA	39	518	584	717	22,095	B	
IFUGAO	25	192	168	175	4,865	C	
QURINO	30	142	174	184	5,188	C	
ISELCO I	50	550	785	1,299	25,694	A	
ISELCO II	50	548	649	1,117	23,396	A	
CAGELCO I	40	463	610	788	21,670	B	
CAGELCO II	40	553	505	786	17,006	B	
KAL-APA I	30	335	259	282	8,065	C	
KAL-APA II	30	202	117	118	3,088	C	
TOTAL	--	3,504	3,851	5,466	131,067		

Existing COOP's as of end of 1976

ISELCO Dec. 1976	30	157	126	310	4,250	130	59
CAGELCO Dec. 1976	30	124	101	115	2,800	51	23

Table 12-2 ISELCO'S OPERATING EXPENSE

January - June 1977

	Account (₱)	o/o
Office Supplies & Expenses	16,620	1.013
Transportation Expenses	207,600	12.66
Travelling Expenses	22,020	1.34
Security Service	13,680	0.83
Salaries & Wages	411,915	25.12
SSS, Medicare & SIF	23,017	1.40
Generation Expenses	858,706	52.36
Depreciation Expenses	60,000	3.66
Sales Discounts	4,000	0.24
Others	22,500	1.37
TOTAL	1,640,058	100.00

Excluding the Generating Expenses for diesel generation and Depreciation, the operating expenses of ISELCO for 1 year of 1977, becomes

₱721,352 x 2 = ₱1,442,704

or approximately ₱1,450,000.

Thus the operating expenses of 9 COOP's in 1984 (when the distribution trunk lines are scheduled to be nearly completed) will become

₱1,450,000 x 12 x 1.6 = ₱27,800,000 --------- (1)

with an estimated 7%/year of escalation of expenses taken into account.

After 1985 also, 7% annual escalation is considered. Before 1983 when the extension of the distribution system is still under way, the operating expenses are estimated as follows, with the expenses in 1984 as 100%.

1984	100%
1983	90%
1982	80%
1981	70%
1980	65%

12-1.2. Calculation of System Rate

The investments of construction costs from 1978 through 1982 are shown in Table 8-7, and they are as follows.

	1978	1979	1980	1981	1982
F.C. 10^3 ¥	1,256	3,580	3,848	272	429
D.C. 10^3 ¥	33.53	39.75	34.42	28.8	29.53

The target year when all the Barrios will be served with distribution lines is 1984. On the assumption that the construction cost will be expended uniformly over 1983 and 1984, the expenses of the construction cost is computed. And the gross system rate is calculated based on the forecasted KWH demand, as shown in Table 12-3. In the calculation, it is assumed that the energy to be sold plus energy losses of 10% will be purchased from NPC at the rate of ₱0.239/KWH, the estimated rate in the NPC's Implementation Program for the Cagayan Valley Electrification Project. As for the capital cost of construction, it is assumed that for the Foreign Currency portion the interest rate will be 3.25% per annum and amortization will be made in 25 years including 7 years of grace period. As for the Domestic Currency portion, the interest rate will be 3% per annum and amortization including interest payment will be made in equal annual installments in 25 years after 5 years of grace period. (The rate of installment on the principal and interest accumulated in 5 years of grace period will be 5.74%.)

The system rate is thus computed to be ₱0.421/KWH in 1982, ₱0.414/KWH in 1984 and ₱0.410/KWH in 1986, and it gradually goes down.

Table 12-4 shows the system rate of COOP's in Luzon Island, which range between ₱0.378/KWH and ₱0.300/KWH, and the rate in the Project area will be about ₱0.1/KWH higher than these rates, but will be about ₱0.2/KWH lower than ₱0.63/KWH of the current rate of ISELCO.

Table 12-3 Operating Cost Per KWH, Region II (1st stage)

(1\$=¥277=₱7.5)

Year		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
no.	i	1	2	3	4	5	6	7	8	9	10
Construction Fund											
F·C· (10^6 ¥)		1,256	3,580	3,848	272	429	2,550.5	2,550.5	—	—	—
Total	A	1,256	4,836	8,684	8,956	9,385	11,935.5	14,486	14,486	14,486	14,486
D·C· (10^6 ₱)	B	33.53	39.75	34.42	28.8	29.53	40.21	40.21	—	—	—
Total	C	33.53	73.28	107.7	136.5	166.03	206.24	246.45	246.45	246.45	246.45
Repayment											
F·C·Interest(10^6 ¥)	D=A×0.0325	40.8	157.0	282.2	291.1	305.0	387.9	470.80	470.8	470.8	470.8
F·C·Amortization(10^6¥)	E=0.056×	—	—	—	—	—	—	—	521.4	521.4	521.4
Sub Total	F=D+E	40.8	157.0	282.2	291.1	305.0	387.9	470.80	992.2	992.2	992.2
Change to Peso(10^6₱)	$G=\frac{7.5}{277}\times F$	1.10	4.25	7.64	7.88	8.26	10.50	12.75	26.86	26.86	26.86
D·C·interest(10^6₱)	H=0.03×B	1.00	1.19	1.03	0.86	0.89	1.21	1.21	—	—	—
D·C·(Loant Subsidy)	$I=B_{i-5}+5\times0.03B_{i-5}$	—	—	—	—	—	38.53	45.7	39.57	33.1	33.98
Total	$J=\Sigma Ii$	—	—	—	—	—	38.53	84.23	123.80	156.9	190.88
D·C·Repayment	K=0.0574×J	—	—	—	—	—	2.21	4.83	7.11	9.01	10.96
Repayment Sub Total	L=G+K	1.10	4.25	7.64	7.88	8.26	12.89	17.58	33.97	35.87	37.82
COOP Operating Cost N (10^6 ₱)		—	—	18.0	19.4	22.2	25.0	27.8	29.7	31.8	34.0
SOLD Power(10^6 KWH) O		—	—	117.1	151.0	191.9	232.8	300.9	367.0	460.0	550.0
Received Power fyom											
NPC (10^6 KWH)	P=1.1×O	—	—	128.8	166.1	211.0	256	331	403.7	506.0	605.0
Power Cost(10^6₱)	Q=0.239×P	—	—	30.8	39.7	50.4	61.2	79.1	96.5	120.9	144.6
Cost Grand Total(10^6₱)	R=L+N+Q	—	—	56.44	66.98	80.86	99.09	124.48	160.17	188.57	216.42
Cost(₱) Per KWH	S=R/O	—	—	0.482	0.444	0.421	0.426	0.414	0.436	0.410	0.393

Note: F·C·Term 25 Years, Interest········3.25%/Year.
Term underdeemed 7 Years, and 18 Years amortization.
D·C·Term 30 Years, Interest········3%/Year. Term underdeemed 5 Years, from 6th Year, accumulated interest and Capital are repaied with the ratio 5.74%/Year.

TABLE 12-4 COOP'S Powercost in Luzon Island, 1976,

NAME of COOP	Report Mo.	COST mils／KWH				System loss %	Connected No of Houses		SOLD MWH	KWH／House-Mo	Connected Houses／Total House
		System rate	Power cost	Others cost	Gross Margine		As of DEC. '76	As of DEC. '75			
Region I											
ILOCOS NORTE	11	352	194	99	58	19	15,918	10,446	5,846	40.3	24.2%
ILOCOS SUR	11	352	204	81	67	24	13,000	7,295	5,620	50.3	18.3%
Benguet ※	11	241	172	14	55	18	17,148	15,380	68,612	383	51.9%
Region III											
Zambales	9	372	237	67	68	9	15,673	9,447	8,567	75.8	26.6%
Bataan	11	319	199	51	69	28	24,692	20,674	21,784	87.4	72.6%
Nueva Ecita I	11	378	215	90	75	28	21,578	17,471	13,314	61.9	31.7%
Bulacan	11	362	334	69	△ 41	27	30,478	20,704	13,042	46.9	49.9%
Tarlac	10	360	198	120	42	25	9,745	6,628	4,235	47.0	不
Region IV											
Batangas	11	300	146	82	72	13	12,903	5,420	7,750	76.9	24.8%
Laguna	10	316	196	69	51	23	13,722	13,448	7,580	55.8	72.2%
Region II ※※											
CAGELCO	6	810	1163	229	−581	13	2,796	144	133	15	5.6%
ISELCO	11	893	814	209	−130	10	4,251	1,286	1,637	53.7	7.7%

NOTE: ※ KWH/Hous-Mo 383 larger than others. This COOP sends Power to many Large industries.

※※ Use Diesel Generator

12-2. Calculation of Internal Rate of Return (IRR)

The following basic conditions are set for calculation of the internal rate of return (IRR) of the 1st stage (1978 - 1982) construction works.

1) Period of calculation is 25 years, from 1978 through 2002.

2) Construction cost for the 1st stage only is considered. (Table 8-7)

3) KWH demand from 1979 through 1982 is according to Table 6-13 and after 1983 it is assumed that the number of residential consumers in 1982 will remain constant and the unit consumption will increase by 3 KWH/month each year.

4) Gross income is computed by the multiplication of the KWH demand by the system rate of ₱0.45/KWH.

5) Wholesale rate from NPC is 0.239/KWH.

The result of calculation based on 10% of the present work factor is shown in Table 12-5. At 10% of the present work factor, the sum of present worth of the gross income is ₱331,400,000 as against the present worth of the cost of ₱361,610,000, and the IRR is less than 10%.

The results of calculations for 8% and 12% of the present worth factors are as follows.

Present worth rate	8%	10%	12%
Gross income (10^6 ₱)	405.17	331.4	275.64
Construction cost (10^6 ₱)	371.83	361.61	351.95

And the IRR becomes 9.1%.

Therefore, this Project is economically feasible sufficiently, and if the demand increases further, the IRR will take higher values than 10%. This indicates that the system rate may be lowered further from ₱0.45/KWH in the future.

Table 12-5 Calculation of IRR, at RATE 10% (Power Rate 0.45/kWh)

	C.Y.	Construction cost 10⁶ ₱	SOLD Power (10⁶ kWh)	Revenue ₱ 0.45/kWh	Power Cost ₱ 0.239×1.1/kWh	Coop's income (10⁶ ₱)	Present Value Factor	Present Value cost (10⁶ ₱)	Present Value Revenue (10⁶ ₱)
1	1978	67.54	—	—	—	—	1.000	67.54	—
2	1979	136.68	—	—	—	—	0.90909	124.25	—
3	1980	138.61	117.1	52.7	30.8	21.9	0.82645	114.55	18.1
4	1981	36.160	151.0	67.9	39.7	28.2	0.75131	27.17	21.2
5	1982	41.140	191.9	86.4	50.4	36.0	0.68301	28.10	24.6
6	1983	—	198.1	89.2	52.1	37.1	0.62092	—	23.0
7	1984	—	204.3	92.0	53.7	38.3	0.56447	—	21.6
8	1985	⋮	210.5	94.7	55.4	39.3	0.51316	⋮	20.2
9	1986	⋮	216.7	97.5	56.9	40.6	0.46651	⋮	18.9
10	1987		222.9	100.3	58.6	41.7	0.42410		17.7
⋮	⋮		⋮	⋮	⋮	⋮	⋮		⋮
24	2001		309.7	139.4	81.4	58.0	0.11168		6.5
25	2002		315.9	142.2	89.0	59.2	0.10153		6.0
Total								361.61	331.4