INFRASTRUCTURE SURVEY REPORT

FOR

RIO TUBA MINE

IN

REPUBLIC OF THE PHILIPPINES

JUNE 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

INFRASTRUCTURE SURVEY REPORT

FOR

RIO TUBA MINE

IN

REPUBLIC OF THE PHILIPPINES

JUNE 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request of the Government of the Republic of the Philippines, the Government of Japan decided to conduct a survey on the improvement of facilities related to the Rio Tuba Mine and entrusted the survey to the Japan International Cooperation Agency (JICA). The JICA sent to Palawan Province a survey team headed by Mr. Takeji Yasuda from January 25 to March 14, 1984.

The team exchanged views with the officials concerned of the Government of the Philippines and conducted a field survey in Bataraza area, Palawan Island. After the team returnd to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

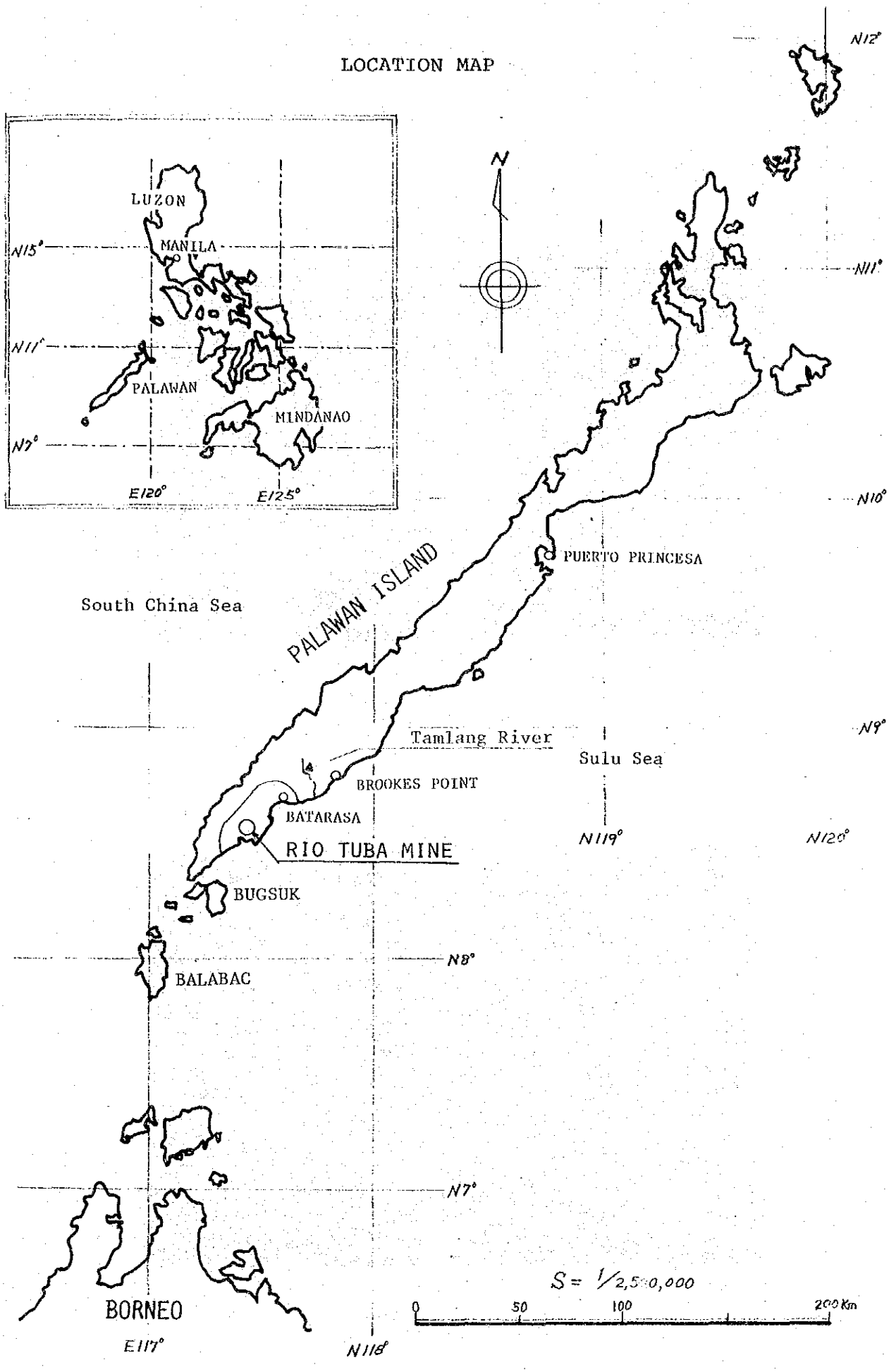
I wish to express my deep appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

Tokyo, June 1984

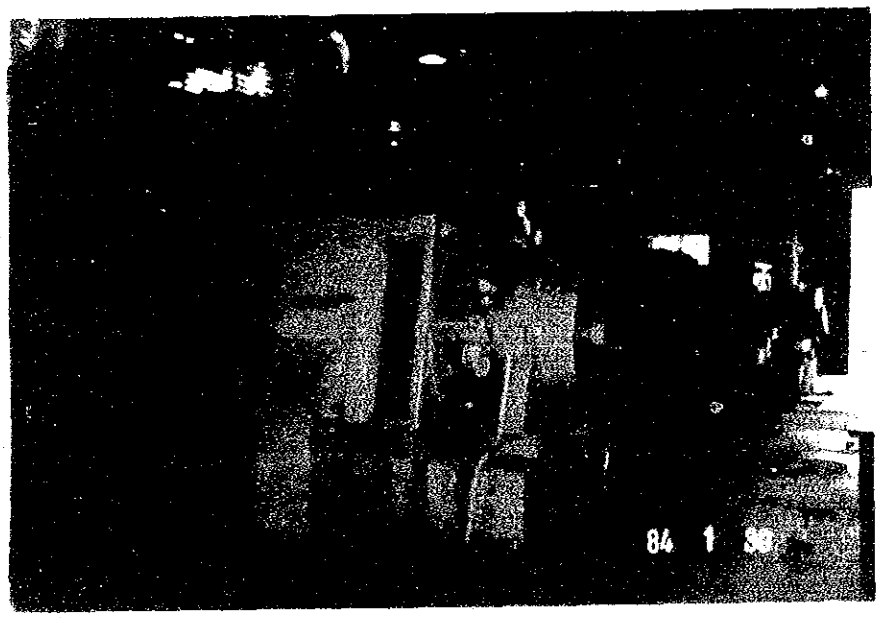
Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency

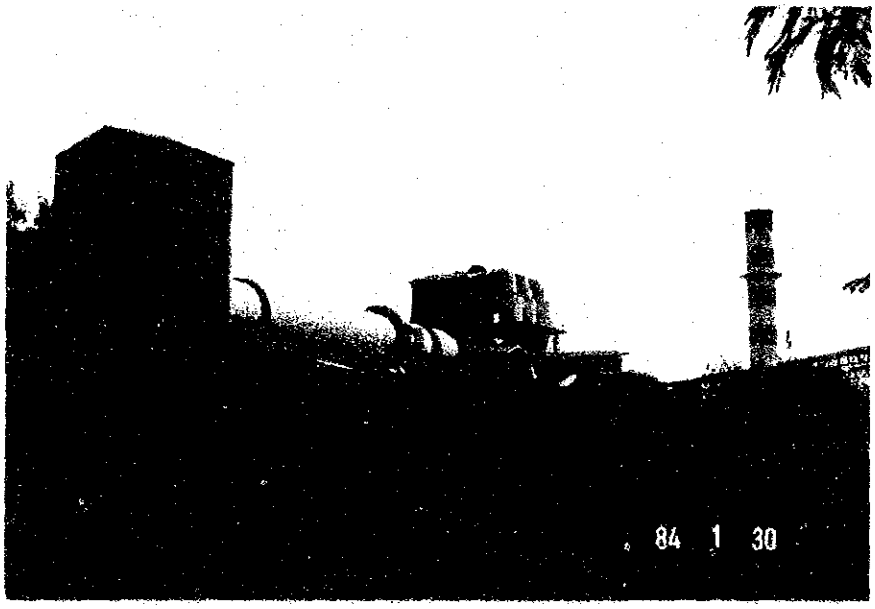
LOCATION MAP



Nickel Ore Strip Mining
(Rio Tuba Mine)

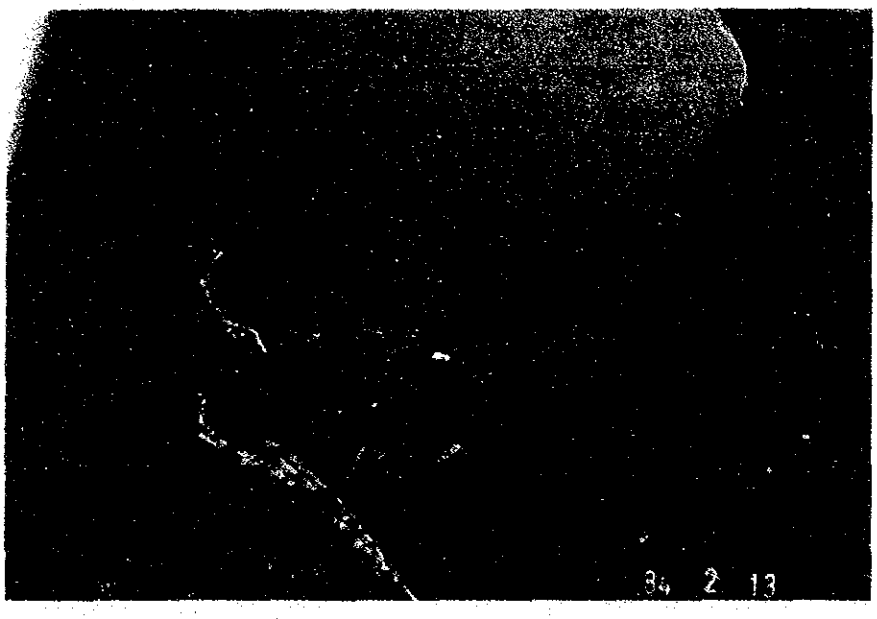


Diesel Power Plant
(Rio Tuba Mine)



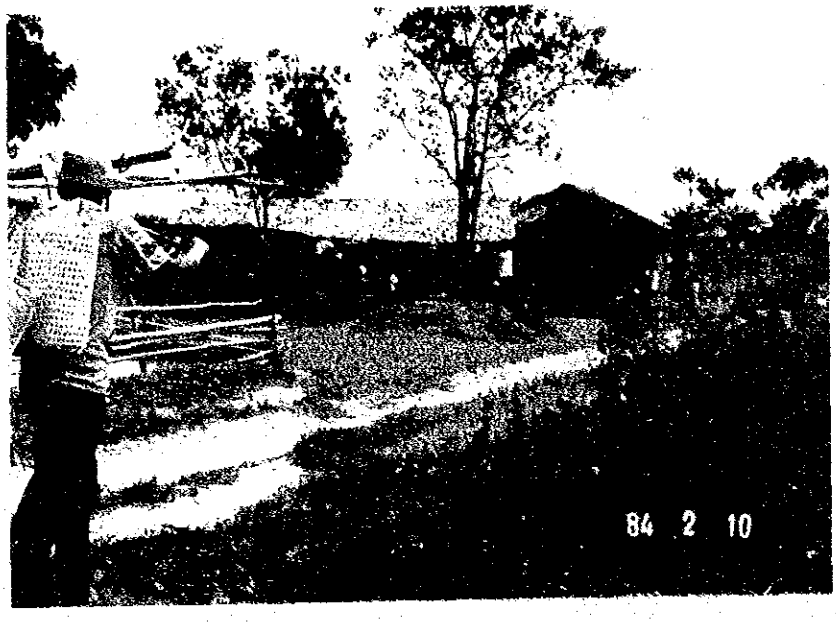
Drier Facilities
(Rio Tuba Mine)

Ore Sun Light Drying
(Rio Tuba Mine)



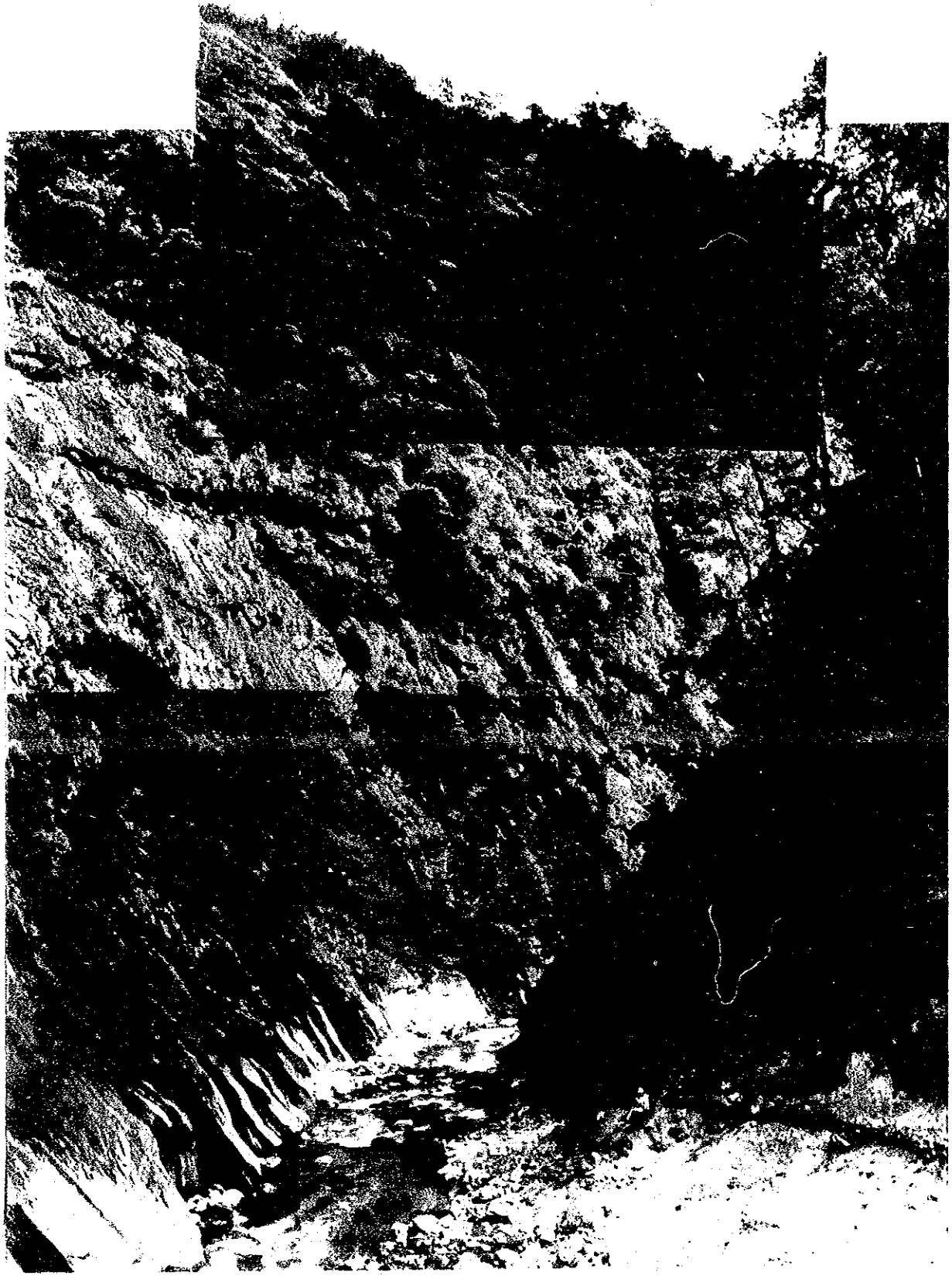
Brookes Point Town

Diesel Power Plant
(Brookes Point Town)

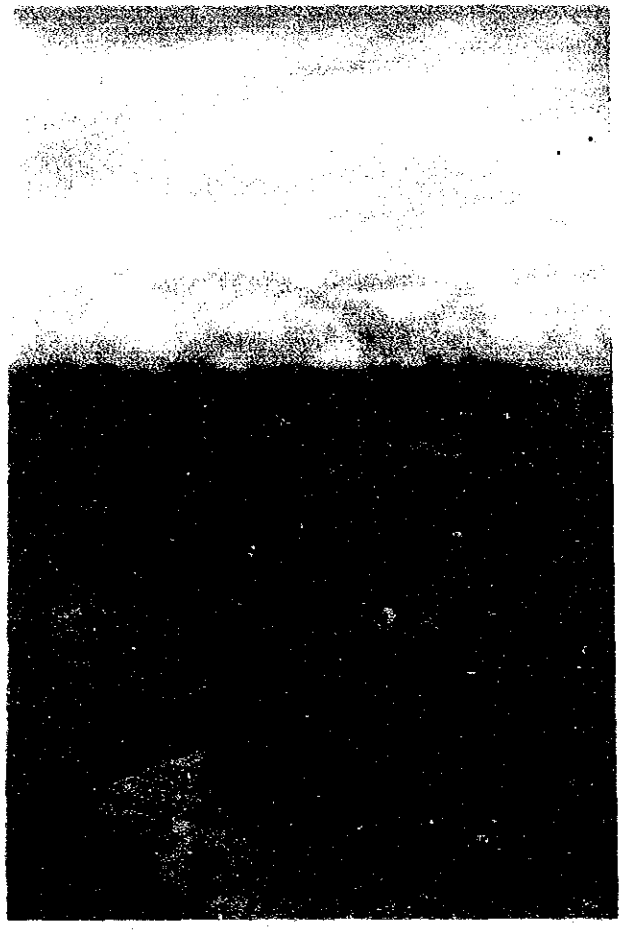


Sandoval Market Place

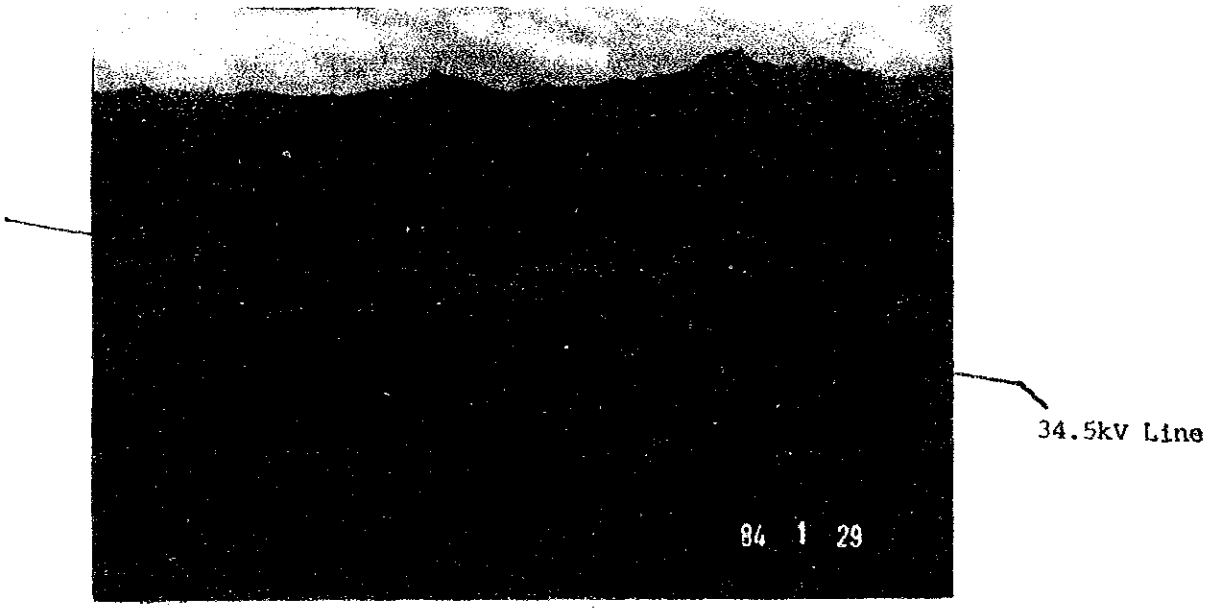
Typical Rural Residence of
Middle Income Familiy



Tamlang River Dam Site (Upstream)



Tamlang River, Proposed Hydropower Site
(Downstream)



Marangas Rivers and Transmission Line Route

ABBREVIATION

JICA	-	Japan International Cooperation Agency
NEA	-	National Electrification Administration
PALECO	-	Palawan Electric Cooperative, Inc.
NIA	-	National Irrigation Administration
NPC	-	National Power Corporation
PAGASA	-	Philippine Atmospheric Geophysical and Astronomical Services Administration
NEDA	-	National Economic and Development Authority
NWRC	-	National Water Resources Council
PIADP	-	Palawan Integrated Area Development Project
NCSO	-	National Census and Statistics Office
MHS	-	Ministry of Human Settlements
MNR	-	Ministry of Natural Resources
ADB	-	Asian Development Bank
UNDP	-	United Nation Development Programme
EEC	-	European Economic Community
PMSIP	-	Philippines Medium Scale Irrigation Project
MOE	-	Ministry of Energy
MERALCO	-	Manila Electric Company

US$	-	United States Dollars
₱	-	Phillippine Pesos
¥	-	Japanese Yen
FC	-	Foreign Currency
LC	-	Local Currency
EIRR	-	Economic Internal Rate of Return
FIRR	-	Financial Internal Rate of Return
O & M	-	Operation and Maintenance
L.F.	-	Load Factor
E.L.	-	Elevation in m AMSL (above mean sea level)
W.L. (WL)	-	Water level in m AMSL
H.W.L. (HWL)	-	High water level in m AMSL
L.W.L. (LML)	-	Low water level in m AMSL
F.W.L. (FWL)	-	Flood water level in m AMSL
mm	-	millimeter (s)
mm/hr	-	millimeter per hour
hr	-	hour
cm	-	centimeter (s)
m	-	meter (s)
km	-	kilometer
m^3	-	cubic meter
km^2	-	square kilometer (s)
ha	-	hectare
m^3/sec	-	cubic meter per second
kg	-	kilogram
t (ton)	-	metric ton
DMT	-	dry metric ton
WMT	-	wet metric ton
ℓ	-	liter
%	-	percent
^oC	-	centigrade

o	-	degree
N	-	north
Hp	-	horsepower
pm	-	revolution per minute
Hz	-	Hertz (cycles per second)
ø	-	diameter
kcal	-	kilocalorie
kV	-	kilovolt
kVA	-	kilovolt ampere
MVA	-	megavolt ampere
W	-	watt
kW	-	kilowatt
MW	-	megawatt
kW	-	kilowatt hour
MWH	-	megawatt hour
GWH	-	gigawatt hour
V	-	volt
A	-	ampere
BTU	-	British Thermal Unit

SUMMARY

SUMMARY AND RECOMMENDATIONS

A. Summary

(1) Palawan Island is situated at the southwest end of Region IV, one of the 12 Regions that constitute the Republic of the Philippines. The said island extends southwest for a total length of about 490km towards the northeast tip of Borneo, with the narrowest width at only approximately 15km. Total area is 14,900km^2 or 5% of the entire country with a population of about 400,000 or 0.8% of the total national population. Most of the island has yet to be developed. Main industries are agriculture, forestry and mining, while 45% of fish consumed in Manila is supplied from the island's coastal waters.

The climate is tropical with annual temperatures ranging from 23-33°C and an average annual rainfall of 1,550mm recorded over a period of 25 years at Brookes Point Municipality where the proposed power plant will be located.

(2) The entire island is politically designated as Palawan Province and contains 21 municipalities. The Rio Tuba Mine is located within Bataraza Municipality while the Tamlang River Hydropower Project is within Brookes Point Municipality.

(3) Principal mineral resources include nickel, copper, manganese and silica. The Rio Tuba Nickel Mining Corporation in particular is one of the few large enterprises on the island, and, as part of the Philippine export industry, contributes to economic development and employment opportunities in Palawan Province.

(4) The Rio Tuba Mining Corporation which began operation in January 1977, has a nickel reserve of approximately 23 million WMT and presently produces about 0.5 million tons annually, all of which is exported to Japan. Quality and water content of shipped ore is approximately Ni: 2.3% and H_2O: 26%, respectively.

(5) Electric power for Rio Tuba Mine operation is supplied by three diesel generator units of 700kW each. Due to annual fuel cost increases and the low international nickel rate however, conversion of the energy source for the drier system, etc. from diesel to hydropower is presently being planned.

(6) The principle source of power in Palawan Province is the Palawan Electric Cooperative, Inc. (PALECO). Total installed capacity of PALECO is 6,750kW, and by the end of 1983 the peak load was 2,725kW with percentage of energization at 38%, all of which is supplied by diesel generators. Consequently, average system rates in Palawan are among the highest in the country, while Bataraza Municipality remains unelectrified. A rural electrification plan by the Natinal Electrification Corporation (NEA) is presently being promoted with the objective of 100% electrification by 1990. Due to budget limitations however, the above scheduled development program has been delayed. Accordingly, expectations for electrification of south Palawan Island under the present Project are high.

(7) The Rio Tuba Mining Corporation considers that the proposed Hydropower Project will serve not only the requirements of Rio Tuba Mine, but will also provide rural electrification, answering local demands.

(8) The existing diesel plant of PALECO will be replaced by the proposed Tamlang River Hydropower Project which will reduce power costs and provide a stable energy supply, greatly contributing to rural community development. Priority for the first 10 years thereafter will be given to supply of rural electrification demand which is estimated at 1,000kW including complete electrification of Bataraza Municipality.

(9) Optimum project scale for the Tamlang River Hydropower Project, was determined mainly in consideration of effective utilization of the island's limited hydro potential, unit construction cost per kWh and benefit/cost ratio.

(10) Features of the proposed power scheme are as follows:

- Catchment Area	39.0km^2
- Generation Method	Canal-type with regulating pond
- Maximum Output	3,800kW
- Maximum Turbine Discharge	4.5m^3/sec
- Maximum Effective Head	101.3m
- Annual Produced Energy	20.51GWH
- Dam Height	47m
- Headrace Length	1,493m (including penstock)
- Powerhouse	Ground - indoor type
- Turbine	1 Horizontal-shaft Francis Turbine
- Generator	1 Horizontal-shaft 3-phase AC synchronous generator
- Transmission Lines	Single line: -Voltage: 34.5kV, -Extension: 44km

Construction costs for the envisioned Project are estimated at 4.03 billion yen as of March 1984, and the proposed construction period is 28 months.

(11) Economic and financial analysis was carried out to determine viability of the project using estimates of power demand for facilities presently in operation, and other future possible demands, since power demand for the new smelting facilities under study is not yet known.

(12) All funds for construction work were assumed to be supplied in the form of a loan with conditions proposed as follows:

a) 3% annual interest rate for 70% of total loan; 20-year repayment period; 5 year grace period.

b) 8% annual interest rate for 30% of total loan; 7-year repayment period; no grace period.

(13) Results of financial and economic evaluation are as follows:

FIRR: 9.0% (3.2% and 7.9% for other cases)

EIRR: 11.6% (5.7% and 10.1% for other cases)

(14) Although, other than the direct economic benefits, stable electric supply to PALECO recipients in the southern area, and

reduction of overall power rates, numerical evaluation of Project benefits is not possible, numerous indirect benefits may be expected, such as increased rural production and improved standards of living in local rural communities, as well as national economic benefits related to decreased dependence on foreign currency, mitigation of sedimentation by dam construction, etc.

B. **Recommendations**

(1) The Project, which is the first hydropower development project on Palawan Island designed to provide power for both rural electrification and a ferro-nickel & smelting process, is both technically and economically feasible.

(2) Research for a new smelting system for the Rio Tuba Mine and subsequent implementation of the same will not be completed until at the earliest 1990. Considering the above condition, commissioning of the Project should ideally commence in April of 1988 in order to lower PALECO's system rates and supplement the present supply deficiency, and at the same time lower the cost of production at the Rio Tuba Mine. Accordingly, activities such as evaluation of financing conditions, formulation of detailed implementation plan including detailed design works, tender document preparation and evaluation, etc., should be timily concluded to permit commencement of construction by the beginning of 1986.

(3) In the interim before construction commencement, as much data as possible should be collected by the Rio Tuba Mining Corp. from the proposed rain-gauging and stream-gauging stations.

(4) Discussions should be promoted between the Rio Tuba Mining Corp. and PALECO concerning basic issues related to domestic power supply such as sectionalization point, determination of energy allotment and measurement, protection system in the event of temporary shut-down and power rates.

(5) The Rio Tuba Mining Corp. should obtain the necessary water rights from the National Water Resources Council (NWRC) before commencement of construction.

(6) Discussions should be conducted between PALECO and NEA regarding among other issues extension of distribution lines and recipient facilities, arrangement of materials and equipment, and preparation of required budget for distribution and substation facilities in Bataraza area.

(7) As the present Project is designed to contribute to both stabilization and reduced cost of power supply for rural electrification as well as to reduced production costs in nickel mining, one of the Philippines important export industries, a long-term low-interest loan is considered appropriate for financing the same.

CONTENTS

	Page
Preface	i
Location Map	ii
Pictures	iii
Abbreviation	ix
Summary	xi
1. INTRODUCTION	1
1.1 Background	1
1.2 Objectives and Scope	2
1.3 Survey and Analysis	3
1.3.1 Field Work	3
1.3.2 Home Office Work	7
2. BACKGROUND	9
2.1 Population	9
2.2 Socio-Economy	10
2.2.1 Administration	10
2.2.2 Economic Trends	11
2.2.3 Political Trends	12
2.2.4 Palawan Economy	12
2.3 Development Plan	13
2.3.1 Five-Year Development Plan	13
2.3.2 Palawan Integrated Area Development Project (PIADP)	15
2.4 Electric Power	16
2.4.1 Agencies Concerned with Electric Power	16
2.4.2 Power Supply and Demand	17
2.4.3 Rural Electrification	17
2.4.4 Electric Power Conditions on Palawan Island	18
2.5 Mining and Oil	19

Page

3. RIO TUBA MINE 28

3.1 History and Future Prospects 28
3.2 Electrical Facilities and Power Demand 29
3.2.1 Electrical Facilities 29
3.2.2 Power Supply Conditions 30

4. POWER AND ENERGY DEMAND FORECAST 35

4.1 Objectives of Load Forecast 35
4.2 Study of Domestic Power Supply 35
4.2.1 Present Conditions 35
4.2.2 Residential Power Demand 36
4.2.3 Load Forecast for Residential Power Supply 36
4.3 Study of Rio Tuba Mine Power Supply 38
4.3.1 Present Conditions 38
4.3.2 Demand Forecast of Power Supply for Mine Use . . . 38
4.4 Power Distribution for Domestic and Mine Use 40
4.5 Balance of Supply and Demand for Mine Use 40
4.5.1 Case Analysis 40

5. SCHEME OF DEVELOPMENT 55

5.1 Optimum Development Plan 55
5.1.1 Basic Considerations in Planning 55
5.1.2 Comparative Cost Analysis for Alternative Power Generation Plant and Determination of Benefit Value of kW and kWh . . . 56
5.1.3 Optimum Development Plan 57

Page

6. POWER PLANT: COST AND CONSTRUCTION IMPLEMENTATION 62

6.1 Power Plant 62
6.1.1 Main Structures 62
6.1.2 Main Electrical Facilities 63
6.2 Estimated Construction Cost 64
6.3 Annual Disbursement Schedule 64
6.4 Implementation Schedule 65

7. FINANCIAL ANALYSIS 67

7.1 General 67
7.2 Conditions of Financial Analysis 68
7.3 Benefit/Cost Calculation 69
7.3.1 Benefit 69
7.3.2 Cost 71
7.4 Financial Internal Rate of Return (FIRR) 71
7.5 Sensitivity Analysis 72

8. ECONOMIC ANALYSIS 82

8.1 Approach 82
8.2 Benefit Estimates 83
8.2.1 Benefit for Rio Tuba Mine Use 83
8.2.2 Residential Supply Benefit 84
8.3 Cost Estimates 84
8.3.1 Tax 85
8.3.2 Exchange Rate 85
8.3.3 Labor Wage 85
8.3.4 Land 86
8.3.5 Fuel 87
8.4 Economic Internal Rate of Return (EIRR) 87

Page

9. INDIRECT PROJECT EFFECTS 97

9.1 Introduction 97

9.2 Effect on Productivity of Plain, Mountain and Fishing Villages 97

9.3 Improvement of Non-Agricultural Sector and Socio-Economy 97

9.4 Improvement of Living Environment in Rural Areas 98

9.5 Effect on National Economy 98

9.6 Effect of Dam Construction on Erosion 98

LIST OF ILLUSTRATIONS

Figure		Page
1-1	RIVER BASIN MAP	8
2-1	HOUSES CONNECTED AND ENERGY SOLD BY PALECO	21
3-1	SINGLE LINE DIAGRAM	31
2	ENERGY SUPPLY CONDITIONS AT RIO TUBA MINE	32
3	DAILY LOAD CURVE (JAN. 30, 1984)	33
4-1	ENERGY DEMAND OF RIO TUBA MINING CORPORATION	42
5-1	STUDY OF SCALE	58

LIST OF TABLES

		Page
2-1	ENERGY DEMAND	14
2	PHILIPPINE ELECTRIC POWER FACILITIES	22
3	RURAL ELECTRIFICATION CONDITIONS	22
4	ELECTRIC COOPERATIVE CONDITIONS	23
5	HISTORICAL AND STATISTICAL DATA OF PALECO	24
6	PALECO ELECTRIFICATION CONDITIONS	26
7	ENERGY DEMAND AND ENERGY SOLD BY PALECO	26
8	BROOKES POINT MUNICIPALITY ELECTRIC CONDITIONS	27
3-1	INTERNATIONAL NICKEL PRICE FLUCTUATIONS	34
2	CHANGES IN PRODUCTION, SALES AND FINANCIAL CONDITIONS OF RIO TUBA MINING CORP.	34
4-1	DEMAND FORECAST FOR RURAL ELECTRIFICATION	43
2	ESTIMATED MAXIMUM POWER DEMAND AND ENERGY DEMAND FOR SOUTH OF BROOKES POINT TOWN	44
3	PERCENTAGE OF ENERGIZED HOUSEHOLDS FOR TOWN AND RURAL COMMUNITIES	45
4	DEMAND FORECAST OF RIO TUBA MINING CORPORATION (CASE 1)	49
5	SUMMARY OF DEMAND FORECAST	50

Page

4-6	AVAILABLE HYDROPOWER ENERGY FOR RIO TUBA MINING CORPORATION	51
7	BALANCE BETWEEN POWER DEMAND AND SUPPLY FOR RIO TUBA MINING CORPORATION (CASE 1)	52
8	BALANCE BETWEEN POWER DEMAND AND SUPPLY FOR RIO TUBA MINING CORPORATION (CASE 2)	53
9	BALANCE BETWEEN POWER DEMAND AND SUPPLY FOR RIO TUBA MINING CORPORATION (CASE 3)	54
5-1	COMPARATIVE COST ANALYSIS	59
2	COMPARISON OF DEVELOPMENT SCALE	60
3	OUTLINE OF DEVELOPMENT PLAN	61
6-1	IMPLEMENTATION SCHEDULE	66
7-1	THREE CASE STUDIES FOR FIRR	73
8-1	THREE CASE STUDIES FOR EIRR	88

I. INTRODUCTION

CHAPTER I INTRODUCTION

1.1 Background

In 1969 the Rio Tuba Nickel Mining Corporation was established to mine and develop oxidized nickel ore deposits discovered in the southern Bataraza area on Palawan Island, in the Republic of the Philippines. Said company commenced mining operations with capital participation of several Japanese firms, the first of which was Pacific Metals Corporation (holding 40% of total stock) in 1973 followed by Nippon Steel Corp., Nisshin Steel Corp., and Nissho Iwai Corp. in 1975.

In 1977 actual mine operation began and by 1983 annual mine production reached approximately 500,000 DMT of ore, all of which is exported to Japan. The mine thus represents one of the few large scale enterprises on Palawan Island, providing vital foreign exchange for the country as a whole, and fostering regional economic development by greatly contributing to increased employment opportunities. In the face of recent decreases in international nickel prices however, reduction of production costs by conversion from present diesel generated electricity (700kW; 3 units) to hydropower generation is under study.

Electric power services in Palawan Island are managed by PALECO (Palawan Electric Cooperative, Inc.) under the jurisdiction of the National Electrification Administration (NEA). Only 38% of the island, however, is presently being energized and Bataraza where the Rio Tuba Mine is located particularly lacks electrical facilities. Moreover, an estimated 24,000 residents of Bataraza area not only lack the benefits of electricity but in addition are subject to the effects of periodical flood and drought.

Due to the above conditions, Pacific Metals Corp., requested the Japanese Government to provide technical assistance in the form of a feasibility study on the Marangas and Tamlang rivers located near the Rio Tuba mine for possible development of a hydropower site. In response, JICA conducted a preliminary survey in May 1983 and in January 1984, CKC was contracted to carry out an infrastructure survey on the Rio Tuba Mine with principal objective to formulate a viable alternative energy source.

The members of the Survey Team are as listed below:

Advisors	Komatsu, Takao	Mining and Industrial Development, Cooperation Department, Ministry of International Trade and Industry
	Matsuura, Takeshi	Mining & Industrial Development, Cooperation Department, Japan International Cooperation Agency
Team Leader	Yasuda, Takeji	Chuo Kaihatsu Corp.
Geology	Oseki, Tadashi	" " "
Hydrology	Suzuki, Takafumi	" " "
Civil Engineering	Aoki, Motoaki	" " "
Electrical Engr.	Kuroda, Kunio	" " "
Geo-technician	Nakaie, Isao	" " "
Surveyor	Kozawa, Kiyogi	" " "
Economist	Nagata, Masaaki	Engineering Consultant Firms Association

1.2 Objectives and Scope

The purpose of the Survey has been to determine the technical and economic feasibility of a hydropower development project for possible financing under JICA's financial aid program. One important aspect of the above is to evaluate whether the Project benefits not only the Rio Tuba Mine, but also makes substantial contributions to development of the entire area through increased distribution of PALECO's electrical services and effective reduction of costs for the same.

To fulfill these Survey objectives, a preliminary development plan was formulated based on a variety of data collected including topographical maps, geological survey results, various field studies. Basic design of structures, implementation plan, and estimated construction costs were also worked out, and the appropriateness of the proposed project for JICA financing was evaluated in terms of technical and economic feasibility, tax analysis and economic evaluation.

The study was conducted not only to estimate benefits from ore processing at the Rio Tuba Mine but also to evaluate Project effects on the rural community. The latter issue involved preparation of power estimates on supply and demand in rural communities, consultations with NEA and PALECO to determine concurrence on basic items such as method of

electrical supply connection to new areas, and study of an appropriate distribution system for a larger scale electrical supply system.

1.3 Survey and Analysis

1.3.1 Field Work

A study was conducted from 25 January to 14 March 1984. During said period, the following field works were undertaken.

(1) Field Study

The field study included aerial reconnaissances, map analyses, and field survey of proposed hydropower development sites (refer to section (7) below, Comparative Study of Alternative Hydropower Development Sites), detailed field survey of the Tamlang River, the site with highest potential, selection of location for main structures such as dam, driving canal, head tank, penstock, power plant, and all necessary topographical measurements and geological studies.

(2) Field Discussions

Discussions were held with agencies and officials of the Philippine Government concerned, and necessary data was collected. The agencies involved are: NEA, NIA (National Irrigation Administration), NPC (National Power Corperation), PALECO (Palawan Electric Cooperative), Palawan Provincial Government, PAGASA (Philippines Atmospheric, Geophysical and Astronomical Service Administration), NEDA (National Economic Development Authority), NWRC (National Water Resources Council), MPWG (Ministry of Public Works and Highways), Rio Tuba Nickel Mining Corporation, PIADP (Palawan Integrated Area Development Project), etc.

(3) Hydrological Survey

Meteorological and flow data collected from the above agencies, especially from PAGASA and NIA, was analysed and flow measurements were taken several times during the field survey period at the proposed water gauging site near the proposed power plant and at the dam site. In addition, various PAGASA reports were evaluated and data was obtained from the same for further hydrological analysis in the home office.

(4) Topographical Survey

A Philippine firm, Techniks Group Corporation, was contracted to carry out topographical survey of the items listed below, data from which was used in study of general layout for hydropower structures, formulation of basic designs, and determination of necessary accuracy and scale for future detailed implementation designs.

Levelling : study of existing benchmarks and relation of the same to the proposed main structure sites

Cross-section Survey: survey of the ponding area which extends from approximately 100m downstream of the dam to the reservoir (scale: 1/500)

cross-section analysis of canal and penstock routes (scale: 1/500)

Topographical Survey: survey of dam site and power plant vicinity (scale: 1/500)

The above survey covered a difficult topographical area where steep river slopes (average 1:20) and river banks exist, and rock outcroppings and stands of virgin forest occur between the same along the right bank area which is selected for the canal route. With the use of precision light wave measuring instruments (Topkon, EDM Thodolite Guppy GTS-206) brought in by the Consultant, however, stadia survey was accomplished and topographical study completed in the allotted time without loss of accuracy.

(5) Geological Survey

Besides the topographical survey of the dam site, reservoir and ponding area, and driving canal route, core drilling was performed at the proposed head tank, penstock anchor block points, and power plant site. As the steep approach prevented mobilization of the boring equipment to the dam site, the non-dynamite stacking-type seismic prospecting survey method was used[1/]. Details for each bore site and seismic prospecting survey are tabulated below.

1/ Course of traverse extension: 181m

BOREHOLE SURVEY

Location	No. of Samples	Depth (m)
Water tank	1	18
Penstock (anchor block)	2	18
Power plant site	2	13
Tailrace site	1	8
Total	6	57

(6) Electrical Demand Survey

Data required for power demand study was collected from Rio Tuba Corporation and PALECO, and analysed. In addition, a survey of each household in the Rio Tuba Mine area proposed for electrification under the Project was conducted for estimation of future demand.

(7) Comparative Study of Alternative Hydropower Development Sites

In a previous preliminary study, Tamlang River was selected as the most suitable development site while the Marangas River was disqualified. The Tamlang River was therefore the main focus of the present field survey. The economic development scale for the same however, is at most only about 4MW which will result in future supply shortages for envisaged mine operations. Accordingly, possible development of the Marangas, Condwaga and Calasian rivers within the Project was also studied. A brief outline of the surveys conducted and the results for each is given below.

1) Marangas River

The Marangas River is located about 14km to the west of Tamlang River and has a catchment area of 38km^2. The average slope in the upper reaches is 1:12, which is inadequate for economic hydropower development. Discharge is likewise insufficient, as discharge measurements amounted to only

half those of the Tamlang River taken on the same day. Moreover frequent occurence of fissures and layers of sandstone and shale present poor conditions for dam foundation and increase the likelihood of seepage. For the above reasons, the Marangas River site was eliminated.

2) Condwaga and Calasian Rivers

From study of topographical maps (scale:1/50,000) a basic plan was proposed consisting of diversion from the Condwaga River (catchment area 34km^2 at the intake site) to the Calasian River, thereby increasing the head to produce approximately 4MW of power. As shown in FIG. 1-1, three alternative approaches to the above were determined and an aerial survey was conducted for the same, findings for which are:

a) The two rivers run almost parallel to one another, and both originate in the Mantaling Mountains, flow westwards though the swampy area along the coast and into the Sulu Sea;

b) The upstream portion of the Condwaga River has a slope of 1:25 and the area around the headwaters is heavily forested with little visible occurence of riverbed deposit;

c) The Calasian River on the other hand, has a steep slope ranging from 1:80 to 1:100 and abundant riverbed deposits in midstream;

d) Three alternative sites with viable power plant and hydropower production potential were determined according to location of the diversion canal between the 2 rivers, and the ratio of canal length to head for each is as follows: Alternative A: 1:23; Alternative B: 1:34; Alternative C: 1:45;

e) The basins of both rivers are composed of basaltic lava with no apparent degraded area;

f) Of the 3 alternatives, B was selected as the optimum development site. Although alternative A had a small canal length/head ratio which indicated high economic feasibility, construction of a 1.2km tunnel would be required for hydropower development. The canal length/head ratio for alternative C on the other hand was largest and thus less economical than alternative B; and,

g) Field survey of alternative B was conducted including levelling to check net head for the same. Flow gauges and rainfall measuring devices were also set up and data collected for a one year period. Based on the results of the survey, feasibility study of alternative B is recommended.

1.3.2 Home Office Work

Completion of the Infrastructure Survey Report was undertaken in the home office to establish an appropriate hydropower development scheme based on geological survey results, topographical maps and other data collected in the field, including financial and economic analysis of the same. As hydrological analysis is the fundamental component of any hydropower development scheme, additional studies were made including correlation of scarce water level records, discharge data and records from nearby rainfall gauging stations, tank model analysis having a daily rainfall for a 14-year period, etc.

An appropriate power generation plan was determined after comparative study of dam type and height, study of power plant scale, calculation of potential generating capacity, basic design of structures and estimation of construction cost. In addition, due to poor accessibility of the site, and the consequently important effect of road construction on implementation schedule and economic feasibility, comparative study of each development plan focused on access road development.

As local power demand is an important consideration in economic and financial evaluation, power cost, including unit power cost for mine use and nickel price, was determined on the basis of balance between power demand for local residents and the economic interests of the nickel mine. Contributions of the Project to other aspects of local communities and regional development, were also studied.

Plan	Intake Water Elevation(m)	Tail Water Elevation(m)	Gross Head (m)	Total Water Way Length (km)	Ratio
A	225	100	125	2.85	1/23
B	225	50	175	5.95	1/34
C	180	35	145	6.50	1/45

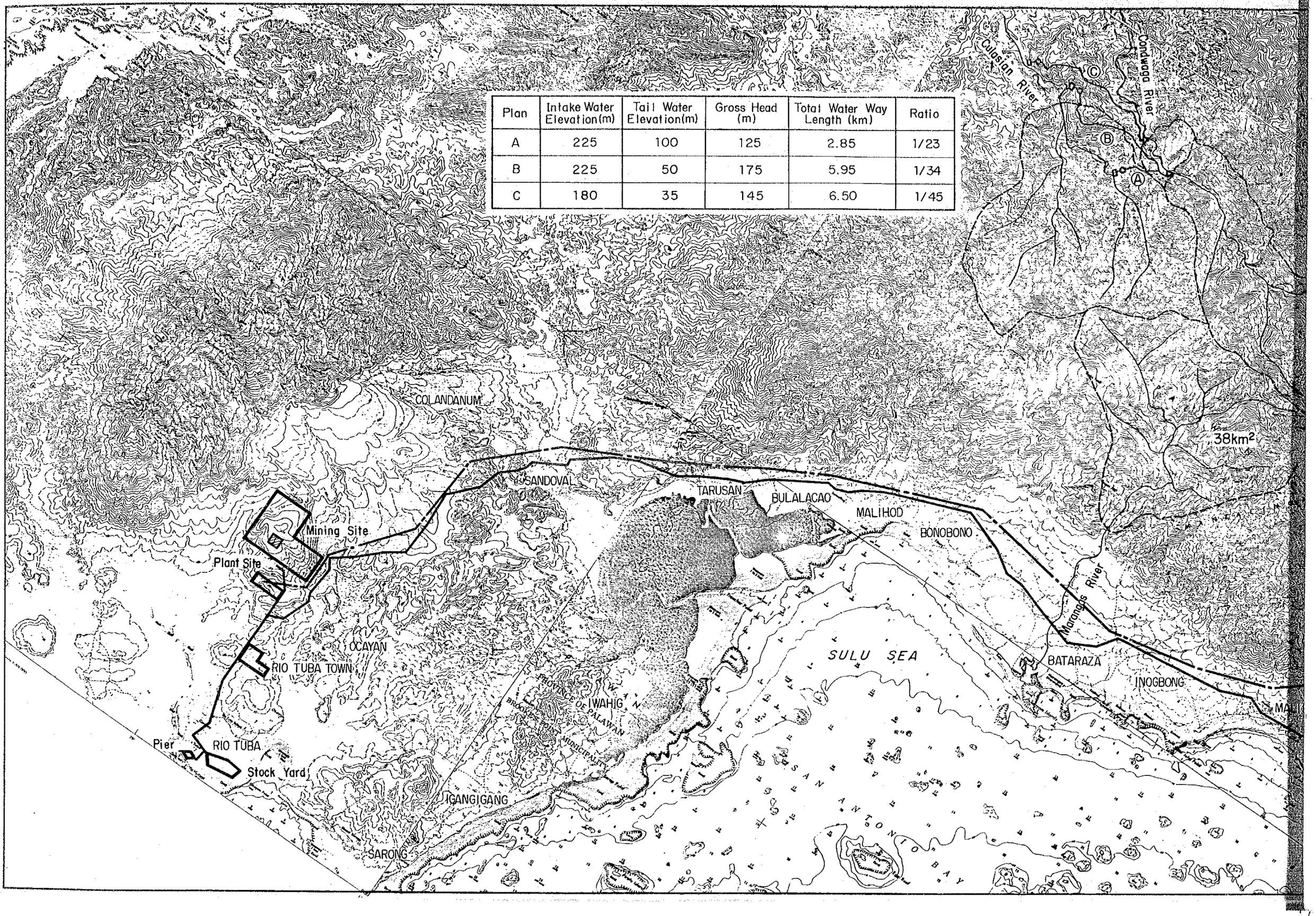


FIG. 1-1

l Water vation(m)	Gross Head (m)	Total Water Way Length (km)	Ratio
100	125	2.85	1/23
50	175	5.95	1/34
35	145	6.50	1/45

Culasian River
Cordoba River
Ⓒ
Ⓑ
Ⓐ
34km²
38km²
39km²
21km²
40km²(39+1)
1km²
MANTALINGAJAN RANGE
N
LEGEND
Road
Transmission Line
Catchment Area
TARUSAN
BULALACAO
MALIHOD
BONOBONO
Maranggas River
SULU SEA
BATARAZA
INOGBONG
MALIS
SAMARINIANA
SALOGON
Tamlang River
SARAZA
Tamlanbobog River
TUB-TUB
TAGPERARA
ORINGORING
BROOKES POINT
SAN ANTONIO BAY

RIO TUBA HYDROPOWER PROJECT
Republic of the Philippines

RIVER BASIN MAP

JAPAN INTERNATIONAL COOPERATION AGENCY

DWG.NO. SHEET OF

II. BACKGROUND

CHAPTER II BACKGROUND

2.1 Population

A national census is conducted in the Philippines every 5 years by the National Census and Statistics Office (NCSO), and the most recent census available for review was completed in 1980. According to the same, total population of the Philippines as of 1 May 1980 is approximately 48 million, indicating an average population increase of 2.9% in 20 years since the 1960 census. Although this average increase is comparatively high, annual increase has actually been gradually declining in recent years (2.8% from 1970-75 and 2.7% from 1975-80) due to promotion of family planning by the Government. Based on a predicted average population increase of 2.3% for the 1980s and 2.0% for the 1990s, NCSO estimates that the population of the Philippines will reach approximately 61 million and 75 million in 1990 and 2000, respectively.

At the same time, population increase within the country varies widely from one area to another. Population increase in Metro Manila, for example, was as high as 4.5% for the 20-year period from 1960-80, whereas that for Region VIII was only 1.6%. The urbanization trend has been steadily progressing with 37.8% of the country's total population in 1980 residing in urban areas versus only 31.8% in 1970. With the resettlement efforts of the Ministry of Human Settlements (MHS) and continued population inflow arising from rural development however, population increase in even the farthest reaches of Palawan Province wherein the Project site lies is recorded as 4.2% in the last 20 years.

The population of Palawan Province in 1980 was approximately 370,000 with a population density of 25/km^2, while the population of Palawan Island was about 270,000. The populations of Brookes Point Municipality and of Bataraza Municipality which constitute the present Project area, were approximately 46,000 and 18,000, respectively. The majority of residents in both municipalities are not original inhabitants but rather immigrated at various periods from other areas of the Philippines. The average annual population increase in the former is 4.6% and in the latter 3.0%; however, as described later, migration into the area due to integrated area development, population increase in future is predicted to exceed past population trends.

Although no data is available on population employment patterns for either of the above municipalities, the majority of people are engaged in the agricultural sector while some are engaged in service industries mainly related to fisheries and commerce. The only exception to the above are those employed by the Rio Tuba Mine, the population of which, including workers and workers' family members, totals about 4,000. In addition, a small number of natives which are of Borneo descent live in the mountains, and existing only on a barter economy.

2.2 Socio-economy

2.2.1 Administration

The Philippine central government consists of 20 Ministries including the Office of the Prime Minister, and the present Cabinet was formed on July 28, 1981. Seperate from the above, but of equal importance, is the National Economic Development Authority (NEDA) which functions as a national development planning agency, and is currently directed by the Minister of Finance.

Ministries responsible for hydropower development are the Ministry of Energy which has jurisdiction over the National Power Company (NPC) and the MHS which presides over the National Electrification Administration (NEA). the Ministry of Energy which has jurisdiction over the National Power Company (NPC). Mineral resource development and mining is managed by the Ministry of Natural Resources (MNR). The latter currently holds the office of Cabinet Coordinator for the Palawan Integrated Area Development Project. Overall coordination and integration of development plans, on the other hand, is under the jurisdiction of NEDA.

The Philippines is composed of 12 regions, which are further broken down into 73 provinces and 1,500 municipalities. Under the municipalities are town and village communities referred to as Barangays and numbering approximately 40,000. In addition, although not in themselves administrative units, the Philippines is broadly divided into 3 areas; Luzon, Visayas and Mindinao.

Both Brookes Point Municipality, within which the Tamlang River and proposed Project area are located, and Bataraza Municipality, wherein lies the Rio Tuba Mine, are part of Palawan Province. The province belongs in

turn to the Southern Tagalog Region, also referred to as Region IV-A. The said Region covers an expansive area including both Mindro Island and the entire southwestern portion of Luzon Island within which the suburbs of Manila are situated.

2.2.2 Economic Trends

GNP and employment statistics indicate that strong emphasis has been placed on the agricultural sector of the national economy and in particular on production of export crops. Other than agriculture, natural resources such as copper, lumber, iron, chrome and nickel, have also constituted important export commodities. In the latter half of the 1970s however, import substitutions and development of new export commodities increased. The proportion of traditional primary export goods correspondingly decreased from approximately 80% to 40% in 1982 while the proportion of non-traditional export products including chemical, electric and electronic goods, processed foods, bananas and pineapples, increased to 50%. Growth in exports of electrical and electronic goods was particularly noticeable, jumping from virtually zero in 1970 to 1 billion dollars or 20% of total exports, becoming a major export industry in the Philippines.

From 1972 to 1978 GNP increased with an average annual growth rate of 6.3% while the proportion of exports within the same grew at a substantial annual rate of 22.6%. Even during the second oil crisis in 1979 the Philippine economy continued to grow at 6.0% in comparison with a 3.4% average growth rate for non-oil importing developing countries in other parts of Asia. In the 1980s however, the Philippine economy, particularly the agricultural sector and energy-consuming manufacturing industries, suffered the effects of the world recession directly and/or indirectly, resulting in a general slowdown of the previously high growth rate which dropped to as low as 2% in 1982, the lowest record since the end of World War II. Although market conditions for primary products recovered in 1983, there was no corresponding increase in exports due to drought damage and growth rate continued to decline (as low as 1% according to ADB's Annual Report).

The drop in exports contributed to deterioration of the current balance of accounts and accumulation of foreign debts hindering foreign

loan investment in the country. To remedy this the Government fo the Philippines requested the foreign financial institutions at the Consultantion Meeting in October, 1983 to defer payment of all foreign loans. As a result, many development projects were suspended, the Philippine peso was devaluated by 27.3% (October 5, 1983) and emergency measures were taken to deal with the public financial crisis and credit situation such as credit restraint and import controls. Review of the Five-Year Philippine Development Plan was also required and the targets of the same are presently under revision by NEDA.

The general outlook for the future including the latter half of 1984 is fairly positive, and a renewed increase in exports is expected to follow gradual recovery of the Philippine agricultural sector from drought and general recovery of world economic conditions.

2.2.3 Political Trends

After 400 years of colonial rule, first by Spain and later by the United States, the Philippines became an independant constitutional republic on July 4, 1946. Not withstanding changes in affiliated party and approach, the basic policy of the Government has been support of a capitalist economic system with emphasis on private enterprise. In the early 1970s however, various factors affected the political environment. As a consequence, martial law was declared in 1972 to enable strengthening of the administrative structures. Subsequently the Government was able to lift the martial law decree in January 1981.

2.2.4 Palawan Economy

Agriculture is the basis of GDP in Palawan Province, followed by mining (mainly of nickel), forestry and fisheries. Although not yet flourishing as much as was expected, development of offshore oil resources should be mentioned. The main agricultural products are rice, cocoanut and corn, with rice production at one time exceeding local demand by as much as 30% and the surplus being exported to other islands. In recent years however, rice production has decreased on Palawan Island due to black bug infestation and in 1982-83 production was not sufficient to meet even local demand. The island has approximately 4.11 million coconut trees, copra production from which is approximately 540,000 tons. The largest

copra producing area is Brookes Point Municipality which produces about 190,000 tons or 36% of the entire island's copra.

Nickel mines, though few in number, bring in the greatest acquisitions of foreign currencies for natural resources. Other than the Rio Tuba Mine, a large mining enterprise operated by one of the San Miguel's affiliates is located in southeast Palawan Island near Quezon. As for forestry, 9 major lumber companies hold timber rights for approximately 510,000ha of land, production from which increased 337% from 1979 to 1981 to approximately 410,000m^3.

The Palawan Island vicinity is considered the best fishing area in the Philippines, the fish harvest in July of 1982 reaching a high of approximately 54,000 tons. Of the said yield, 35% was shipped to Manila and other places, supplying 45% of total demand in Manila. Fishing employs the second largest number of people in Palawan Province next to agriculture, especially in the northern islands, with approximately 19% of all households on Palawan Island (about 14,000 households) deriving their income from the same.

Industrial enterprises, on the other hand, are almost non-existant excluding the said lumber companies and cottage handicraft industry and manufacturing of artifacts from wood, shell, bamboo, etc. Development of industry is expected in future; however, at present infrastructures and market facilities necessary for such development are insufficient.

2.3 Development Plan

2.3.1 Five-Year Development Plan

The Philippine Government is presently undertaking a Five-Year Development Plan (1983-87) the main objectives of which are (i) sustainable economic growth, (ii) greater equitable distribution of the fruits of development, and (iii) total human development. Several programs have been made to achieve those objectives, and realization of the same depends on productive and gainful participation of local citizens at the planning stage. The development plan is designed to deal with specific problems as follows:

a) reduction of unemployment and underemployment by creating increased job opportunities;

b) increased agricultural and industrial production through efficient distribution of capital, technology, etc.;

c) elimination of rural and regional disparities;

d) reduction of dependancy on oil imports;

e) development of sufficient infrastructures such as mini-hydropower, small-scale irrigation and farm-market access roads;

f) mobilization of domestic financial resources;

g) control of population growth; and,

h) strengthening of the private sector as the major source of growth.

As a result of these measures, GNP growth is expected to increase by 6.5% annually during the Plan period and per capita income to reach 13,199 pesos by 1987.

In the energy sector, reduction of dependency on oil is the main focus with a goal of 44.1% dependency by 1987 at Plan's end as opposed to 85.6% in 1981 (83.8% of which was supplied by oil imports). While progressing with development of offshore oil along the Island's coast, the Plan is also promoting development of alternative energy sources such as hydropower, coal, etc. Reference to this progress is tabulated below in TABLE 2-1.

TABLE 2-1 ENERGY DEMAND

(Unit: Oil Exchange Million $)

Item	Actual		Objective			Average Annual Growth Rate
	1980	1981	1982	1983	1987	1983-87(%)
Hydropower	5.87	6.24	7.78	9.29	15.50	13.7
Geothermal	3.46	4.62	5.91	6.68	16.53	25.4
Coal	1.04	1.00	6.25	11.63	22.44	17.9
Oil	77.26	72.60	72.08	70.33	63.23	(2.6)
Atomic Power	-	-	-	-	6.06	-
	0.02	0.37	1.11	1.61	5.33	34.9
Total	87.65	84.83	93.13	99.54	129.09	6.7
Oil Dependency Rate(%)	88.1	85.6	77.4	70.7	49.0	
Imported Oil Dependency Rate(%)	83.8	83.8	72.0	65.2	44.1	

Source : Five-Year Development Plan

As the table shows, during the Plan period domestic oil production is expected to reach a production of 15 to 19 thousand barrels a day, supplying 10% of total oil demand. This coupled with conversion of industries which are heavy oil consumers to coal will aid in reducing dependency on foreign oil imports.

At the same time, consumption of electricity is expected to increase at a yearly rate of 8.7% during the Plan period from 1983 to '87. A 50% increase in facilities with 5,215MW capacity is required to meet this increased demand and thus development of new hydropower facilities is being promoted with emphasis on geo-thermal, hydro, coal-fired, and atomic power generation.

2.3.2 Palawan Integrated Area Development Project (PIADP)

To resolve the problem of regional disparities the Government of the Philippines established a National Council on Integrated Area Development (NACIAD) composed of high-ranking officials and specialists from each Ministry. The said council formulated an Integrated Area Development Program with the goal of developing underdeveloped areas. At present, there are 7 on-going projects in the nation including Palawan, while another 7 projects will be implemented in the near future. Approximately two-thirds of the total area of Palawan Island or southern Palawan is thus incorporated into the Palawan Integrated Area Development Project (PIADP). A feasibility study was undertaken for the same in 1980 with technical cooperation from ADB and UNDP, and, upon financing by ADB and EEC amounting to US$55 million, first stage construction (1982-88) was begun in 1982.

The first stage is focused on higher income and improved standards of living among the large agricultural population by means of increased production through development projects in several sectors as described below.

1) Agricultural Development

   a) Rehabilitation of existing 2,400ha of communal irrigation and construction of a new irrigation scheme for an area of 2,100ha;

   b) Agricultural intensification and diversification through establishment of a provincial agricultural center and 8 rural service centers

to facilitate farm support and extension services for training, development of appropriate farming systems, etc.;

c) Upland stabilization program consisting of development and implementation of various types of support programs for minorities;

d) Livestock development through establishment of a livestock resource center to improve marketing and circulation for small-scale farms, and research and extension activities on improved breeds; and,

e) Improvement of the existing agricultural credit system for financing of various types of enterprises.

2) Transportation Development

a) Improvement and construction of 159km and 160km of the main road and branch road, respectively which run from Puerto Princessa to Bataraza; and,

b) Improvement and construction of facilities at Puerto Princessa and Brookes Point ports.

3) Health Facilities and Services

a) Strengthening of malaria eradication services; and,

b) Development of potable water supply systems in rural areas.

4) Other

a) Land classification and land title;

b) Implementation of an environmental survey; and,

c) Establishment of a Project Office for proper project management.

In the first stage of PIADP, projects which directly contribute to increased income and improved environment for local residents due to the limited funds were selected and are presently being undertaken. Electric power generation and industrial development on the other hand will be undertaken in Stage II. Apart from the above, tourism is being positively promoted mainly by Philippine Air Lines and others.

2.4 Electric Power

2.4.1 Agencies Concerned with Electric Power

Electricity related enterprises in the Philippines are under the jurisdiction of the Ministry of Energy established in 1977 by a

Presidential Decree. Responsiblity for stable electric supply is presently born by NPC and MERALCO, and private electric cooperatives are under the directive of NEA. NPC is conducting a large scale generation and transmission enterprise based on unification of electric generation and transmission. NEA is in charge of planning and implementation for power generation facilities of less than 10MW and of electric cooperatives, while planning of electric facilities from 10-20MW is undertaken by the same in consultation with NPC.

Distribution and sale of electric power in the capital, Manila, is under the control of MERALCO while that for rural areas is through NPC and NEA via electric cooperatives in each rural area. Some of the latter presently use diesel generators for power production.

2.4.2 Power Supply and Demand

Total capacity of power generation facilities throughout the Philippines at the end of 1982 was 5,194MW, with 20,906GWH generated. Power generation facilities in the Philippines are as shown in TABLE 2-2. Energy consumption in Manila in the MERALCO distribution area was 9,444GWH while that in other areas under the jurisdiction of local electric cooperatives was 1,830GWH.

Distribution of NPC wholesale electric energy, which is estimated to be close to the actual consumption in each network was 82.6% in the Yuzon network including Manila, 4.5% in the Visayas network composed of numerous islands, and 12.9% in the Mindanao network.

Under the 10-Year Electric Power Development Plan (1981-90) NPC estimates that annual kW increase from 1981-85 will be 7.3%, and from 1986-90 will be 7.0% while priority is given to development of geothermal, coal-fired and hydropower generation, in that order.

2.4.3 Rural Electrification

The main objective of the rural electrification plan supervised by NEA is promotion of the overall socio-economic development of rural communities by providing electric power required for rural modernization, strengthening and developing irrigation, farm mechanization and medium to small-scale rural enterprises and improving social facilities. Mid-1990

is the target year for 100% electrification and funding for the plan is provided by NEDA.

At the end of 1982, there were 112 electric cooperatives. Rural electrification conditions are as given in TABLE 2-3, while those for electric cooperatives are presented in TABLE 2-4. Rural electrification is steadily progressing despite severe economic conditions. Moreover, NEA has continued development of new power sources in its efforts to actualize the rural electrification plan, and in mid-1982, 11 wood-fueled power stations (32MW), and 18 hydropower stations (22MW) had been constructed.

2.4.4 Electric Power Conditions on Palawan Island

PALECO, first established in 1974 (TABLE 2-5), presently manages generation, distribution and sale of electric power on Palawan Island. As can be seen from FIG. 2-1, sale of electricity and number of households have steadily increased while PALECO electrification conditions according to amount sold and number of households, commercial establishments, etc. serviced are shown in TABLE 2-6 and 2-7, respectively.

At the end of 1983 PALECO had five diesel generators totaling 6,750kW with about 175km of 13.2kV distribution line and about 180km of 220V distribution line strung. Moreover, by mid-1984, during this study period, construction would be underway for an approximately 23km extension of 13.2kV distribution line, illustrating the commendable efforts of PALECO for promotion of rural electrification in the midst of adverse economic conditions.

Brookes Point Town is located about 15km northeast of the envisioned power plant site and electric supply to the same commenced in March 1982. Said town has one of the lowest electric consumption rates in both the Philippines and Palawan Island, illustrating that power consumption level within the same are still low (TABLE 2-8). This fact may explain initial exclusion of the town from a 24-hour supply servive. The 24-hour sypply service was extended to the same in March 1984, however, and consumption is expected to increase accordingly.

As for Bataraza Town, through which transmission lines will pass under the Project, the 14kVA diesel generator of the same supplied 5 hours of electricity in the evening to about 80 households. Due to poor

management however, generation was discontinued in August 1983 causing great inconvenience to local residents. At present, the bakery and the national road construction office possess a 5kVA and a 14kVA generator, respectively, while those areas through which distribution lines pass remain unelectrified.

A diesel generator owned by the Rio Tuba Mine Corp. supplies electricity to mine employees residing in Rio Tuba Town.

2.5 Mining and Oil

The Philippines is rich in mineral resources, beginning with large-scale copper reserves and including gold, silver, chrome, nickel, iron, zinc, coal, all of which are mined.

Close to ₱30 million is spent annually by the government on studies for mineral resource development while production from mining operations in 1981 amounted to 4.334 billion tons of copper, 784 million tons of iron, 1.933 billion tons of gold, 97 million tons of chrome, 1.751 billion tons of nickel and 9.633 billion tons of coal. However, except for certain cases, ore veins are generally small and quality often inferior. Costs for extraction of the same coupled with declining international prices has resulted in a general trend towards reduced mine production.

Copper production and exports have steadily increased except for a few occasions such as the 1975 oil crisis, the 1977 drop in copper prices and the 1982 market slump. Gold along with copper is one of the Philippines 10 major export commodities, approximately 470,000 Troy ounces of which were exported in 1982 bringing in about US$169 million foreign capital (about half the income from copper exports).

Philippine chrome deposits are reportedly the largest in the world and extraction and export of the same is expected to increase during the next development stage. In 1982, 355.5 DMT of ore was extracted, US$15 million worth of which was exported.

Nickel ore was seldom mined before 1974. Since that time however, nickel mining has rapidly increased amounting to ₱1.437 billion in 1980 and ₱1.026 billion in 1981, and nickel has become the third most important mineral resource in the Philippines next to copper and gold. Value added for nickel, however, have been extremely low, the price for the same in

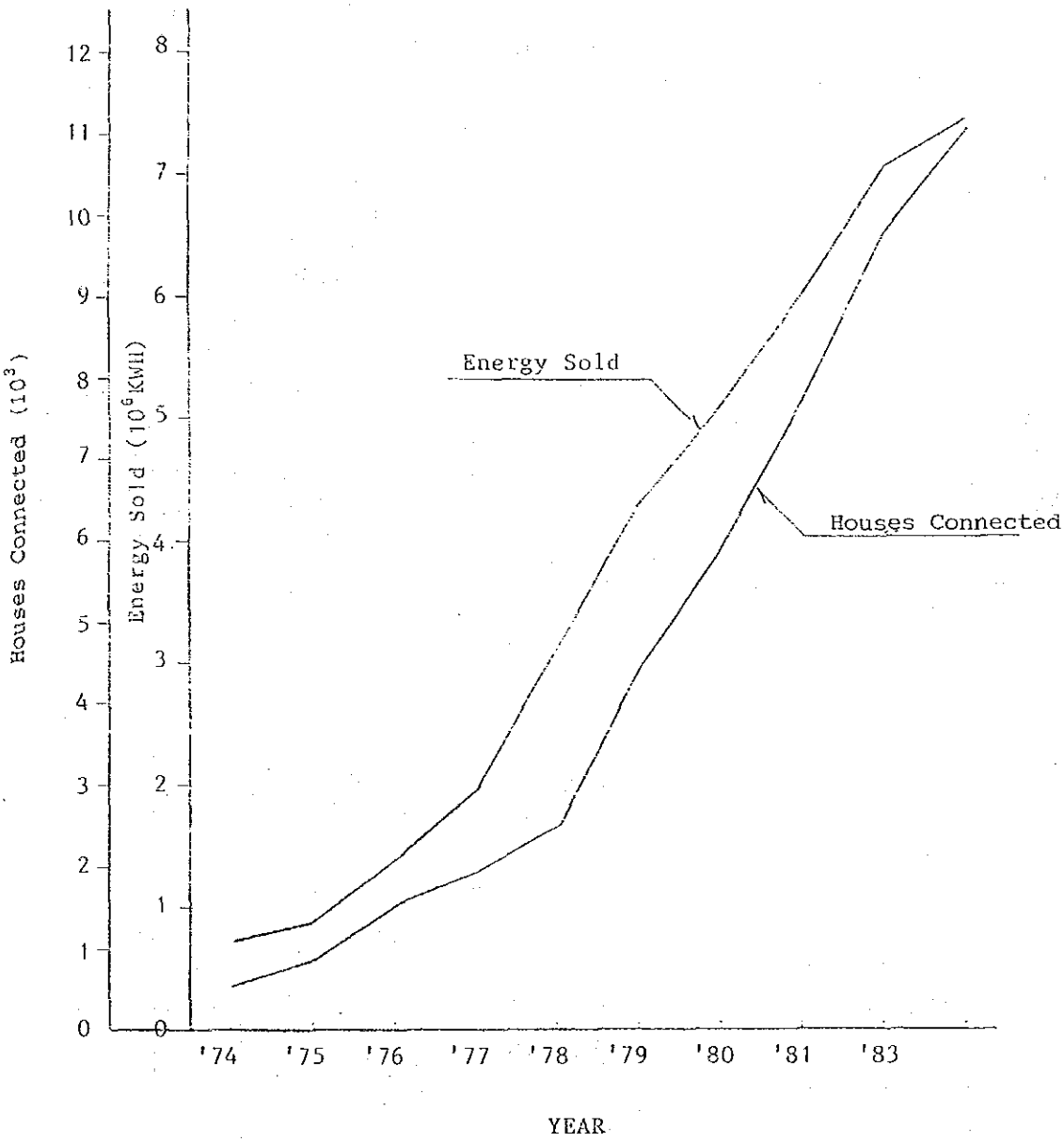
1982 was only 1/15 of that for copper, due to lack of refining facilities in the Philippines and export of nickel as mineral ore.

Coal, unlike the above which are adversely affected by the present world recession, is mainly being developed for domestic use, and production in 1982 increased 90% over the previous year at about 600,000 tons. The quality of the same is relatively inferior in calories however, and reportedly must be mixed with higher quality coal imported from Australia before it can be used.

Oil exploration was carried out along the Visayas and Palawan continental shelf after 1949 and in 1977 a sufficiently large oil deposit, the Nido oil field, was discovered offshore from Palawan Island. Later Matinloc oil field was also discovered and developed, producing 3.6 million barrels of oil, the equivalent of 5% of national oil consumption, in 1982. Oil exploration continues and 2 new fields (Linapacan 2 and San Martine) were recently discovered in the oil belt offshore on the northwest side of Palawan Island.

The Philippine Government, through development of both domestic oil production and alternative energy sources, is thus working towards reduced dependency on imported oil.

FIG. 2-1 **HOUSES CONNECTED AND ENERGY SOLD BY PALECO**



Source: Historical and Statistical Data of PALECO

TABLE 2-2 **PHILIPPINE ELECTRIC POWER FACILITIES (1982)**[1/]

	POWER GENERATION CAPACITY			
	Capacity (MW)	Percentage (%)	Electric Energy (GWh)	Percentage (%)
Organization				
NPC	4,489	86.4	17,940	85.8
Electric Cooperative	227	4.4	334	1.6
Other	478	9.2	2,632	12.6
Total	5,194	100.0	20,906	100.0
Type of Power Plant				
Hydropower	1,270	24.5	3,965	19.0
Diesel	3,315	63.7	12,883	61.6
Coal	50	1.0	246	1.2
Geothermal	559	10.8	3,812	18.2
Total	5,194	100.0	20,906	100.0

1/ 1983 Philippine Statistical Year Book, and Annual Report of NPC and NEA

TABLE 2-3 **RURAL ELECTRIFICATION CONDITIONS**

Connection	Total Coverage	Number Energized	
Municipalities	1,306	1,148	(87.9%)
Barangaga	32,396	15,768	(48.7%)
Households	5,049,000	2,031,040	(40.2%)

Note: From 1982 to the present

Source: NEA Annual Report, 1982

TABLE 2-4 **ELECTRIC COOPERATIVE CONDITIONS**

	1980	1981	Rate of Increase	1982	Rate of Increase
No. of Electrified Municipalities	934	1,060	(13.5%)	1,148	(8.3%)
No. of Electrified Barangay	10,955	13,694	(25.0%)	15,768	(15.1%)
Household Demand	1,441,281	1,769,817	(22.8%)	2,031,040	(14.8%)
Peak Load (kW)	409,779	505,488	(23.4%)	595,732	(17.9%)
Available Energy (MWH)	1,531,849	1,909,622	(24.7%)	2,326,624	(21.8%)
Amount of Energy Consumed (MWH)	1,202,769	1,514,344	(25.9%)	1,829,339	(20.8%)
Rate of Loss (%)	21.5	20.7		21.4	

Source: NEA Annual Report, 1982

HISTORICAL AND STATISTICAL DATA OF PALECO

1974	January 25, 1974	:	Date of Registration
	May 21, 1974	:	Date of Loan Signing Original Loan - ₱ 8,500,000
	July 1, 1974	:	Turn-over of Puerto Princesa Electric Service Facilities
	November 20, 1974	:	Construction of Interim Plant and Distribution System
1975	January 11, 1975	:	First Energization at 12 Hours
	February 11, 1975	:	First Energization at 24 Hours
1976	April 15, 1976	:	Start Construction of Headquarters
1977	April 11, 1977	:	Blessing of Headquarters
	June 22, 1977	:	Provisional Certificate of Franchise No. 023 issued
	August 8, 1977	:	Completion of Permanent Distribution System
	November 12, 1977	:	First Annual General Membership Meeting
1978	November 11, 1978	:	2nd Annual General Membership Meeting
	December 23, 1978	:	Completion of Aborlan Interim Distribution System & Energization
1979	February 21, 1979	:	Blessing of Power Plant officiated by Msgr. Gregorio Espiga with US Ambassador Richard W. Murphy as Principal Sponsor
	June 6, 1979	:	Start of Marra Distribution System
	August 8, 1979	:	Grant of Permanent Franchise
	August 15, 1979	:	Start of Roxas BLISS Project
	December 12, 1979	:	Signing of the following loans: Pielstick Loan ₱ 22,421,533 Transmission & Distribution System 14,000,000 (Puerto Princesa, 12,000,000 Aborlan, Narra) 6,000,000
1980	March 8, 1980	:	Narra Energization
	June 5, 1980	:	Aborlan Dendro Project Organized
	December 17, 1980	:	Signing of Dendro Thermal Tree Plantation Loan Contract (Aborlan) ₱ 4,040,000

1981	January 25, 1981	:	4th Annual General Membership Meeting
	May 4, 1981	:	Iwahig Central Energization
1982	February 20, 1982	:	5th Annual General Membership Meeting
	February 21, 1982	:	1st Annual District Meeting - Narra - Aborlan
	February 20, 1982	:	PALECO Choral Group born
	September 23, 1982	:	Cuyo-Magsaysay granting of Franchise
	March 20, 1982	:	Brookes Point Elects its First Director
	March 10, 1982	:	Sta. Lourdes Dendro Organized
	July 28, 1982	:	Signing of Dendro Thermal Tree Plantation Loan (Sta. Lourdes, Puerto Princesa City) ₱ 4,390,000
	Sapt. 1, 1982	:	Signing of Loan for Dendro Thermal Power Plant, Sta. Lourdes, Puerto Princesa City ₱ 42,754,000
1983	March 26, 1983	:	6th Annual General Membership Meeting
	May 2, 1983	:	Father of Palawan Electrification Dies - Atty. Francisco Ponce de Leon
	Dec. 31, 1983	:	Total Amount of Loan ₱ 63,161,559.00 Total Loan Releases ₱ 44,788,785.97

TABLE 2-6 **PALECO ELECTRIFICATION CONDITIONS**

Connection	Object Number	Energized in 1982	Energized in 1983	(Electrification Rate)
Municipalities	6	4	4	(66.7%)
Barangay	142	58	66	(40.8%)
Households	26,000	9,807	11,674	(33.7%)
Peak Load (kW)		2,515	2,725	

Source: NEA Annual Report, 1982
PALECO Manager's Report, 1983

TABLE 2-7 **ENERGY DEMAND AND ENERGY SOLD BY PALECO**

End User	Number of End Users	(%)	Energy Sold (kWh)	(%)
Residential	8,808	(75.5)	2,183,154	(29.1)
Commercial	1,898	(16.2)	2,609,506	(34.8)
Industrial	6	(0.1)	698,413	(9.3)
Public Buildings	319	(2.7)	1,861,575	(24.8)
Street Lights	648	(5.5)	146,575	(2.0)
Total	11,674	(100%)	7,499,223	(100%)

Source: PALECO Manager's Report for The Year 1983

TABLE 2-8 **BROOKES POINT MUNICIPALITY ELECTRIC CONDITIONS**

	1982	1983
Generator Facilities (kW)	450	450
Peak Load (kW)	-	17.5
Demand (No.)		
- Residential	657	1,003
- Commercial	140	257
- Industrial	-	-
- Public Buildings	22	37
- Street Lights	12	10
Total	831	1,307
Energy Supplied (kWh)	106,480	245,823
- Residential	63,906	136,021
- Commercial	34,285	87,523
- Industrial	-	-
- Public Buildings	6,954	20,586
- Street Lights	1,335	1,693